A Model For The Digital Representation And Transaction Of Complex Pricing And Ordering For High-Value Spatial Products And Services

vorgelegt von

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zur Erlangung des akademischen Grades

Doktor der Ingenieurwissenschaften
- Dr.-Ing. -

genehmigte Dissertation

Promotionsausschuss:

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Tag der Wissenschaftlichen Aussprache: 17. Juni 2003
Berlin 2003
D 83

Overview

Figures

Tables

Abbreviations

AAA/WAAS	Web Authentication Authorization Service
B2B	Business-to-Business
BSM	Basic Service Model
CAD	Computer Aided Design
FGDC	Federal Geographic Data Committee
GDI NRW	Geodaten-Infrastruktur Nordrhein-Westfalen
GIS	Geographical Information Systems
GML	Geographical Mark up Language
GSDI	Global Spatial Data Infrastructure
MathML	Mathematical Mark up Language
OGC	OpenGIS Consortium
SDI	Spatial Data Infrastructure
SiG	Special Interest Group
WCS	Web Coverage Service
WCTS	Web Coordinate Transformation Service
WFS	Web Feature Service
WMS	Web Mapping Service
WPOS	Web Pricing & Ordering Service
XCPF	XML Configuration & Pricing Format
XCPF-WSC	XCPF Web Service Call

Acknowledgement

First of all, I would like to thank Prof. Dr. Herbert Weber and the Fraunhofer Institute für Software- und Systemtechnik ISST in Berlin and Dortmund for the creative environment. This environment offered a good perspective for research. Also, the institute stimulated the exchange of knowledge and discussions with other scientistes worldwide, which was a key element to get involved into the core information stream of the geo-information domain.

I would like to thank Prof. Dr. Herbert Weber as well for his support and for helpful annotations. I would like to thank as well Prof. Dr. Günther, Humbold University, Berlin, for critical opinions in the process.

Special thanks to Peter Gabriel, who was often an important discussion partner in the early phase, where the need to solve the problem was uncertain. He helped me to move into the community discussion by posting scientific papers to conferences and by presenting ideas in workshops. These public discussions helped to find critical aspects, which should be solved for a general solution. These discussions were key elements to develop my ideas.

Special thanks as well to Dr. Bernhard Holtkamp, who supported me in the second phase. He arranged the project "Geobroker Brandenburg", which was a proof-of-concept for my ideas. In that phase, I learnd much for the applied approach.
Dr. Bernhard Holtkamp supported the regional Geo-data-Infrastructure NRW initiative by taking personal responsibilities for several tasks. This initiative, with more than ten institutions from academy, private industry and public administration, was the primary permanent discussion forum, which later enabled me to post my ideas to the international forum OpenGIS successfully.

I would like to thank Jens Hemme and Hatice Elmasguenes in Berlin and Martin Kupisch, Bastian Baranski, Frank Burkhardt and Sascha Wolter in Dortmund for the implementations of my ideas and their critical questions.

Mr. Jon Bryan was a great help with his domain-specific knowledge and his native English in the last documentation phase.

1 Introduction

1.1 Geo-Information

Maps, distance tables or traffic signs are commonly known expressions of spatial relationships. They give orientation and can help to solve the question "where…?". They can also help in simulations and planning, which often try to solve the question "When…?".

These kinds of questions have been important for a long time. The Romans used milestones to mark distances. Sailors used many different instruments, e.g. compass for the same purpose. Modern examples are navigation systems for cars. Some products reached the customer mass market. The usage is easy. There are many familiar examples of geo-referenced phenomena, like a traffic jam, that have a temporal and spatial dimension.

Today, modern electronic devices can be used more and more to represent these kinds of information as electronic data. Because of the spatial characteristics and manipulation methods of this kind of data, the term "geo-information" is often used.

After the first approach to cover geographical objects with computer aided design (CAD) tools in the eighties, more and more geo-referenced information was made available in digital form. The possibilities of CAD are limited by narrow functionality.

More specialized computer software was developed in the nineties to manipulate geographical objects. As this trend emerged, these developments became known as Geographical Information Systems (GIS). New software releases improved the possibilities and low-cost hardware offered enormous computer performance. To these applications were added more and more very specialized features for almost all geographical tasks. After this evolution a few products are dominating the market. The "price" for this specialization was a separation into a few "GIS worlds", where data exchange between these worlds was a difficult issue.

Digital geo-information has two main characteristics. It is very voluminous. It requires concepts for storing and manipulation in very large databases, e.g. 1 Petabyte for satellite data. On the other hand, geo-information is derived from real world circumstances, subject to unceasing change. Therefore, geo-information needs to be updated continually.

With the introduction of the Internet World-Wide-Web protocol and growing bandwidth, digital data could be easily exchanged on a global scale with relative low costs. The possibility to transfer voluminous geographical data was increasing with growing bandwidths and even more powerful hardware. Actual information could be delivered for a specific surface on-demand.

The monolithic behavior of GIS products on the one hand and the new Internet opportunities on the other hand, show the need for interoperable geographical solutions. A spatial enabled network with enhanced search and access functionalities is required.

1.2 Spatial Data Infrastructure (SDI)

A proposal for the need for a spatial enabled network is the "Spatial Data Infrastructure" idea. Nebert (Nebert, 2001) defines it: The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general. The word infrastructure is used to promote the concept of a reliable, supporting environment, analogous to a road or telecommunications network, that, in this case, facilitates the access to geographically-related information using a minimum set of standard practices, protocols, and specifications.
The set-up of spatial data infrastructures is being discussed worldwide in various communities for different spatial levels. An approved requirement for all initiatives is interoperability between different scales of SDI's (Rajabifard, 2001).

1.2.1 Global Spatial Data Infrastructure (GSDI)

In the mid-90s the global community realized the advantages of a global SDI for decision makers. The GSDI initiative met the first time in Bonn, Germany, in 1996.
Impacts like earthquakes, global warming, famine and floods can be better treated with global geo-information (GSDIa, 2002). The realization of this idea requires many coordinated actions on technical, organizational and political levels.
Common standards in technical specification, organization structures and political decisions are required (GSDIb, 2002).
An important GSDI document is the "GSDI Cookbook" (Nebert, 2001), which covers organizational and technical aspects. Topics are the building of data for multiple users, describing spatially with Meta-data, making data discoverable with catalogues, online mapping for visualization and data access and delivery, but also building communities.
Although the GSDI initiative does not provide technical specifications, the idea of an interoperable global SDI unifies all regional activities. This idea is an important help in every day discussions. Every two years the GSDI offers a conference forum for new solutions or approaches. This forum is important to meet people with similar ideas.
In 2002, the GSDI initiative changed to a non-profit organization, which is based in Reston, VA, USA.

1.2.2 US-National Spatial Data Infrastructure (US-NSDI)

The provision of easy access to public geographic data and the creation of national geographical data infrastructures are a matter of concern in many nations around the world. A leading role was taken by the USA in 1994 when a "National Spatial Data Infrastructure" (NSDI) was initiated by which public geographic data should be offered free of charge or at small prices to all users (Clinton, 1994). NSDI is coordinated by the inter-agency „Federal Geographic Data Committee" (FGDC). FGDC operates the

„National Geo-spatial Data Clearinghouse“: an Internet service, which provides online-access to the metadata of approximately 180 national and international geographical databases, most of them from the public sector. Since then, the US-market for geographic data, geographic information systems (GIS) and geographic information services has experienced a rapid growth.
Many national initiatives have followed the US approach since 1994, e.g. in the Netherlands, in Canada, or in Australia (Nebert, 2001). Whereas the FGDC clearinghouse and its successors follow a de-centralized architecture with online-access to all databases, there is also a number of more catalogue-like, centralized systems: examples are Portugal, the “Geographical Data Description Directory” covering the geographic data of 36 European survey and mapping agencies or the Internet-service (Lachman et al., 2002).

1.2.3 Geo-data Infrastructure Northrhine-Westphalia (NRW SDI)/ “Geodaten-Infrastruktur NRW” (GDI NRW)

The highly populated German state Northrhine-Westphalia organizes the cadastral administration in a decentralized manner. More than 50 local institutions cover the administrative tasks with some common regulations. After the introduction of digital processing, each local cadastral administration could choose a suitable software solution. Constant software interoperability conflicts quickly created a need for a spatial data infrastructure.
In 1999 the state launched the “Geographic Data Infrastructure”-project (GDI NRW). GDI NRW should solve the administrative tasks within NRW. But the GDI NRW should also push forward the geo-information market in Northrhine-Westphalia by providing an open network for geo-information and geo-data based services (Brox, Kuhn, Bishr 2000; Brüggemann, 2000; Greve 2002). Target groups of GDI NRW are

- Public and private geo-data provider,
- Geo-data enabler in the value chain and
- Users of products and services based on geographical data.

Because of the diversity in GIS software installations, interoperability with international standards and architectures is a key issues in the GDI NRW project. The OGC and ISO standards will be used.
GDI NRW has, beyond the technical part, also a strong organizational part. New or developing standards can be discussed in several special interest groups (SiG), e.g. Architecture, e-Commerce or Metadata to exchange knowledge and to find a common interpretation. To prove interoperability of software implementation, the GDI NRW initiative organized two test-beds.
A German nation-wide project “GeoMIS.Bund”, a Meta-data Information System, started in 2002 (Grünreich et al, 2001). The approach to connect federal institutions is similar to the decentralized NRW approach.

1.3 Standardization Organizations

Interoperability can only be achieved by using commonly accepted standards. Therefore, organizational structures are needed to conduct an acceptance process. Any new specification has to fit into the abstract and applied architecture. Because of the importance of these standardization bodies, they are described in detail in the following two sections.

1.3.1 OGC

In 1994 an initiative was founded to coordinate these developments, to collect new ideas and to promote the advantages of distributed and interoperable geo-information streams. It was named "OpenGIS Consortium". The members of the new community saw the enormous potential value of integrated geo-information streams for specialists as well for many consumers. The OpenGIS Consortium managed to involve itself with all-important international players.

At the beginning, more fundamental work was carried out to get a general and common understanding of distributed spatial data infrastructures. The interface specifications were based on CORBA technology, which is a general IT approach for distributed and multi-language code applications. Because of some security reasons and general reservations, the CORBA technology was not accepted in many IT-communities. The implementation costs between CORBA and non-CORBA software are very high. An alternative was founded with the use of the HTTP protocol and XML encoding. This approach was widely accepted and supported with many tools.

In April 2000 the first "Web Service Implementation Interface Specification" was released. It was the "Web Mapping Service" (WMS) (Jeff De La Beaujardière, 2001), which defines the generation of geo-referenced information as Internet images. Another goal was the cascading approach. That means that a user requests geo-data from a client to a service, which may not store all data on the same server, rather the service requests other services with the same protocol to get the data, to integrate data and to delivery it to the user within seconds. This method is called "on-the-fly" delivery. The average time to deliver requested data via HTTP is within seconds. The advantages of this new specification are obvious: usability, low client requirements (only a standard Internet browser), easy data integration and a wide field of possible application.

This new (and today famous) Web Mapping specification has some general characteristics:

- Common understanding of spatial reference systems and the encoding
- Capability Information with XML encoding (GetCapabilities)
- On-the-fly response
- Cascading
- The abstract Basic (Web) Service Model (BSM) (Jeff De La Beaujardiere, 2001)

- Service Description with Metadata (today ISO19119)

The WMS Specification was aimed to setup a standard for the integration of bitmaps, where a "bounding box" defines a spatial surface within a common spatial reference system (SRS). Even though bitmaps might have a high value for humans, the disadvantage remains that machines cannot easily process them. To give an example, the question "Do two roads cross each other?" cannot be answered with simple methods in the case of bitmaps. The solution for enhanced geo-referenced analyses is the "Web Feature Service" (WFS) and the "Geographical Mark up Language" (GML) technology, which deal with vector respective object manipulation. These specifications were released in 2002. Some more specifications like the Gazetteer Service, Coverage Service or Web Registry Service are being developed and discussed.

The OpenGIS Consortiums offers with these developments important and standardized specifications for geo-data services.

1.3.2 ISO

The International Organization for Standardization (ISO), TC 211, started an approach to standardize geo-information aspects in its 191xx series.
The working group TC 211 is working close together with many relevant groups and especially with the OGC. Due to the fact that many ISO involved parties are as well involved in OGC activities, a reconcilement of interests is assured.
The most famous standard today is the Metadata definition ISO 19115 for geo-data. Metadata is data about (geo-) data. It describes the characteristics of the origin data. This mechanism is needed if the origin data cannot be easily compared or accessed.
A general example is the image case. A bird in an image cannot be found by using textual matching patterns, because the representation of information is handled completely different with binary data. Only image analyses may help to compare in this example. But if this image file also contains a textual description, key word search would be possible.
From a historical point of view, the ISO 19115 approach unifies the long range of prior standards, which were used locally or in specific communities. The CEN (CEN TC 287, 1998), FGDC (FGDC, 1996) or the IngeoMDF (InGeoForum, 2000) Meta-data standards are some competing examples. Because of the claim to support a wide range of users from different countries and continents, the development was controversial and long enduring (Ruzicka, 2001). But finally the vote for the ISO 19115 took place in spring 2002.
The standardization of the metadata encoding is an important key element toward a general architecture for spatial data infrastructures.

1.4 Levels of Functionality for Spatial Data Infrastructures (SDI)

As mentioned in the last section, the set-up of a spatial data infrastructure is a complex challenge. The ISO 19115 Metadata proposal solves the discovery functionality (see 1.2) on a product description level. But it is not sufficient in the case of commercial data sets for an automated infrastructure. The author introduced an enhanced abstract classification of functionality-levels for business-enabled SDI's (Wagner, 2002b).
The aim of a SDI is the simple data exchange between two different environments. The metaphor shown in Figure 1 may help to understand these levels.

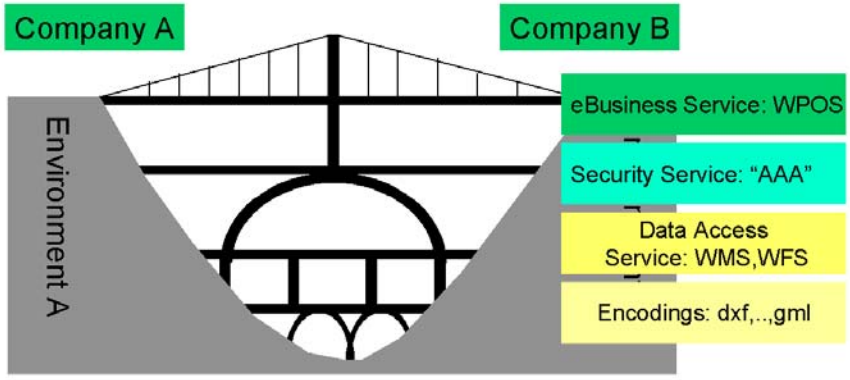


Figure 1 The Metaphor "Building Geo-Information Infrastructure means Building Bridges from Environment A to Environment B"

The lowest level or common denominator for digital data exchange is an accepted data encoding on both sides. Multiple computer platforms and multiple encoding tables are, in general, serious problems. Most traditional standalone systems store geo-information in proprietary formats. Some offer widely used data formats. A commonly used format for geo-information is the "dxf" format. But all binary formats are inappropriate in a distributed environment. XML is the typical mainstream approach to provide a solution in such situations. The OpenGIS developed the dialect GML, geographical mark-up language, to store geo-referenced data in an independent format (Cox, Cuthbert, Lake, Martell, 2002). Therefore GML offers a fundamental solution for many applications.
On acceptance of the format, geo-information may be exchanged in a simple way via posting or e-mail within different computer platforms. This level is mentioned in Figure 1 as the "Encoding" level.

A higher level of efficiency can be achieved by using (web-) services for the data exchange. A remote request can be automatically processed and the desired data can be delivered. Thus remote procedures can be invoked to generate the desired data. The OpenGIS initiative has released some web service implementation specifications, e.g.

Web Mapping Service (WMS). These services are a suitable way to distribute freely available data. Figure 1 shows this level as the "data access service" level.

In the case of independent restricted environments, the distribution of high value data needs some functionally for access control. This level needs an interoperable mechanism to ensure security with authentication (A), authorization (A) and access control (A). This service is called AAA or in a Web Service manner WAAS for Web Authentication & Authorization Service. There are some possible solutions available for that task, but the OGC has been released a specification.
In the case of independent commercial environments, the distribution of high value data needs some functionally for accounting. Geo-eBusiness services are required.
If a solution can be found, which supports these desired functionalities without disturbance of the existing specifications, but which supports cascading, complex price models and different protocols, the final step towards conduct of common trade would be achieved. Geo-data products could be accessed subject to common business rules.
This goal would open a wide perspective for many applications, which could be designed and realized without the major handicap of geo-data procurement. This level is the highest which needs to be achieved in a distributed SDI.

1.5 Demarcation to pricing policies and this dissertation

Pricing policies are important topics in a spatial data infrastructure because of the high value of geo-data. Since the 18th century, many governments and the militaries had a need for geo-data and spent money for these efforts (e.g. Ordnance Survey, 2003). Today none-governmental institutions are willing to purchase geo-data for many commercial reasons. Therefore a pricing and policy strategy is essential for the public mapping agencies. But which value has geo-data? There are costs for the digital capturing of geo-data and there are several other cost to manipulate it and for maintenance. Digital data can be reproduced today with minimal costs.

But the question "How much does 'geo-data x' cost in fact for me?" is not trivial. There are several views how to price the product "geo-data" (Craglia, Annoni, Masser, 1999). An opposite approach is federal US declaration "Freedom of Information " (Clinton, 1994) which provides geo-data for free. But in most European states, the product "geo-data" is not free of charge (See EC-Data Policy Workshop: Austria, Finland, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Portugal, United Kingdom and Wallonia (Craglia, Annoni, Masser, 1999)). The different approaches are discussed in several contributions (Onsrud, Lopez, 1998).
There are many different reasons for many different pricing approaches. An important factor is the absolute costs for geo-data.

But most approaches result in a more or less complex pricing model.

The digital representation and transaction of these complex-pricing models is the aim of this dissertation.

*It is **not** the aim of this dissertation to contribute to the pricing and policies of the public sector.*

1.6 Chapter Overview

This document covers the requirements, approaches and applications for a model for the digital representation and transaction of complex pricing and ordering for high-value spatial products and services.

There are many aspects to discuss within this topic, relating both to business and technology. Each chapter in this document deals with a specific issue of this topic.

Chapter 1 aims to give the reader an orientation into the spatial world and its digital representation. The "spatial" community is introduced by describing some institutions, initiatives and important developments.

Chapter 2 covers the scientific problem. It shows a gap in the interoperable framework for spatial infrastructures. This gap and the relationship to other developments are discussed on a general level.

Chapter 3 discusses the main topic on a detailed level. It gives some use-cases for a better understanding of the problem or the gap. The use-cases are analyzed to identify common structures, which are requirements for any solution. Some approaches from different initiatives are discussed with their advantages and disadvantages. All topics in the 3rd chapter are state-of-the-art.

Chapter 4 shows the author's approach with functionalities and data models to solve the identified requirements on two levels. The abstract section shows principles and methods, which are introduced and arranged to solve the problem. The applied section derives the principle and methods into web services. The result of this chapter is the Web Pricing & Ordering Service (WPOS) and the XML complex Configuration & Pricing Format (XCPF).

Chapter 5 presents a demonstration example for better understanding. But it gives also a methodology for how to use the developed solutions. The example is the solution of the first use-case of chapter 3.

Chapter 7 shows a number of implemented applications in different environments. The realizations are proof-of-concepts for the theoretical approaches.

Chapter 8 concludes the complete theory and describes open and unsolved topics.

The last part contains references, which will assist further investigation.

2 Scientific Problem

This chapter contains the explication of the main scientific problem on an abstract level. There are many aspects involved. First of all the reader will be introduced into the specific environment by presenting related work, pricing policies discussions and e-commerce, to emphasis the overall need. The case study "GeoMarkt.NRW" illustrates the benefits and the required functionalities. A discussion compares available specifications and solutions along a general e-commerce workflow. The results identify a gap, which represents the main scientific problem in this document. The chapter "Limitations" separates explicitly some topics that will not be covered in this thesis.

2.1 Pricing policies

A key topic is the cost of geo-data. If the total amount seems to be too high by potential purchasers, the flow in the value stream will not rise significantly. Most geo-data is created and administrated by public agencies. These are mainly mapping agencies, but also scientific agencies, e.g. NASA or ESA. These agencies sometimes provide their data free or with a fee. The fees are a matter of political debate in many countries, e.g. the Netherlands (Kok, v. Loenen 2001). The European Union aims to set-up a common policy and has invested in the state-of-the-art with a report (Craglia, Annoni, Masser, 1999).
Keller (Keller et al. 2001) introduced a classification of different pricing policies in the "Pricing Strategies for Geo-spatial Data" report. There are four possible variants of geo-data pricing:

- Public domain: Provision of the data at no cost.
- Low cost: Customers are charged only those costs that arise directly from dissemination itself (dissemination costs).
- Partial return on investment: In addition to dissemination costs, customers also bear a portion of the maintenance and/or collection costs.
- Full cost: Customers are charged the full costs of collection, maintenance, and dissemination.

The classification was enhanced in the ETeMII report (ETeMII, 2002). Frederiksen (Frederiksen, 2002) discuss these price models: In the future it is likely that public owned geo-data and related services have to be divided into groups depending on origin, producer, production circumstances etc. Each group will then have its own price model – one of the previous mentioned or variants of them – depending on a possible competitive situation in the private market, where a full cost model normally applies.

Nevertheless, whatever general pricing policy is used in future by public institutions, private data suppliers will still have their own approaches.
A wide range of different price models exist already today and will continue to exist independent from the deployment of public pricing policies.

2.2 The Need for Geo-eBusiness

As described in the introduction and in the previous section, geo-information has a high value for many institutions and individuals. The study by Fornefeld and Oefinger (Fornefeld, Oefinger, 2001) estimates the market volume to 50 Mio. € for the German State NRW alone. The realized turnover is about 5 Mio. €. This value is not yet being exploited (Brox, Bishr, Senkler et al., 2001). But this market cannot be exploited with raw data. Selling raw data requires that the user has the expertise to use the data (Brox, Krek, 2002). The mass-market users are customers, who need customer consumable products. Raw data is not ready-to-use and therefore the market does not work yet.

Fornefeld and Oefinger (Fornefeld, Oefinger, 2001) introduced the "value-add paradox". This paradox says the creation costs of geo-basis data are high, but the market value of this basis data is low. But the market value rises, if value-add services enable the product (see Figure 2). Typically the enabling process merges geo-data with other general data. An example is a message about a traffic jam with a spatial view.

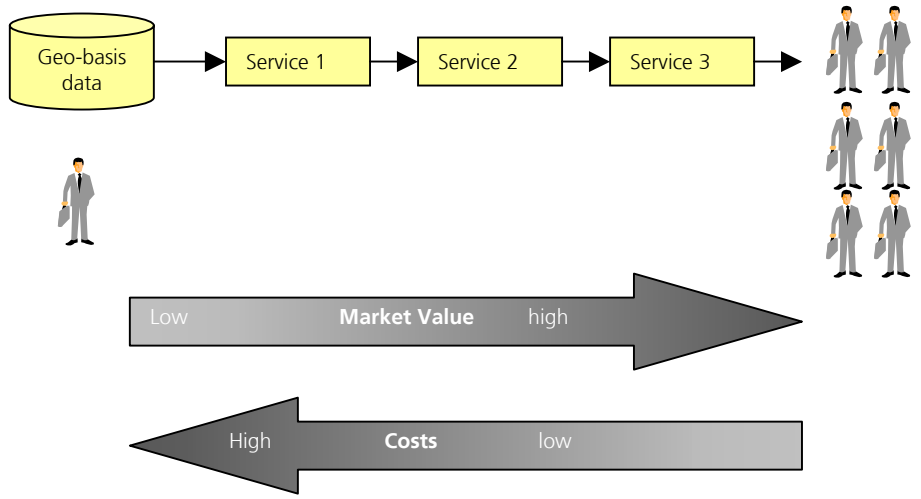


Figure 2 Value-add paradox (Fornefeld, Oefinger, 2001)

There is a need for value chains (Niedzwiadek, 1999) and business networks (Brox, Kuhn, 1999). The contributions show that there is a need for the involvement of value-adding players to impact upon consumers.

Currently, the goal of the GI market in e-commerce and e-business is to search, order, deliver, and pay geographic data sets via the Internet (Brox, Kuhn, 2001).

A spatial data infrastructure would help to set-up these value-chains, if a SDI covers pricing & ordering between independent data suppliers and value-add companies.

Therefore a SDI needs pricing & ordering functionalities.

2.3 Trading Geo-Information Today

Although the market for geo-data is not exploited yet, there is a significant market today (5 Mio € in the state NRW alone). The market transactions are very often processed manually (Lverma, 2002). The price calculation is based on pricing documents. The survey companies offer a telephone line for pricing & ordering information. Some digital pricing models require some geographical calculations, which manually take time. An example is shown in 3.1.1. This pricing model is based on the area extent. The extent can be derived from geographical co-ordinates, which have to be specified. Therefore, exact price information is difficult to give in a telephone situation, which requires a response within minutes. Anonymous requests are not possible at all.

An automated pricing retrieving mechanism would help to increase the customer relationship significantly.

2.4 Case Study: GeoMarket.NRW

The research project of the Internet portal "GeoMarket.NRW" was to investigate new technological concepts to provide professional users of geo-data products a quicker access to distributed sources.
The concrete use case and a known unsolved problem were the distributed responsibilities for cadastral geo-information products in the German state NRW. In fact, the data was located and governed in more than 50 municipalities. A good reason for that organization is the importance of maintaining data currency as part of its overall value. Geo-data is an image of the world, which is always changing.

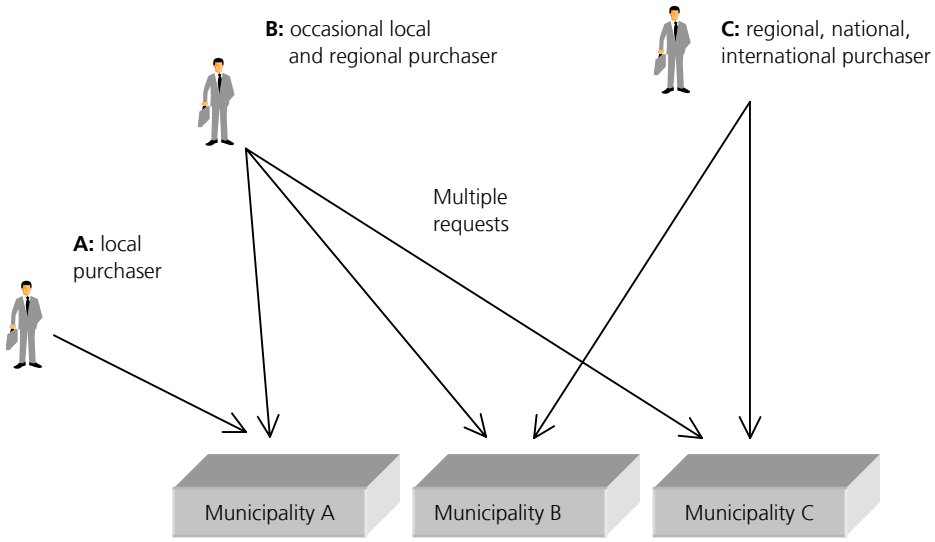


Figure 3 Purchaser groups A, B and C and their relationship to municipal data providers

This organization model was very effective for local purchasers (see in Figure 3 purchaser A). On the other hand, regional- or national-wide players (see in Figure 3 Purchaser B and C) require, say for new roads or pipelines, permanent detailed geo-data as a basic prerequisite. Multiple, time consuming requests are necessary to obtain the base data. 20 municipalities were asked in a use case for a new pipeline.
The differing interests of the data providers concerned have, for a long time, made it very difficult to provide acceptable data distribution for both purchaser groups. But towards the end of the last decade, it seemed that the use of new technologies could help to solve this problem. With the new possibilities of the World Wide Web, the Internet can connect all local data providers to a single entry point for purchasers, called a "portal". The portal offers the products with descriptions of the connected local municipalities, without a data replication mechanism. After the portal receives an order, it may be divided into parts and transmitted electronically via the network to the

data supplier concerned. The local services produce the requested data and send it back to the portal. This transaction may take just a few minutes.

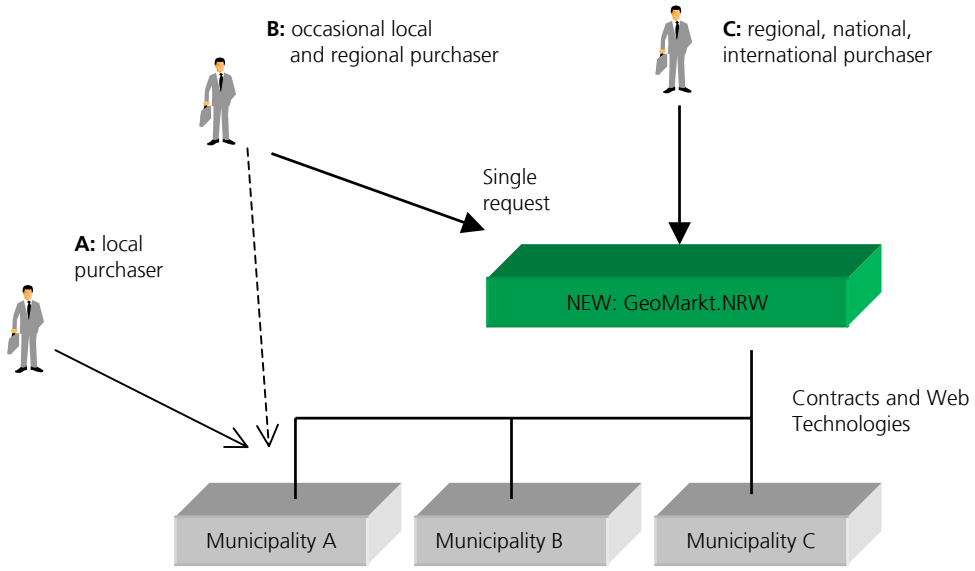


Figure 4 GeoMarkt.NRW: Efficient purchase with single request for (B) and (C) without disturbing relationships (A)

With this electronic mechanism, the player C may no longer need to ask multiple local data supplier for multi regional data sets. Even local purchasers may use this functionality electronically rather than asking directly (see purchaser B).
The most important technology concept to reach an optimal solution for both purchaser groups is interoperability within distributed environments. The project "GeoMarket.NRW" was an implementation proof of concept of OGC and ISO standards in a multi-tier architecture.

2.4.1 Required Functionality

The conceptual advantages of the portal approach are evident and shown in the use case Northrhine-Westphalia (NRW) with more than 50 local data-providers. But for a realization, "suitable" and accepted standards are required to achieve interoperability and to meet the necessary functionality. "Suitable" solutions have to support:

- Query mechanisms to find desired data
- Textual and graphical geo-data description
- Ordinary business transactions in this specific domain
    - Pricing models and licensing,
    - Price calculation
    - Security mechanism
    - Ordering and delivery

and

- Distributed environments principles
- Web services methods
- XML as a format for data encoding

2.4.2 Open Questions

Although specifications are available for meta-data, geo-data formats, meta-data catalogue and geo-data services, OGC provides a methodology, which may be used partly as well for a specification for pricing and ordering aspects. Following the OGC and the general web service principles, the solution should consist of a data format for geographical price-models and methods to calculate a price and to start an order process.

2.4.2.1 How to Design a Machine-Readable Data Format for Geo-Domain Specific Business Price Models?

The calculation of a price may sound simple in the case of tailored mass products like books or wine bottles. Modern geo-services provide a wide range of possible product configurations. Because geo-data is, in Europe and elsewhere, extreme costly, the wide range of possible product configurations are inextricably linked with resulting complex price models.
The solution of the open question should be able to cover the wide range of price models used today. Some examples are described in detail as use-cases in chapter 4.1.

2.4.2.2 Which Interface Functions are needed for Pricing and Ordering?

Other open questions are procedures, which operate on the price model data formats and other data sources like purchaser databases. Typical procedures are product and licensing information, price information, and order forms for purchaser address and billing data, receipts and bills of delivery. But are these typical procedures sufficient for the wide range of price models?

2.4.2.3 How to embed the new Components into the existing OGC/ISO Workflow?

A possible solution should enhance the general workflow, but therefore it needs to complement already released standards. The first approach of OGC/ISO workflow covered the main runtime procedures "search" and "access" of free geo-data as described in the previous section.

The metadata standard ISO 19115 already identifies the business case "ordering" and provides a simple, but not machine-readable, unit for this purpose shown in Table 1. Teege (Teege, 2001) describes the principle needs of machine-readable Meta-data.

B.2.10.5 Standard order process information

298.	MD_StandardOrderProcess	StanOrdProc	common ways in which the resource may be obtained or received, and related instructions and fee information	Use obligation/condition from referencing object	Use maximum occurrence from referencing object	Aggregated Class (MD_Distributor)	Lines 299-30
299.	fees	resFees	fees and terms for retrieving the resource. Include monetary units (as specified in ISO 4217)	O	1	CharacterString	Free text
300.	plannedAvailableDateTime	planAvDtTm	date and time when the dataset will be available	O	1	Class	DateTime (B
301.	orderingInstructions	ordInstr	general instructions, terms and services provided by the distributor	O	1	CharacterString	Free text
302.	turnaround	ordTurn	typical turnaround time for the filling of an order	O	1	CharacterString	Free text

Table 1 ISO 19115 extracted Unit MD_StandardOrderProcess

2.4.2.4 How to embed Pricing and Ordering Functions into cascaded Architectures?

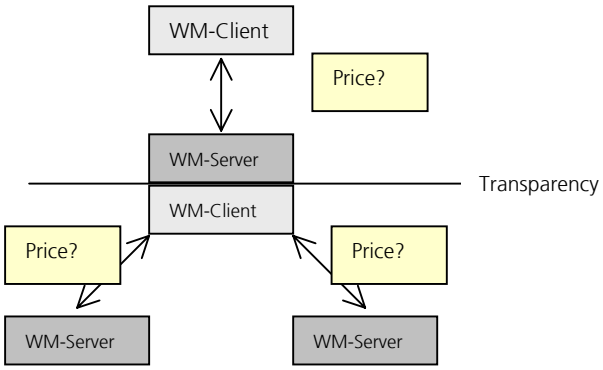


Figure 5 Example of a cascaded OGC Web Mapping Service Architecture

The integration of geo-data is the most important topic for OGC interoperability activities. Modern architectures provide the mechanism of hierarchical "cascaded"

chaining of similar services. Figure 5 sets an example of the Web Mapping Service in a cascaded case.
How to find a solution, which will be -by principle- implementation-independent to conserve the advantages of using any protocol-conforming products?

2.5 E-Business and Domain specific Standards

2.5.1 Business Phase Model and Workflow

Beyond the pricing policy, the support of these price models with distributed computer software is important for their efficient realization. Hauswirth, Jazayeri and Schneider (Hauswirth, Jazayeri, Schneider 2000) proposed definitions and a general phase approach for e-commerce business models.
The expressions request, offer, order and product are defined as:

Request: defines a service or product a party is interested in; sent from a customer or intermediary to a provider or intermediary

Offer: defines a service or product of a provider or intermediary (including legal terms and prices); sent from a provider or intermediary to a customer or intermediary

Order: if a party is satisfied with an offer (possibly after a negotiation phase) an order is placed with the offering party; sent from a customer or intermediary to a provider or intermediary

Product: goods (service, information, material goods, tangible or intangible), which are traded in a business model; sent from a provider or intermediary to a customer or intermediary

The role of intermediary is relevant for the geo-information domain. (Craglia, Annoni, Masser, 1999). Hauswirth et al. defined the general workflow in five business phases:

- Advertising, (Phase I)
- Negotiation, (Phase II)
- Ordering, (Phase III)
- Payment, (Phase IV)
- Delivery, (Phase V)

These workflow steps are functionalities, which should be supported by e-commerce software.

2.5.2 The Workflow and the unsolved "Gap"

The model of business phases (Hauswirth, Jazayeri, Schneider 2000) is a general model for electronic trade. But the product "geo-data" is an intangible commodity (Konstantas, Morin, 2000) and has some domain-specific characteristics. The business

phase "Advertising" contains the description of the product, which is "published" as Meta-data (Nebert, 2001).

Because of the need for a geo-information retrieval mechanism, OGC, ISO and other standardization bodies, e.g. ingeoforum (Göbel, Lutze, Giger, 1998; InGeoForum, 2000), have already developed meta-data formats (e.g. ISO 19115) (ISO/TC 211, 2001) and query languages (e.g. CQL) (OpenGIS, 1999) for the geo-domain. The documents and specifications cover the complete functionality required to

- describe a geo-data set,
- to find it,
- to offer further information about it and
- where to get the data.

The OGC Web Mapping Service (WMS) implementation specification (Jeff De La Beaujardière, 2001) can be used in a very efficient way to provide geographical navigation functions and direct data access in the case of bitmaps.

Some other specifications like the OGC Web Feature Service (WFS) (Vretanos, 2001), Geographical Markup-Language (GML) (Cox, Cuthbert, Lake, Martell, 2002), the Web Coordinate Transformation Service (WCTS) (Müller, 2002) or WMS with Style Layer Description (WMS SLD) (Lalonde, 2002) offer enhanced data manipulation, which meet the described requirements. These standardized specifications activities continue.

All these developments take free data sources into account, which may be accessed online via HTTP. In the case of restricted or commercial products, the contact information is offered, but no automated pricing & ordering.

But the approach to first find a solution for free data or internal data sources was an important step in the development and it offered itself many advantages. These specifications can be used for (online) delivery in the business phase model.

Form a purchaser point of view; the functionalities can be arranged in a general workflow with five principle steps. Figure 6 shows the workflow and gives an overview of the availability of suitable solutions.

Business Phase Model Step	Workflow	Suitable solution in the spatial domain
I	Search for geo-data and their sources	✓ ISO 19115 Metadata ISO 19119 Metadata OGC Catalog Service OGC WRS
	Textual and graphical information	✓ ISO 19115 Metadata OGC WMS
II/III	Pricing and ordering	⊘ ?
	Security mechanisms for Authentication, Authorization, Access Control (AAA)	⊘ ?
IV	Payment	
V	Geo-data production and manipulation, e.g. integration or transformation	✓ OGC WFS, OGC WMS SLD, OGC WCTS

Figure 6 General trading workflow in steps and availability of solutions in distributed web environment

The domain standardization bodies do not provide a suitable solution for the workflow steps II/III, pricing & ordering and security. Figure 6 visualizes the "gap" in a business case.
Due to low acceptance on the Internet, the step IV „Payment" can be covered off-line. Business-to-business trade often uses monthly accounting.

2.6 Limitations

2.6.1 Product and Service Description

The common workflow of e-commerce systems contains product description as the first step. In the GIS world the product description is called "Metadata", which describes the geo-referenced data. This kind of data is important in the case of searching geo-data by using catalogues. There are several approaches, which define semantics to provide a digital data representation. The most important today is the new ISO 19115 standard, which is widely accepted. This metadata standard describes all necessary topics about a geo-data set or, in the case of geo-eBusiness, about the product geo-data. Therefore, this standard caters for product description.
Similar to description of content with the ISO 19115, the ISO 19119 describes the web service and its properties. With these standards, the product "geo-data" can be searched and found in catalogues.

2.6.2 Security (AAA)

A Geo-eBusiness service calculates prices, receives orders and delivers. Typical of commerce, a certain level of security is necessary for these transactions. But that does not mean that a Geo-eBusiness service development needs to provide proprietary security mechanism, rather than use known and accepted standards (See step III in Figure 6).
Authentication, Authorization and Access-Control (AAA)-Services are needed for many tasks where data is not free or should only be accessible to a certain group. There are some approaches to define these AAA Services in detail.
The AAA should also provide a simple purchaser database, where address and login data is stored.

2.6.3 General Web Service Developments

The development of web service technology emerged towards the end of the last decade and there are several development streams. Many things can be solved with different definitions, e.g. encoding rules. The availability of tools and marketing streams will influence the trend.
In general, consolidated findings provide mechanisms, which are not dependent on a particular instantiation. Nevertheless it is necessary to choose a particular encoding to demonstrate the benefits.

3 Use Cases and Requirements

In the following section some use-cases describe the every day situation in many agencies. The wide diversity of price model approaches shows the heterogeneous market situation. The second section analyses the use-cases for common characteristics, which may be used for automation. It defines several requirements, which have to be resolved. The next two sections describe some fundamental principles, relevant IT standards and IT e-business approaches. Finally the most important open questions are defined in the last section.

3.1 Use Cases: Categories of Pricing Models

3.1.1 Description – Area based pricing (ATKIS)

The price model described below is very typical for area based pricing (LGB, 2002a). It was created and published by the LGB Brandenburg, a German State mapping agency. This price model was translated into English and the Courier font is used to mark it. It is a common pricing model. The price is calculated as a result of price per square kilometer and of the requested area (in square kilometer).

Basic pricing approach

LGB	Group 2				Pricing Catalogue LGB		
	The Topographic – Cartographic Information system				Released 10.12.01		
					Pricing base		
Position	Description				Unit		Amount in €
2.1 2.1.1 2.1.1.1	Digital Topographic Data ATKIS – DLM Basis-DLM – Basis Amount						
2.1.1.1.1	from	1	to	5.000	Land coverage 1 km²		7,50
2.1.1.1.2	from	5.001	to	25.000	Land coverage 1 km²		2,50
2.1.1.1.3	from	25.001			Land coverage 1 km²		1,00

Table 2 Area dependent pricing approach

Delivering with simplified data structure

For more simplified data structures, a rebate will be given on base of the basis amount. A delivery in a data structure without object separation, e.g. Data-Exchange-Format-DXF, reduces the base amount of money by 50 %.

Delivery with object groups:

A delivery in object groups of the Basis-DLM data sets, reduces the amount to following percentages:

Object group	Percentages
Settlement	25 %
Traffic	40 %
Vegetation	20 %
Water bodies	10 %
Territories	5 %

Figure 7 Multi usage license for digital Topographic Data

The multi usage license for the delivery of data is granted, if the customer is using the data for internal purposes only.
It will be calculated by a multiplication of the base amount with the following, suitable Factor:

Number of Workstations	Factor
2 to 5	1,5
6 to 20	2,0
21 to 50	2,5
51 to 100	3,0
101 to 150.	3,5
151 to 200.	4,0

3.1.1.1 Remarks

The scaled pricing approach in Table 2 need some additional explanation, not defined in the original text. That can cause misunderstanding. A scaled price will be calculated based on separated intervals and then aggregated. An example can illustrate this mechanism:
A purchaser would like to get the basic price for 6000 km² coverage. The basic price result is 5000 km² * 7.50 EUR/km² + 1000 km² * 2.50 EUR/km² = 40 000 EUR. Some purchasers may interpret the scale price formula and calculate a price like 6000 km² * 2.50 EUR/km² = 15 000 EUR.
This given use-case is deliberately simplified for a better understanding. In real life, this basic model is likely to be modified in various aspects.

3.1.2 Objects-based Pricing

After the introduction of CAD Systems spatial objects could be selected and manipulated easily. Together with the principle "more data-higher price" resulted in a pricing per object (LGB, 2002b). The basic price model contains a price per object and a number of objects. This approach is often used for vector data. The state Brandenburg uses it for its building data, as do most municipalities in NRW.

```
Price = price_per_object * number_of_objects
```

Source 1 Example formula for object pricing

3.1.3 Zone-based Calculation

This approach serves as a compromise instead of the non-transparent object pricing, which was shown in 3.1.2 (Fraunhofer ISST/BEV, 2001). The density of objects results in this price model with intervals based on different density zones (see Figure 8 and Source 2). The polygons of these zones can be stored separately as Meta data for pricing purposes. Therefore the pricing principle "more data-higher price" is still valid.
A similar approach is to use a grid with density factors. Another approach is the pricing depending on the number of features in a zone.

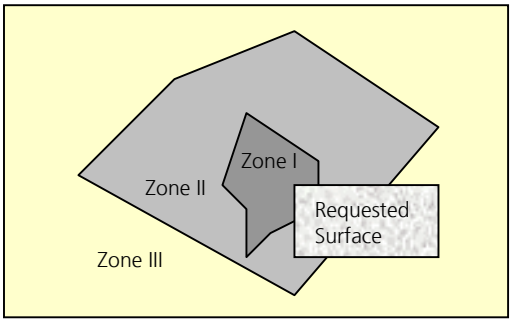


Figure 8 Principle Approach of zone pricing

```
Price =( Surface_in_Zone_I * Zonefactor_I +
         Surface_in_Zone_II * Zonefactor_II +
         Surface_in_Zone_III * Zonefactor_III )  *
         standard_price_per_surface
```

Source 2 Example formula for zone pricing

3.1.4 Pricing Example: Shopping Cart Workflow with reverse Price Correction

Rebates, scale factors mechanism and minimum or maximum amounts are very often due to very high prices in the spatial sector. An example shows these consequences together with the classical idea of shopping carts. The example structures can be derived from price model 3.1.1 (LGB 2002a).

A purchaser selects a 10 km² extent of product A. The price can be calculated and comes to 100 EUR. The purchaser accepts it and puts this item into the shopping cart. In a second tour, the purchaser is looking for product B and selects the product to the value of 350 EUR. This item will be accepted as well and put into the shopping cart. The summation now equals 450 EUR. In the last turn, the purchaser goes back to product A and selects another extent of 35 km². The resulting price may not be 350 EUR if the summation of the extents exceeds a scaled price. The given price at the first item is therefore not valid any more. Shopping cart item prices may depend on each other and cause complex pricing circumstances.

3.1.5 Surface-and Time-based Pricing (Satellite Industry)

Satellites have the ability to capture geo-data from large territories into campaign series. New satellites and their campaigns are planed in long cycles. Because of fast technological developments in the satellite industry, these series have therefore a well-defined temporal value. The value of a serie has only historical value after a new satellite with a higher quality started a new campaign.
The shown approach depends in principle on a covered surface and the time interval date of the contract – campaign time (Düren 2002). Different prices for landscape and urban area are enhancements of the pricing model. Source 3 - Source 13 shows the required equations and Figure 9 gives a principle graphical impression of this approach.

```
TimeInMonthsSinceLastUpdateButSmalerAsCampainDate = MAX
(TimeInMonthsSinceLastUpdate, CampainDate)
```

Source 3 Limitation function for permanent service costs for historical requests

```
Amortization=1/ CampainDate *
TimeInMonthsSinceLastUpdateButSmalerAsCampainDate
```

Source 4 Current Amortization

```
CurrentValueLand= CaptureValueLand- (Amortization*( CaptureValueLand -
CaptureValueLand * HistoricalValue))
```

Source 5 Current value of land assets

```
CurrentValueCity= CaptureValueCity-(Amortization*(CaptureValueCity-
CaptureValueCity* HistoricalValue))
```

Source 6 Current value of city assets

```
CurrentValuePerKM2Land= CurrentValueLand / LandSurface
```

Source 7 Current land asset value per km²

```
CurrentValuePerKM2City= CurrentValueCity / CitySurface
Current City asset value
```

Source 8 Current city asset value per km²

```
CostForPurchasingLandInKM2= CurrentValuePerKM2Land *
PurchaseSurfaceInKM2Land
```

Source 9 Cost for land asset order per km²

```
CostForPurchasingCityInKM2= CurrentValuePerKM2City *
PurchaseSurfaceInKM2City
```

Source 10 Cost for land asset order per km²

```
CostsWithoutDiscountAndServiceCosts= CostForPurchasingCityInKM2 +
CostForSellingLandInKM2 + ServiceCosts
```

Source 11 Cost without any discount, but with service costs

```
CurrentDiscount= CostsWithoutDiscountAndServiceCosts / (CurrentValueLand+
CurrentValueCity) * MaxDiscount
```

Source 12 Current Discount

```
price = CostInclDiscount= CostsWithoutDiscountServiceCosts *(1-
CurrentDiscount)
```

Source 13 Final price

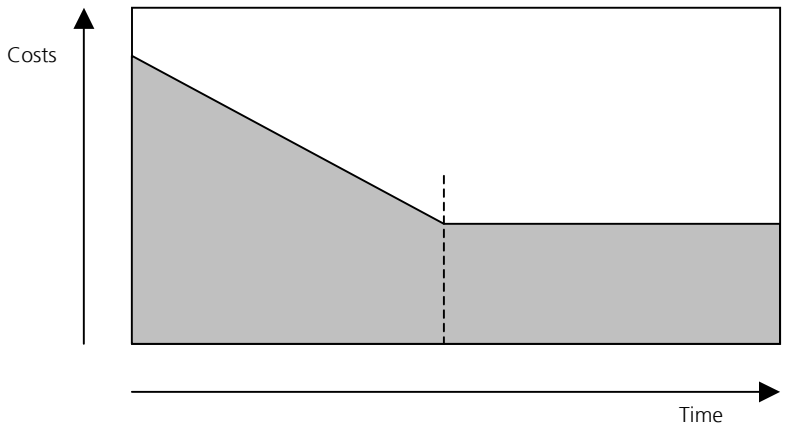


Figure 9 Principle Approach

3.1.6 Protocol Example: OGC Web Mapping Service

Although not a real world business use-case today, web services are a key issue in a spatial data infrastructure and getting more and more prominent in the geo-information sector. But how to set up a pricing & ordering mechanism for services and how to price these services?

To illustrate, a well-publicized example of a standardized protocol is described here in detail for a better general understanding of web services. The specification was released in 2000 and implemented worldwide. This service protocol needs to be supported with pricing & ordering as shown in GDI NRW Testbed I (Remke, Bernard, 2001).

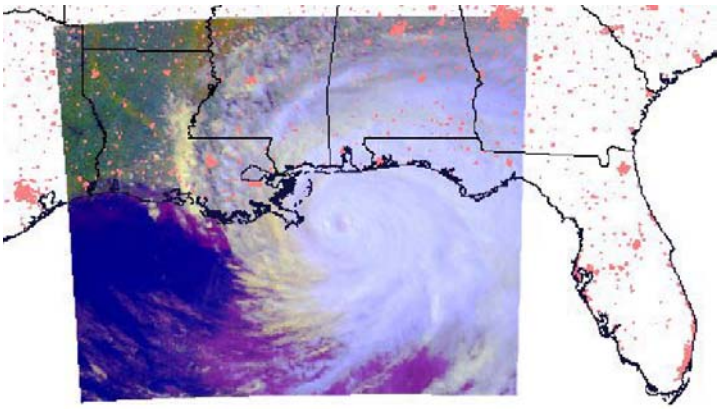
Another example is the Danish Web Map service project developed by the (Danish) National Survey and Cadastre (Kortforsyningen, 2002). Although the concrete price model is not defined yet (Frederiksen, 2002), there is a need for a pricing mechanism.

The OGC Web Mapping Service (WMS) is a service, which delivers bitmap maps in the popular gif, png and jpg formats and can be used easily in standard www-browsers. Geo-data can be integrated as geographical layers by the cascading of several WMS services. The service specification contains all necessary elements for the OGC publish-find-bind mechanism and is therefore a perfect web service example.
Source 1 shows an example HTTP Get request. It contains the operation "GetMap", the spatial location with a bounding box (BBOX), the four layers and some other parameters. This request can be executed in every browser.

```
http://a-map-co.com/mapserver.cgi?
VERSION=1.1.0&
REQUEST=GetMap&
SRS=EPSG%3A4326&
BBOX=-97.105,24.913,78.794,36.358&
WIDTH=560&
HEIGHT=350&
LAYERS=AVHRR-09-27&BUILTUPA_1M,COASTL_1M,POLBNDL_1M
STYLES=default&
FORMAT=image/png&
BGCOLOR=0xFFFFFF&
TRANSPARENT=TRUE&
EXCEPTIONS=application/vnd.ogc.se_inimage
```

Source 14 The example request "GetMap" is taken from the OGC WMS specification (Jeff De La Beaujardière, 2001)

The response is the bitmap, which was generated by the cascaded WMS service. It shows the four layers. The layer "AVHRR-09-27" shows the hurricane.



Source 15 Web Mapping Service Response

Bitmaps are very useful for many applications of human decision support. Actual geo-data, which can be integrated within seconds, has a high value and should be priced.

3.2 Analysis

The aim of this section is to abstract the uses-cases for common characteristics of price structures in the context of distributed services in a spatial data infrastructure and to define requirements.
The basic technology used restricts the design frame with some formal principles. These limits are important to know for any new suitable design and may help identify further improvements. Existing solutions, e.g. business standards need to meet these technical requirements.

3.2.1 Architecture Requirements

Modern service architectures consist of three or more tiers as shown in section 2.2.2. From a business point of view, each tier can be an individual business identity. Some tiers may be combined in a single business. That depends on the general business model, which varies, of course. A good technological concept should be generic and support re-usability of the software components in all business cases.
In the case of transparent pricing, each component may have an influence. In most business cases, a price at the front office depends on the procurement price in the back office. The structure of pricing formulae, not just a single price, should be known. Therefore it is required to exchange complete price models via the Internet. The Internet requires a data file for each instance of data exchange.

That means that a data file format is required, capable of storing complete business price models.

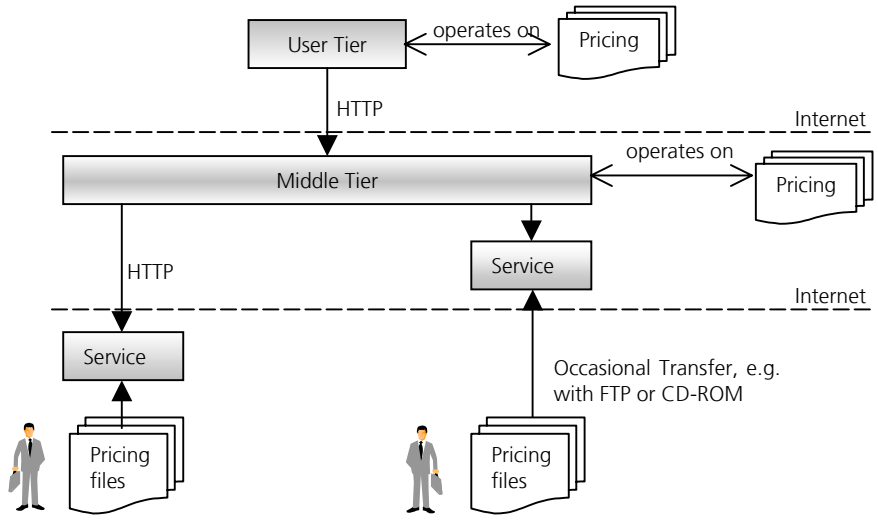


Figure 10 Different business cases with a pricing data file format: left a three tiers and right a more affordable two tiers model.

Figure 10 illustrates two general business models with a pricing data file format. The enhanced, connected business model with an SDI connection on the left side and on the right a data supplier, which offers its geo-data with low IT and no SDI infrastructure by using application service providers. The right business approach is important as a low cost starting point for any SDI and for business models, which consider data providing as a part-time activity.

3.2.2 Pricing Structures

Use-case 3.1.1 gives an example, and the others an impression about, the different pricing approaches. But price models may change rapidly. No general pricing approach has been accepted in the geo sector yet. Other sectors like telecommunications have just a few, generally accepted basic pricing rules, e.g. time distance zones and monthly fees. The geo information economy is still testing the pricing rules. An automatic pricing & ordering processing could help to explore the market faster and to offer easier access to customers.

Each supplier has different, changing pricing rules. The analysis shows, that no general pricing structures with repeated pricing structures like in the telecommunication sector can be found. But all price models can be calculated. Therefore the basic representation of all price models is the mathematical formulae. The price is a solution of a mathematical equation system. Scaled prices can be expressed with conditional equations. It is assumed that the equation system has a solution.

Some pricing models are directly based on a primary geo-data access like the object-based pricing (3.1.2). Therefore, the calculation may be interrupted and external parameters, which are dependant on previously calculated parameters, need to be integrated.
The use-case 3.1.3 shows that geographical operations e.g. intersect, are required for extent calculation. Geographical operations can be treated in general as external data sources.
Section 3.1.4 shows that pricing & ordering is much more complex in the case of multiple products. Prices depend on the constellation of selected products. That can include instances with different configuration of the same product. Therefore it is required that the constellations of multiple selected products need to be covered by a pricing model.
Section 3.1.5 shows the intensive use of formulae to describe a price model for satellite geo-data. This approach required as configuration parameter the actual date for a price calculation.

The digital machine-readable representation of mathematical formulae is a requirement for a solution.

3.2.3 Product Description with Metadata 19115

Spatial data is, in comparison to other digital data, very structured. Several mathematical and geographical rules can be used for homogenous databases and for automatic processing. This is an advantage. Therefore a product description for geo-data is much more detailed, e.g. spatial reference systems, bounding boxes, layers…. These characteristics may be used for an enhanced search.
The ISO has set-up the geo-data description Meta data format ISO 19115, which was introduced in Chapter 2. The OGC develops specifications for catalogue querying (Kottman, 1999b). A solution for geo-data product description is therefore available and defined in all SDI concepts.

It is required to use ISO 19115 for product description in any business applications within the geo sector.

3.2.4 Functionality Example: Ordering Process for geo-data products

The use-cases 4.1.1. - 4. are typical for geo-data products. From a business point of view, these data-file products may be sold once and could be more or less considered as common goods. A good example is satellite data, which covers larges areas and may be acquired in large packages. Updates may be acquired in long time frames.
These data products need to be configured, generated and, perhaps after several hours, be ready for delivery. The files can be downloaded and manipulated locally.

Many applications do not need the latest geo-data to provide value. Examples are car-navigation systems.

3.2.5 Functionality Example: Ordering Process for geo-service products

Services provide data instantly, thus demanding a permanent infrastructure. Weather forecasts are an example of an application, which needs always the latest geo-data.
Therefore some additional components and functionalities are required for pricing & ordering. Geo-data requests of applications need to work hand in hand with business services.

There are no current real world examples of interoperable geo-service providers in the geo-information sector. Some providers use proprietary service definition today (Barwinski, 2001), and there are test beds with an interoperable approach (Vowles, 2002).
The purchaser of a license is very often required to make use of services. This authorizes the purchaser to access the defined services with several conditions and different prices. It is required to offer this kind of functionality by a Geo-eBusiness service; this method of data procurement is becoming more important, along with the growth of a spatial data infrastructure.

3.2.6 Embedding into existing Infrastructures

With its interoperability program, the OGC started a number of new geo service specifications. These services generate and/or manipulate geo-data in a distributed environment. These specifications do not cover any commercial or security aspects (Kottman, 1999a). The real world considers these aspects as crucial for their business models. A co-operation between the geo-technical and the business functionalities is necessary for any sustainable success. But how can these functionalities to be integrated?

In the GDI NRW community, there are two opinions in this question (SIG-ECO, 2001). A group has the opinion that geo-services need to be developed as "e-commerce aware" geo-services. These enhanced services use the basic geo-technical specification with added business functionalities. Therefore, these services would be complete new implementations, which would only be interoperable to the lower versions. The realization seems to be quite suitable without protocol conflicts. This group can be called the "e-commerce aware" group.

The other group in the community has the opinion that functionalities should be separated into two services, which need to be chained in "appropriated" way. But it is unclear what "appropriated" means. Protocol conflicts are predicted. An argument in

the second, the "chaining" group, is that specifications have already been released and many implementations sold and installed. Another strong argument is the object-oriented principle to combine similar functionalities into components. Therefore implementation independence is possible.

It is required to support standardized web services for Geo-eBusiness applications.

3.2.7 Internet-Based Technologies

Web services are based on the HTTP protocol. The HTTP protocol has two relevant connection methods, GET and POST, from a client to a service. The GET method has the ability to send a limited string size to the service, which may be packed with parameter key value pairs, e.g. "parameterName=value&". The POST method was designed to upload large data files, which may be ASCII characters or binary.
A familiar way to use a web-server and service is the usage of a WWW browser. HTML is used to represent information and HTML forms can be used for user input in any browser. This data is sent as key value pairs with the GET method. This mechanism is easy and supported by all WWW browsers. JavaScript may be used for enhanced request creation within the WWW browser client. Web services, which meet these requirements, have the widest potential usage. This kind of design is called "thin-client". But often these capabilities are not sufficient for many tasks.
Although not so known, HTTP may also be used for machine-machine communication. In that case, software running on a server can, through any programming language, create complex and large requests and send them with the POST method. Thins kind of design is called "thick-client" and needs more effort. In this case, a user interacts with at least three tiers: the WWW browser, web software running on a web server and the web service.
XML is used for data encoding as an implementation and platform independent language (Tim Bray, Jean Paoli, Sperberg-McQueen, Maler, 2000).

3.3 Relevant e-Commerce Standards

The Internet opened the prospect of electronic commerce (e-commerce) between consumers and vendors. Later, the key word e-Business was introduced to show the back-office and/or business-to-business (B2B) automation potential. Interoperability and web services have now become key words in the IT business mainstream. Several initiatives were founded to identify common workflows and to develop standards (Kelkar, Leukel, Schmitz, 2002a). The relevant initiatives and their solutions are presented in the next sections.
Although relevant in principle, cXML and EAN UCC will not be described and discussed here, because of similarities with listed items.

3.3.1 UDDI

Universal Description Discovery and Integration of Web Services

3.3.1.1 Initiators

Accenture, Ariba, Inc., Commerce One, Inc., Fujitsu Limited, Hewlett-Packard Company, i2 Technologies, Inc., Intel Corporation, International Business Machines Corporation, Microsoft Corporation, Oracle Corporation, SAP AG, Sun Microsystems, Inc., and VeriSign, Inc

3.3.1.2 Description

The "Universal Description Discovery and Integration of Web Services" (UDDI consortium) aims to set up an infrastructure to find web services quickly, easily and dynamically and transact with them (UDDI, 2002a).
UDDI developments concentrate on registries, which store web service description and binding information on three levels (UDDI, 2000b). The lowest level is called "white" pages, the middle "yellow" and the higher level "green". These expressions refer to classic telephone books.

- The White Pages contain complete lists of records with name, short text descriptions, address, telephone, fax, e-mail and homepage items. Most often, these records are organized by alphabetic order of names. This kind of information is useful, if a record fragment is already known and other access information are desired. An example is to find the telephone number for the entry "Roland M. Wagner" in Lippetal.
- The Yellow Pages contain business categories. This order is useful, if potential suppliers from a given sector are wanted. An example is a "Pizza Service".
- The Green Pages are less classical. This level is being introduced for technical access to business services. The access information describes how services can interoperate.

UDDI is mentioned here in this thesis, because pricing & ordering are aspects, which may be covered in principle by Green Pages. After two years developments of UDDI, the specifications do not aim to cover these aspects. UDDI references other business developments, e.g. rosettanet (UDDI, 2002c).

3.3.1.3 Advantages

UDDI and the Web Service Description Language (WSDL) are general approaches in the IT mainstream (Christensen, Curbera, Meredith, Weerawarana, 2001). Therefore the registries from non geo-sector specific players may be used with a new potential. A bridge from the general entries in the IT mainstream infrastructure into the spatial data infrastructure seems to be feasible.

3.3.1.4 Disadvantages

Because of its general approach, UDDI/WSDL are not capable to support special spatial requirements in the process publish-find-bind. An example is a spatial query with a bounding box.

3.3.2 ECO Framework

E-CommerceNet –eCo Framework Project-

3.3.2.1 Initiator

…(More than 40 members from business, IT and science),
Prime sponsor "commerce one"

3.3.2.2 Description

The eCo group aimed to set-up architectures for electronic commerce interoperability (Chen, Kacandes, Manning, Meltzer, Rhodes, 1999). This approach covers and structures networks, markets, businesses, services and interactions from a general point of view. The eCo framework approach contains registries and business service bindings. The architecture was specified and some machine-readable protocols defined. Figure 11 shows the architecture concept. After a time of making good progress in 1999, the activities were stopped by some reason.

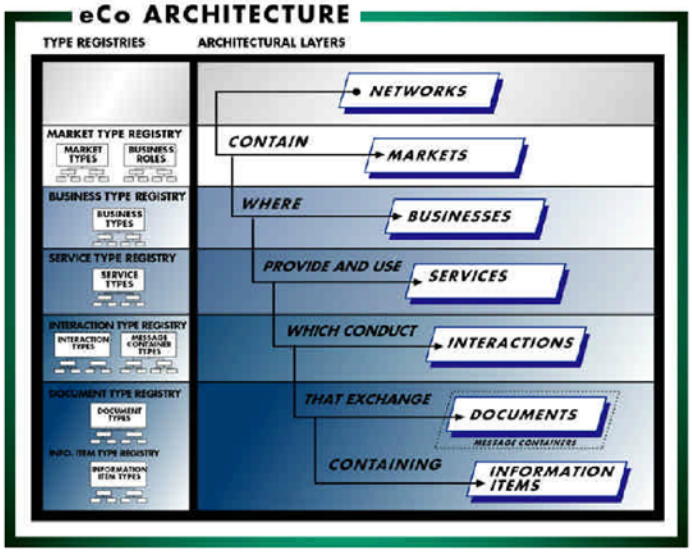


Figure 11 Published eCo Architecture (Chen, Kacandes, Manning, Meltzer, Rhodes, 1999)

3.3.2.3 Advantages

The eCo Framework was an early approach, which was discussed in the GDI NRW SiG e-commerce. It gave a general orientation. The approach is feasible for many off-the-self products.

3.3.2.4 Disadvantages

The eco framework project gives architecture for general businesses, but does not meet the geo-sector specific requirements in complex pricing and supporting in pricing & ordering of existing data-web services.
The eco framework activities seem to be inactive since 2000.

3.3.3 OASIS ebXML

Organization for the Advancement of Structured Information Standards (OASIS) Electronic Business using eXtensible Markup Language (ebXML)

3.3.3.1 Initiator

OASIS has a large list of members and supporting organizations (see homepage: http://www.oasis-open.org). OASIS aims to create worldwide standards for security, web services, XML conformance, business transactions,…, interoperability within and between marketplaces (OASIS, 2002a).

3.3.3.2 Description

ebXML was set-up to provide an interoperable infrastructure for business processes. This web service infrastructure consists of many components. The most important today is the ebXML registry component specification. But not all components are yet specified, or the price model specifications defined. But the Message Service Specification (OASIS, 2002b) contains a possible example, which is shown in Source 16.

```
<?xml version="1.0" encoding="UTF-8"?>
<purchase_order>
   <po_number>1</po_number>
   <part_number>123</part_number>
   <price currency="USD">500.00</price>
</purchase_order>
```

Source 16 ebXML pricing example for a payload in (OASIS, 2002b)

The ebXML approach will be suitable for off-the-self products with simple price models. The pricing complete specifications are not published yet.

3.3.3.3 Advantages

ebXML is a very large approach to set up an e-Business infrastructure. It is connected to many other relevant developments via OASIS and is supported by UN/CEFACT.

3.3.3.4 Disadvantages

ebXML seems not to support complex price models.

3.3.4 Universal Business Language (UBL)

3.3.4.1 Initiator

OASIS

3.3.4.2 Description

Different sectors may have different e-commerce approaches because of different requirements, markets and players. In some cases, there is a need for data exchange between these different infrastructures.

The Universal Business Languages was designed as a data exchange format between different e-commerce frameworks (McGrath, 2002). It is based on ebXML models.

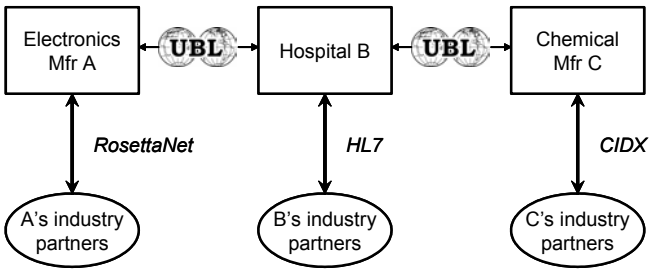


Figure 12 Example of e-commerce data between different sectors (McGrath, 2002)

Figure 12 illustrates the target of UBL. All information needs to be exchanged in one data format or another. Therefore the capabilities of these formats are crucial for the capability of the approach.
Therefore the capability to cover complex price models, like those shown in the use-cases, will be investigated here. The UBL class diagram (UBL, 2002) shows all classes and their relationships to each other. Figure 13 shows the classes "Pricing" and "TradeDiscount" and Figure 14 the class "PricingVariation" with several properties. A product price may consist of a gross price, a net price and other elements. Figure 15 shows an example XML instance.

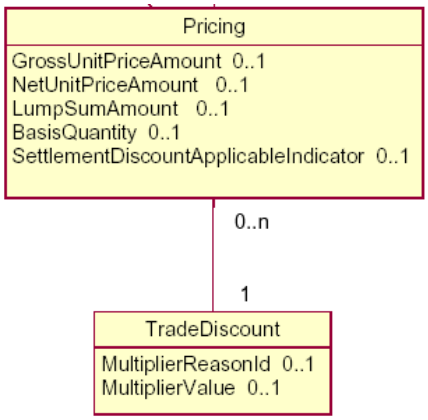


Figure 13 UBL class "Pricing" and "TradeDiscount"

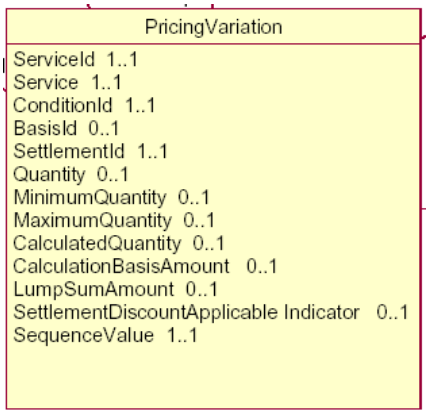


Figure 14 UBL class "PricingVariation"

Figure 15 A UBL pricing variation XML instance

3.3.4.3 Advantages

There is a need for a data exchange format between different e-commerce systems and sectors. The UBL seems to cover this task and it tackles some issues of data conversion. The pricing elements are enhanced compared to other e-commerce data formats.

3.3.4.4 Disadvantages

The UBL approach is to exchange price models with data fields. All these enhanced data fields contain numbers as shown in the example (Figure 15). Complex price models, e.g. with minimum prices or some scaled prices, depending on the configuration, cannot be represented in with this approach.
The configuration of products is limited to classical units.

3.3.5 BMECat

3.3.5.1 Initiator

German Federation of Materials Management, Purchasing and Logistic / Bundesverband Materialwirtschaft, Einkauf und Logistik, (BME)

3.3.5.2 Description

BMECat is an XML-based format for the one-to-one exchange of product data between supplier and buyer. The price model of BMECat is based on a price for a certain article, which may be refined and customized, by a number of specific conditions like territory-specific prices, a minimal order quantity or a quantity scale (Schmitz, Kelkar, Pastoors, 2001).
Since BMECat is defined for a one-to-one communication between supplier and buyer, a general price model cannot be defined (e.g. "all customers from the public sector receive a 50% rebate"). BMECat does not support the complex configuration of digital geo-data (e.g. "*x* square kilometers of layer *A* and *B"*). License models are not dealt with at all.

3.3.5.3 Advantages

BMECat is very suitable for off-the-self products. Because of its light-weigh specification, it can be easily used for data exchange.

3.3.5.4 Disadvantages

This approach cannot cover complex pricing.
BMECat is primarily only supported by European companies and institutions.

3.3.6 XCBL

Common Business Library (xCBL)

3.3.6.1 Initiator

XCBL consortium

3.3.6.2 Description

The xCBL consortium has similar goals as ebXML. It is based on the Commerce One Developments but is free of charge (XCBL, 2002a).
The xCBL has already released the specification version 4.0. It contains a complete set of XML schemas for the described processes. The catalog contains a schema with pricing elements "ProductPriceType". It is described online

```
ProductPriceType:

Description: ProductPriceType gives a set of price information for the
item. If there is more than one relevant price, repeat the element.

Elements:
Amount - supplies the price of the item as a decimal currency amount.
PriceType - gives the type of price being supplied, based on the catalog
creator's or agreed-upon distinctions.
Currency - supplies an ISO Currency Code that overrides the default
currency for the catalog if supplied.
UOM - gives an ISO unit of measure code that is the basis for pricing.
MinimumQuantity - supplies the minimum order quantity at the specified
price.
ShortDescription - gives a single short description of the price. This
takes an xml:lang attribute, which must contain a valid code according to
RFC 1766. If not specified in DefaultLanguage or in a specific element,
the value is assumed to be en for "English."
ValidFrom - gives an inclusive date on which the price becomes applicable.
ValidUntil - gives the date on which the price ceases to be applicable.
PriceBasisQuant - holds the quantity that is the basis of the price. For
example, if the price is $10 for a five-pack, this value would be 5.
```

3.3.6.3 Advantages

Simple price models can be represented. XCBL and UBL have some similarities. But it is not clear, if both developments will converge in future.

3.3.6.4 Disadvantages

Complex pricing and configuring is not possible to represent within xCBL data formats.

3.3.7 XFDL

Extensible Forms Description Language 4.0, W3C Note, 1998

3.3.7.1 Initiator

John Boyer, Tim Bray, Maureen Gordon, UWI Unisoft Wares Incorporated

3.3.7.2 Description

XFDL has a different approach to the other listed initiatives. It is a proposal for new WWW browser implementations to enhance user input capabilities. From the beginning, the web has provided simple user input capabilities via HTML forms elements. XFDL is a proposal to enhance these capabilities. Examples of these enhancements are boxes, lines, grouped buttons, help messages, cells and active computations or input validation (Boyer, Bray, Gordon, 1998).
Source 17 shows an example of presentation elements encoded with XML.

```
<line sid="BLUE_LINE">
   <size content="array">
   <ae>40</ae>
      <ae>0</ae>
   </size>
   <thickness>5</thickness>
</line>
```

Source 17 Example of presentation elements in XFDL

Although XFDL is not an e-commerce standard and was developed for other purposes, it contains a generic approach with formulae within forms in WWW Browsers (see example Source 18).

```
<format content="array">
   <ae>dollar</ae>
   <range content="array">
      <ae content="compute">
         <cval>35</cval>
         <compute> Bill.value * "0.05" </compute>
      </ae>
      <ae content="compute">
         <cval>700</cval>
         <compute> Bill.value </compute>
      </ae>
   </range>
</format>
```

Source 18 XFDL Example with calculation for WWW Browsers (Boyer, Bray, Gordon, 1998)

3.3.7.3 Advantages

Beyond the presentation elements, the XFDL contains a simple approach to active computations within the www browser. Therefore, it is in principle possible to represent pricing formulae, although some missing mathematical functions may restrict the capabilities.

3.3.7.4 Disadvantages

The XFDL was designed as an enhancement of www browsers. Therefore the usability is strongly dependant on the www manufacturers. The dominant browser implementations, MS Internet Explorer, Netscape and Opera, do not provide any proprietary enhancement for HTML forms. Some web applications use JavaScript or Jscript to provide input validation and computations. But most applications today use server site methods to avoid browser dependency.

Another disadvantage is the combination of view and data representation as the examples Source 17 and Source 18 show. Web service designs have a strong emphasis on data exchange without any representation element. The price model formulae are data models. Clients can use different methods like XSL (Adler et al., 2001) together with XML. Since the XFDL approach was posted in 1998 as a "Note" to the W3C, there was no movement until today. But there is a new approach to enhance browser forms functionality in the XFORMS approach (Micah, Klotz, Jr., Merrick, Raman, 2002) together with XSL and XML.

Some pricing formulae (see 3.1.4) need enhanced mathematical functions like summation. Scaled price models need case differentiation (see 3.1.1) with cannot be expressed with simple mathematical functions.

3.3.8 UN/EDIFACT

In 1987 the UN defined the first version of the EDI standard EDIFACT (Electronic Data Interchange For Administration, Commerce and Transport). EDIFACT describes tailored industrial goods with little or no product variations. Product configurations are reduced to product groups and the specification of product quantities, like tons or gallons (UNECE, 2001).

3.4 Conclusion

This section summarizes the given use cases, analysis of use cases and the resulting requirements and the relevant solutions. The state-of-the-art developments are not fit for Geo-eBusiness usage. New approaches are required.

3.4.1 Complex Pricing

The geo domain represents a vast digital product. Geo-data services and web services offer a very large possible product variety. The purchaser can configure its product and retrieve it within seconds or minutes via the Internet. Geo-data is costly to collect and therefore the prices are in general very high (see 3.1.1). The market needs, therefore, a very transparent way to publish prices for automated processing. Pricing models need to be completely represented in data files for exchange. A generic approach is required.

The mainstream IT approaches shown do not meet these requirements. Their target is the mass market of material products. The mainstream standards are designed for these tasks.

3.4.2 Configuration of digital Products

Almost all material products have a very defined shape, which cannot the adjusted easily by purchaser. Very structured digital products like geo-data can be manipulated very easily with services (see example WMS Source 14).
The configuration of geo products may influence the price (see 3.1.1). Therefore a mechanism is required, which integrates configuration and pricing aspects.
The e-commerce approaches described are not designed to support integrated configuration and pricing.

3.4.3 Product Description for Geo-data

Geo-data products need to be described with the spatial ISO 19115 standard for efficient search and retrieval. Most mainstream IT specifications do not support an external product description. Major geo-domain initiatives require ISO 19115 to achieve interoperability within the spatial data infrastructure.

3.4.4 Direct Support of rolled-out Service

The OpenGIS initiative developed and published a basic service for an automated distributed data flow. These specifications and the rolled out implementations need to be supported with pricing & ordering aspects. Multiple protocols should be supported by a business service.
The approaches shown do not support multi-protocol services.

3.4.5 License Model

The usage of digital products may be limited by licenses. Licenses are usually declared by free text, which cannot be processed automatically by machines. The described specifications do not provide a machines-readable semantic for licenses.

4 Approach

Through research and development activity, solutions are being created on different abstraction levels. Fundamental principles have a deep impact within a solution and may be difficult to change afterwards. The applied design can be derived from abstract principles. The applied design in this case uses web service technology.
This Chapter introduces, in the first section, a reference system with different Geo-eBusiness levels. The second section shows the approaches to principles for the pricing data model, the business functionalities and the embedding into existing structures.

4.1 A Geo-eBusiness Reference-Model

4.1.1 Classification of Geo-E-Business

The highest level of a SDI is the business level as shown in the introduction (see 1.4). A suitable Geo-eBusiness solution, which supports the requirements of cascading geo-data services, complex price models, different protocols and a wide range of possible business models would open a wide perspective for different business applications. The different characteristics are described in this section. The author introduces this classification as a reference model for Geo-eBusiness (Wagner, 2002a).

4.1.1.1 Class A: Price Information

The answer of the question "How much does it cost?" is not simple in the domain of geo-information, because of complex price models. Software, which calculates prices, would be itself a great help in the everyday life of customer-facing staff.

Figure 16 Stand-a-lone online price information in a class A application

If this component could be made accessible via the web, price information could be gathered automatically by customers 24 hours / 7 days a week. Automation would be a great help to increase better customer service for these users, with their own particular questions.

Another effect would be reproducible prices, which are not dependant on different interpretations of the written business price models.
A class A system is a Geo-eBusiness component, which is not connected to any other service, e.g. catalogue or geo-data services for data generation. It offers all Geo-eBusiness functionalities except online data delivery. An order will be placed by an e-mail to customer services, which invokes generation of the geo-data and shipping via traditional mail.
Therefore even class A would improve the marketing quality of geo-information products significantly. Figure 16 shows the stand-a-lone pricing & ordering component in a class A constellation without requiring any integration to other components. Therefore a class A is easy to set-up and to use.

4.1.1.2 Class B: Shop

The class B supports the same features as class A, but is connected to a catalogue service with enhanced search functionality and has the ability to deliver digital products online via the Internet. Therefore the eco-component would need a connection to geo-data services. This geo-data management needs some back-office interfaces, which are dependant on the protocols used. But class B, with its online delivery of configured products, would be the first step towards more automated processing for data suppliers, with solely their own products. Figure 17 shows the three integrated components.

Figure 17 Class B with integrated product catalogue and online data generation and delivery

4.1.1.3 Class C: Portal

The class C represents the case of a portal, which integrates more than one single data supplier with a common look & feel. This general solution could only be realized with a common geo-eBusiness standard. Proprietary solutions could not cope with the portal case. A portal with distributed geo-eBusiness services could conserve organizational structures on the one hand, but could also respond to increased customer needs. The advantages of Class C may also be used for internal arrangements of service components. Figure 18 shows the portal case.

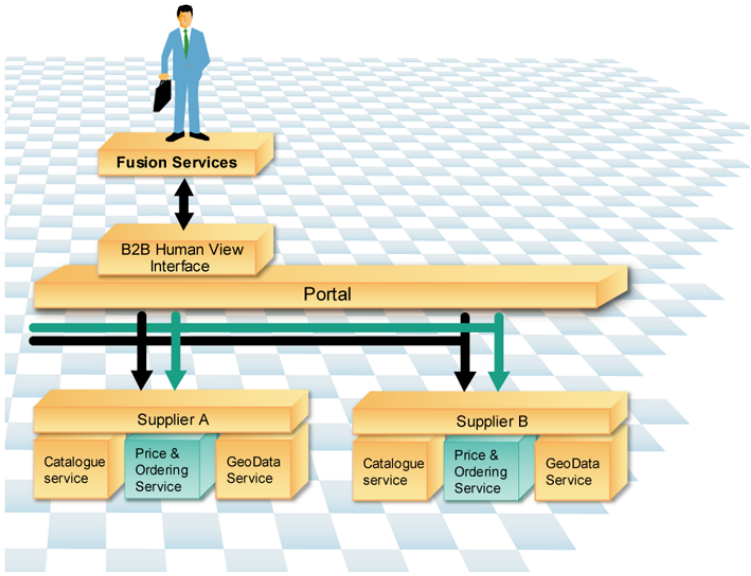


Figure 18 Class C with a human- readable interface

4.1.1.4 Class D: Vertical Integration

The advantage of class D would be a machine-readable geo-eBusiness interface, which would cascade and therefore integrate the complete range of data supplier. This case offers the ability to integrate the procurement of geo-data into a vertical value-chain.
Specialized applications might configure and request data on the market on-demand and on-the-fly and enrich it with other information. The end-user may not even know the sources in this application (see Figure 19).
The "digger" application is a good example (Tms, 2002). Every year underground building works accidentally destroy important utility infrastructures like telephone wires, gas or water lines (ALIZ, 2001). The interruptions are very costly and disruptive. In the case of gas, the damage may be catastrophic. On the other hand, underground construction is necessary for new connections or modernization.

The "digger" application is specialized for this scenario. By using a GPS, this application allows the operator to visualize the underground infrastructure, with all pipes and wires displayed, before even breaking the surface. The utility companies will provide the infrastructure geo-data. Some may provide it would without charge, some may demand low fees for the service and/or data. An interoperable, standardized approach in this example is very worthwhile, due to the diversity of utility companies, with different GIS software environments.

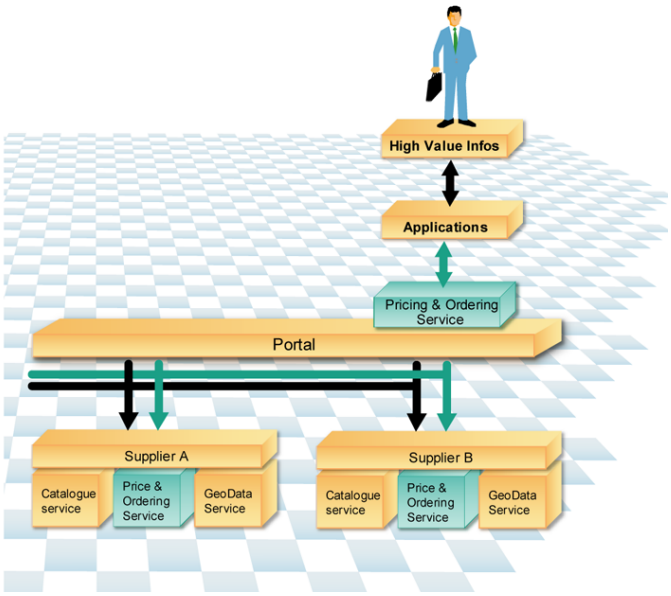


Figure 19 Class D with multiple data suppliers

4.1.2 The Geo-eBusiness Family Concept

A capable Geo-eBusiness service solution can be used in many different business cases as shown (Class A to D). It is possible to provide multiple class applications at the same time in the same Geo-eBusiness service instance: A provider may have its own shop (Class B) for traditional and established customers and at the same time provide its data in, for example, a regional or sector specialized gross market (Class C). A specialized application can procure its data via a Class D vertical value chain.
Seamless adjustments are possible with this family concept. Figure 20 shows all classes in an integrated mode.
These kinds of Geo-eBusiness are even a solution for large databases. Centralized Geo-Data warehouse approaches have to cope with enormous data volumes (Teege, 2001).

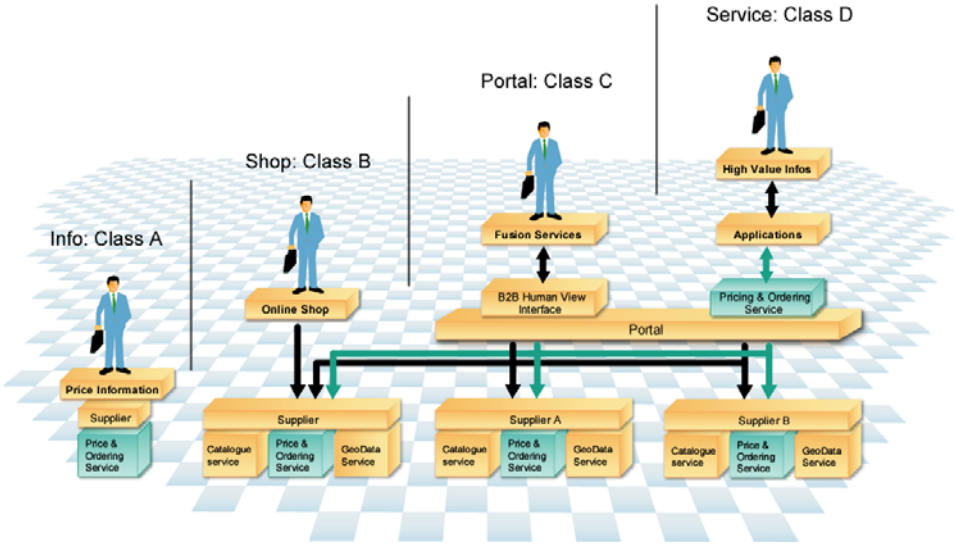


Figure 20 Classification of different business models as a reference model

4.2 Abstract Design

This section covers the fundamental abstract principles for the design of the pricing data model, its functionality and its embedding into the environment already in existence.

4.2.1 Abstract Architecture Principles

4.2.1.1 Separation between Data and Logic

Separation of data and logic, in principle, is the fundamental idea in this design. This approach is more difficult to design and to implement, but offers far-reaching advantages. The same software can handle completely different price models. Different data providers may use the same software instance or an instance of their own as required. The adjustment of prices can be easily realized without any modification to software code, which requires advanced knowledge and permissions. The advantages are evident, but the design much more challenging.

4.2.1.2 Service Cascading and general Chaining

An often-used mechanism to integrate data streams is the cascading of services (OGC 1999-2002). The abstract protocol principle of WPOS uses the "protocol layer manipulation" technology (see section 4.2.4), which supports cascading. Therefore cascading is possible with the same geo-data protocol.

4.2.2 Abstract Data Model and Encoding

4.2.2.1 Transformation Business Pricing Models into mathematical Formulae

Pricing models are designed to provide a customer with a transparent way of determining costs. Today, most price models are published digitally, but with an uncertain semantic (see use cases chapter 3). Conditions are often defined in language. The semantics of this kind of information representation has to be interpreted by humans and relies on a subjective point of view.
There are several real-world examples, showing misinterpretation of a public pricing formula. The scaled price in 3.1.1 is an example. Because of the wide range of price models with completely different approaches (see use-cases in chapter Figure 3), only a generic presentation can be used.
The smallest common denominator to cover these requirements in a case of a pricing method is the mathematical formula. The following steps are necessary:

- Principle: First core pricing elements, then secondary elements like "update" elements
- Declaration of variables and their units
- Successive transformation of free-text business price model into a mathematical formula

As analyses in chapter 4 and experience with the Geobroker project (see chapter 7) (LGB, 2002a) shows, the textual business price models can be transformed into mathematical formulae, likely to be hand written.
This first step cannot be supported by computer procedures.

4.2.2.2 "Filling the receipt"-Concept and Price Model Methods

Data models may have several views depending on use. Views enable the selection of relevant data. However, a plurality of views means a plurality of tools. This design is a trade-off of both.
The general idea of this design is to use a template of a complete receipt as a price model, which can be filled partly by each workflow step.

- The **getPriceModel** method creates an instance of the pricing & configuration catalog and selects the requested product price models up to the root in a hierarchical catalogue.
- The **getPrice** method sets the user given parameter values, calculates the formulae and stores the interim results in each hierarchical level up to the root in a hierarchical catalogue.
- The **orderProduct** method stores the customer relevant data, e.g. address, status and transaction number into the selected catalogue instance.
- The **getOrderList** method returns a valid catalogue structure, but with a list of defined former customer orders.

After a valid and complete workflow the instance can be stored with all contract and interim results for documentation at the customer client site as a result of the response "OrderProduct" and at the supplier site.
There are more methods for calculation, mapping and administration, which are implementation dependent and will be discussed in the applied approach section.

4.2.2.3 Organization of Products in Groups and Catalogues with Data Types

Some suppliers provide a large number of possible products. Therefore it is suitable to organize products in hierarchical product families or product-groups. There are any number of ways to arrange products in groups and catalogues. Product groups can contain other product groups.
Several data objects are necessary to describe a business model completely.
The highest element acts as an envelope and collects one or more catalogues. Suppliers may have their own catalogue. In the cascading case, the catalogues are collected on this level. The catalogue contains one or more product groups. A product group may consist of another level of product groups or consist of product elements. The product element is always a leaf in the hierarchical tree. Therefore, the "product" object and the "product group" objects are the main structure elements. Source 19 shows this hierarchy in a principle representation.

```
+envelope
   +catalogue
      +productGroup
         …
         +productGroup
            +product
```

Source 19 Principle Pricing Catalogue Structures

A "higher" level in this hierarchy means that the level is closer to the root element "envelope". A "lower" level means, that the level is closer to the leaf element "product".

4.2.2.4 Product Elements and the "Basic Process"

The main price-able unit in an order process is a single "product" object. It can offer a complete price calculation result. This mechanism is called the "*Basic Process*". The object and its process is independent and can only be triggered from outside by configuration parameter settings and external data exchange (see 4.2.2.7). The output result is most often a price, which corresponds to a Meta data entry and therefore to a business product.
Different measurement units may cause incorrect calculation and with it incorrect cost publication. Therefore each parameter must have a unit entry. Especially so in the cascading use where different instances from independent suppliers, and different currencies, can occur.

Product-Group Elements and the "Hierarchical Process"

The "product" object calculation capability is sufficient to provide a price for a single product. Price may vary depending on special constellations between instances of "product" objects. More typically, there may be minimum fees, applicable only to special product groups.

The data encoding offers a mechanism, the "*Hierarchical Process*", which enables enhanced pricing on "productGroup" object level depending on multiple results from "product " object level. The results may be prices, but also area extents or other measurement units. The solution is an algorithm, which first sequentially calculates the leaf "product" elements. The results are stored in the parameter objects of each product. After a calculation at "product" object level, the results may be referenced by a "productGroup" calculation formula. There are two reference methods:

- Single-referenced parameter, referring by product ID to a determined value of a determined parameter name
- Multiple-referenced parameter, referring to a list of all parameters on "product" object level with the same name

A default example is the summation of prices in each "productGroup" level for an interim price of all selected product items. Group calculations may summarize interim prices from lower groups. The final result of all calculations is stored in the root calculation object on Envelope level.

4.2.2.5 Inheritance Methods and the Inheritance Process

In the case of a large supplier, many thousands of products have a price model. In fact, in most price models are often series or recurrent entries like contract information. To avoid data redundancy and offer more efficient administration capabilities, the inheritance mechanism has been developed.
Frequently occurring objects may be declared as "inherited" from a certain hierarchical product group level. These objects will be inherited at runtime to all lower "productGroup" levels and finally to the "product" level.
There are two possible methods to interrupt the inheritance process. This occurs, if an inheritance object appears on a lower hierarchical level. The inheritance process will also be stopped if the same object type is found on a lower level.
The Inheritance Process runs prior to other processes, to set-up an initial valid catalogue environment. The inheritance will be invoked at the pricing catalogue level and completed through all lower levels.
An example is contract information. The address of a supplier company is required for every potential contract of a product. Therefore, the contract information object is filled with information and declared in the highest possible pricing catalogue level. If there is another contract information object in the catalogue, this object will be inherited to

each product. The advantage of this mechanism is apparent, if the telephone number is changed for any reason - only one adjustment is needed to the pricing catalogue.

4.2.2.6 Order of Processes

Calculation processes at "product" object level, calculation on "productGroup" level and optimization by inheritance need a certain order, which depends on the request:

1. Inheritance Process
2. Basic Calculation Process
3. Hierarchical Calculation Process

From a more general point of view, the manipulation starts at the XML Document root (with the highest inheritance level) down to the leaves. Then, via setting of configuration parameter-values, this goes back to the root with the calculation hierarchy.

4.2.2.7 External Data Exchange

There are some reasons that price formulae may depend on external data (see 3.1.2, 3.1.5 and 3.2.2). For example, a price can only be calculated, if some parameters:

- are dependant on mass storage filtering, e.g. pricing by number of objects.
- need sophisticated sub procedures, e.g. calculation of extent, which may depend on different co-ordinate systems
- Actual values, e.g. stocks or interests
- other…

Solutions for these external requests are embedded Web Service calls, with a set of output parameters and a set of input parameters. They will be called in the encoding "Web Service Calls (WSC)". Due to time-outs, it is required, that an external process should be done "on-the-fly".

4.2.3 Abstract Functionality Principles

4.2.3.1 Functionality

The content of this document was developed to close the "gap" in a business use case between the search and retrieval functions of a meta-information system (MIS) and the geo-data generation functionalities (see chapter 2). Therefore a typical business workflow needs functions offering all configuration capabilities, pricing and contract information for each product. The return value is the product specific price model.
With these information elements, a purchaser is able to configure a product and to calculate a price in their own system.
An enhancement is to offer a method to calculate a price by a service. In the case of a geo-data protocol, there might be the question: "How much would the result of this specific geo-data request cost?" The return value is a price.
The placing of an order is technically very similar to a price calculation, but includes purchaser accounting information and is, from a business point of view, a signing of a contract with all associated obligations.
The characteristic of most modern digital geo-products is that they can be represented completely as digital data. This circumstance of a special e-commerce product opens the possibility of delivering the desired product online via the Internet.
An optional feature might be a method to track all orders with certain attributes, e.g. price and a status: ready for delivery or error.
Additional sub workflow is needed for aspects like security. But the main functionality can be defined in following methods:

Functionality	Short description
Get Capabilities	Delivers a complete list of all available products
Get Price Model	Delivers all configuration and price information
Get Price	Price calculation as a business offer
Order Product	Ordering
Get Products	Delivery
Get Order List	Accounting

Table 3 Necessary functionality for a business workflow

These methods offer all needed functionally for a complete business workflow. The functionality needs to be defined and mapped to business service methods, which are protocol dependent.
These methods use pricing catalog objects to transfer information to the client. By using the differential "Δ" (Delta) method principle, where each method adds a new differential part to the pricing-catalogue object and the complete pricing-catalogue object will be delivered in the response, the differential part can be encoded for HTTP GET request as key-value pairs or for HTTP POST request as XML objects.

4.2.3.2 Business Protocol vs. Application-specific Protocols

Each protocol enables applications to communicate within the protocol specification capabilities, which works acceptably in the designed scope. Using this ability, cascading systems can merge information from distributed sources in a very elegant way. A well-known example is the cascading OGC Web Map Service using free data sources (see Figure 21).
But it is not possible to enable these application protocols to cover business aspects while transferring value data across company boundaries. A Web Map client can only understand a Web Map service. Using some additional "vendor specific" parameters to transmit business aspects, which are specified, makes a solution dependent on implementation instances. It may work with a cascading Web Map Server product of company "A" but not with another.

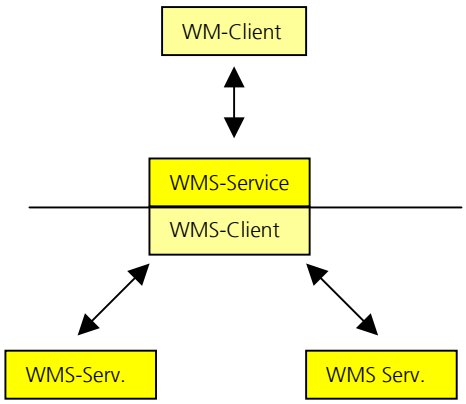


Figure 21 Cascading Architecture with free sources

4.2.4 Protocol Manipulation Layering Method

In the following section, an application service, or in an applied case a geo-data service, is one which has the ability to handle sector specific formats and may merge information. A business service covers transaction aspects like price, ordering and delivery.
The OGC Web Map Server (WMS) is a good example of an application service. The Web Pricing & Ordering Service (WPOS) (see 5.2.2) is an example of a business service. The service name WPOS is here introduced for a better understanding and can be considered here as an abstract component.
A solution to separate application and business data streams comes from introducing the method of *protocol manipulation layer methodology*. Each protocol layer covers its specific aspects then encodes and packs the lower protocol into its layer data stream from the client to the server.

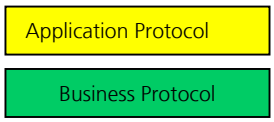


Figure 22 Separation of application data and business data streams with the protocol manipulation layering method

Figure 23, Figure 24 and Figure 25 show the approach in a graphical manner and from different points of view with the applied example of the Web Mapping Service (WMS) as an application-, a WPOS for a business- and an AAA for a security service.

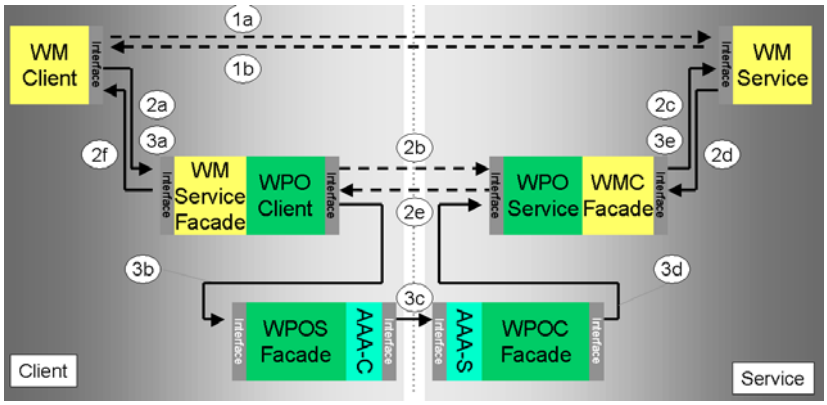


Figure 23 *Protocol Manipulation Layering methodology* from a vertical point of view

The connection between the application geo-data client and its service are defined by a URL (1a), which can be configured in a general manner. The URL is the only general parameter involved in the application data stream. In the business case the application target URL of its service is reconfigured to an emulating business client (2a). The business client accepts the request and the parameter list.

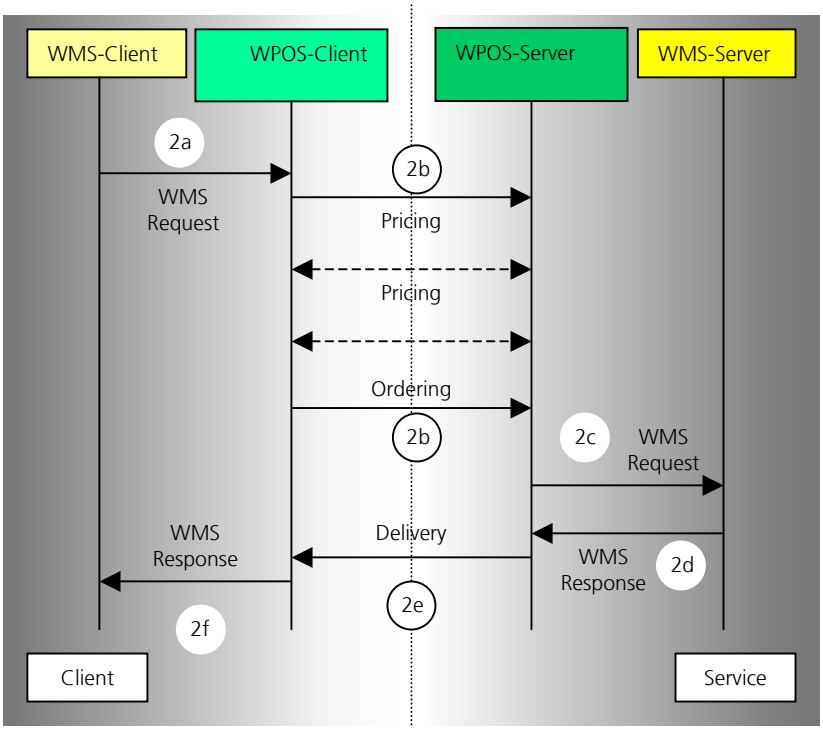


Figure 24 The Protocol Manipulation Layering Methodology from a sequence point of view

The application request can be decoded and analyzed from the business client. In the following steps the business client sends a request to the business server for price models or prices until an order is set-up with an accepted price as a contract by a purchaser. In this case, the business service unpacks the application request, decodes the application request, recalculates the price for security reasons and sends it to the target application service (2c). Only the application service has the ability to create or to integrate the requested data for the application client. This data stream will be routed back (2d) via the business protocol (2e) and presented to the application client as requested (2f). All transactions are tracked and analyzed for further accounting within the business layer.
It is important to mention that each protocol layer may manipulate an embedded request and a response. Therefore it is *not* a simple orthogonal layering.

4.2.4.1 Protocol Manipulation Layering Methodology in a cascaded Case

The "Protocol Manipulation Layering" methodology also supports cascading. The principle of cascading was illustrated in Figure 21. Figure 25 shows this mechanism in a cascaded case. A company B provides geo-data integration as a product, but buys different data sets from company C and D. A technical geo-data request from a WMS Client of company A will be transferred to the WPOS Client of its company (2a). The business client asks the business service of company B, e.g. for a price model.

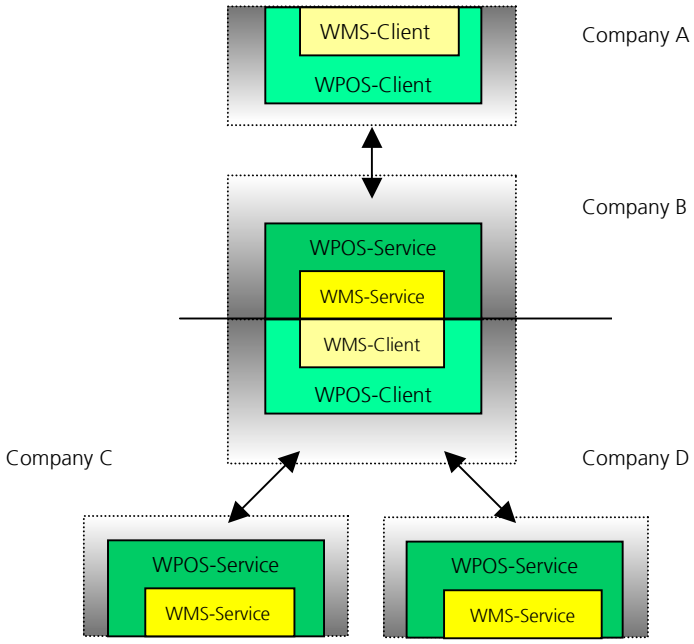


Figure 25 This general approach can be used to cover business aspects without interfering with the data stream between specialized application services

For business requests, which do not need an application request, e.g. GetCapabilities, the business service of company B separates the business request into two requests and bypasses (see I in Figure 26) the application integration service to the business service of company C and D.

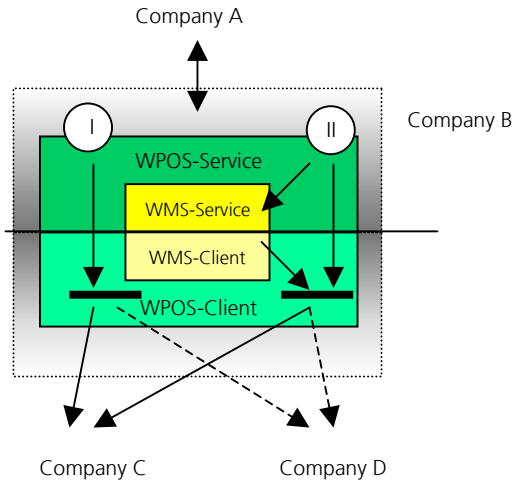


Figure 26 Protocol Layering in a cascaded Case: Bypass business requests (I) and business-application interacting requests (II)

For business requests, which require the embedded geo-data request (see II in Figure 26), the original request will be separated. The geo-data request will be unpacked and

send to the geo-data service, e.g. WMS. This application component has the know-how to understand and to separate the application requests. But the URL of separated back-office request is configured to target the client of the same business. The client may have manipulated each application request and packed it into a back-office business request.
For these business responses, which do not require an application response, e.g. get a price, the application service of company B will receive an application protocol error message. Finally the new back-office business requests can be sent out to the services of company C and D.

4.2.4.2 Façades Service

The approach of the protocol manipulation layering method with its façades has the important advantage of combining different data streams without interference on the one hand but with full manipulation access on the other. This approach makes it possible to design many "service" services: one service designed to support another. The business case with the WPOS is a good example for this class of services.

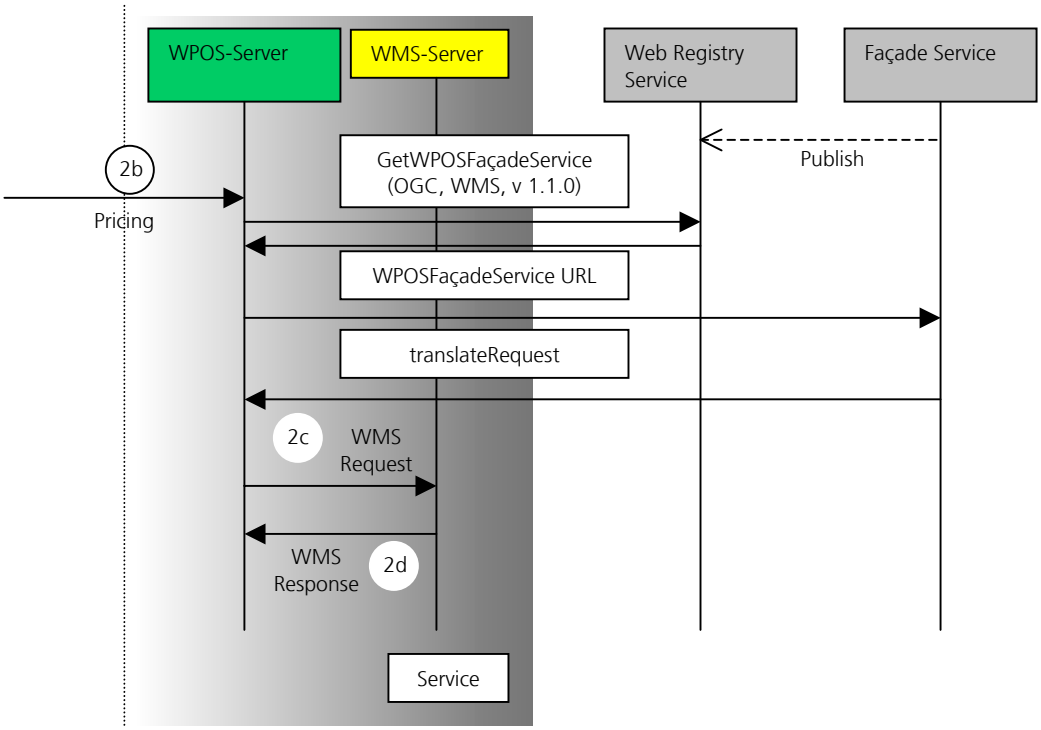


Figure 27 Enhanced WPOS with external Façade Service

But these façades have the obvious disadvantage of being "application" protocol specific. Each protocol may have several versions. Some protocols are "known", which means that they are standardized and accepted by large communities. Some protocols are "un-known". In the long term, a large number of protocols may need a general

solution for this handling of façades. An approach is described in this thesis as an abstract design.

The most important function of a façade is to translate parameter values from a specific application protocol to the abstract XCPF parameter. Therefore these façades can be considered as enhanced translation tables. In some experimental implementations, all needed translation functionalities could be expressed with XSL. From a general point of view, this translation functionality could be separated from the WPOS into a "WPOS Façade Service", without significant effort. This service should be registered with each supported technical geo-data protocol and version in a Registry Service. Figure 27, which enhances Figure 25, explains the workflow sequentially.

This approach is very typical for new service architectures. The advantage is that workload can be shared, which reduces maintenance costs. In this concept the Façade Service may be set-up and maintained by e.g. a WPOS software producer. Unknown protocols or new versions of geo-data services could be stored by this service. But other service providers may offer other Façade Service instances. Other geo-data service software producers may set up Façade Service instances for their own proprietary geo-services. The last scenario opens a far-reaching perspective in a spatial data infrastructure. New services or new versions of services can be introduced seamlessly.

4.3 Applied Design

The first section in this chapter expressed the abstract approaches. This section shows the derived design, which is applied to web-service technology. The XML Configuration & Pricing Format (XCPF) can be derived from data model and the Web Pricing & Ordering Service (WPOS) from the functionality.

4.3.1 Definitions

4.3.1.1 Type Notation in Graphics

Web service technology uses XML for data encoding. Today XML schemas (Fallside 2001) are being used for the definition of XML types. The tool XMLSpy 4.1 (Altova 2002) can be used to create graphics from XML Schemas. It uses a proprietary notation for the XML element characteristics. This will be explained here briefly for a deeper understanding of many following graphics. See the tool description for a more details (Altova 2002).

Figure 28 A single expanded XML element

A single XML element is expressed as a box with a label containing the element name (see Figure 28). If the element has any child objects, the box has a little quadrate with a "-" (see Figure 28) or a "+" (see Figure 29) symbol to expand or to collapse the child level. Annotations are expressed with gray text.

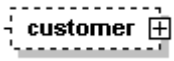


Figure 29 An optional collapsed element

If an element is optional, the box line is dashed (see Figure 29). If the element is a child element and contains only free characters, the element has three short lines in the upper left corner. XML schema offers the opportunity to declare elements locally (standard) or global. If an element is declared global, an arrow appears (see Figure 30).

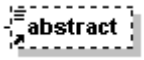


Figure 30 A global declared child element

If elements may occur in multiples, a second shadowed box is shown. The occurrence is expressed with two numbers (see Figure 31).

Figure 31 A referenced multiple element with one minimum occurrence

4.3.1.2 Mathematical Mark-up Language (MathML)

A digital, machine-readable representation of mathematical formulae is needed for the encoding of price models as shown in 3.1.1. The Mathematical Mark-up Language (MathML) (Carlisle, Ion, Miner, Poppelier, 2001) was designed for this purpose. MathML offers the advantage of being derived from XML.
MathML offers two specifications of digital formula representation: The "presentation" specifications for visualization and the "content" specifications for calculation. The first specification contains methods to express visible or non-visible mathematical elements. An example is multiplication points. If the point should be visible, it can be declared in the "presentation" specification.
This design only uses the content specification for calculation purposes. But MathML tools offer the automated transformation style sheets, which may be used in future applications.
Chapter 1 and 4.3.2.5 show some examples for a better understanding of MathML.

4.3.1.3 OGC Basic Service Model

Interoperability is the key to a spatial data infrastructure. To achieve interoperability some basic rules are required. The development of the WPOS aims to fit into the OGC service family and is therefore derived by the OGC Basic Service Model (BSM) (Jeff De La Beaujardiere, 2001). The OGC BSM defines version numbering and version negotiation between client and service. It also defines general HTTP request and general HTTP response Rules. And in the case of any errors, the BSM defines the exceptions encoding. Each service has to provide a GetCapabilities operation to publish the binding parameter. The BSM also defines also the basic service Meta data for web services.

4.3.2 Applied Data Encoding: XML Configuration & Pricing Format (XCPF)

The name "XML Configuration & Pricing Format" for the applied data model was chosen to show, that a data set:

- is based on a XML structure
- contains all capabilities for a (geo)-product, which should be configured by customer
- covers the pricing aspect, which is often closely integrated with the configuration.

4.3.2.1 XCPF Object "Product"

This Object is an important structure and is the smallest unit containing a complete calculation environment. This "product" object corresponds via its ID directly to a data product and to its metadata. A "product" object has, in the sense of the XCPF main axis, no child-elements.

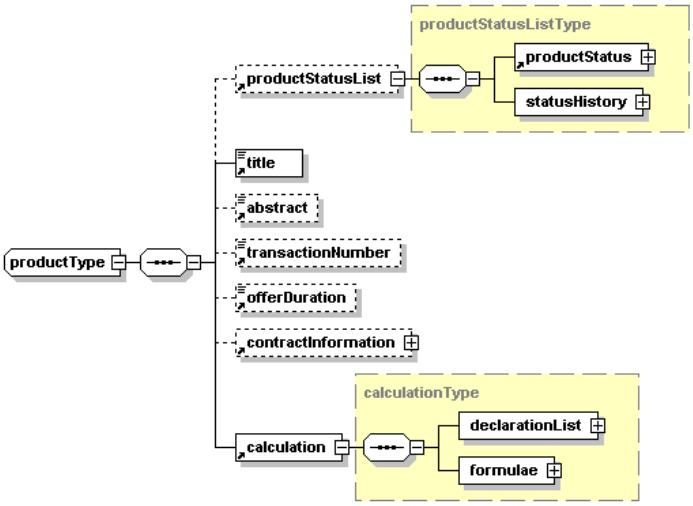


Figure 32 XCPF "product" Element

A WPOS instance can use a XCPF price model instance to store order process information into the status list. Each "productGroup" may have a title, but each product must have a title to allow a user a better understanding. An abstract may be used to give some more background information about the product. But the complete product description may be made in an ISO19115 description and referenced by a "productId".
The field "transactionNumber" (TAN) contains an ID, which is needed for the stateless WPOS transactions. There are three ways to implement the workflow for this field:

1. TAN in the "product" object corresponds to a single ordered product
2. TAN in "productGroup" object corresponds to all entries in an order session
3. TANs in both fields

In the first case, each product data file can be downloaded separately with its own TAN. The second case offers download of compressed data, e.g. a .zip file. Some clients can use the second variant as an accounting mechanism for an ordered shopping cart. The third case offers both possibilities for a user. The tag "offerDuration" contains a valid timeframe for that offer. Orders can be processed under certain circumstances, which must be declared in a contract object, which is described in 4.3.2.2. The calculation object has the ability to calculate a result.

4.3.2.2 XCPF Object “contractInformation”

Trade needs agreed rules, which are defined here as contract information. The contact information of the supplier is transparent. The customer’s contact information needs to be added for a valid WPOS “OrderProduct” request. The customer object contains the same entries as for the supplier, but may use more address objects for delivery and accounting.

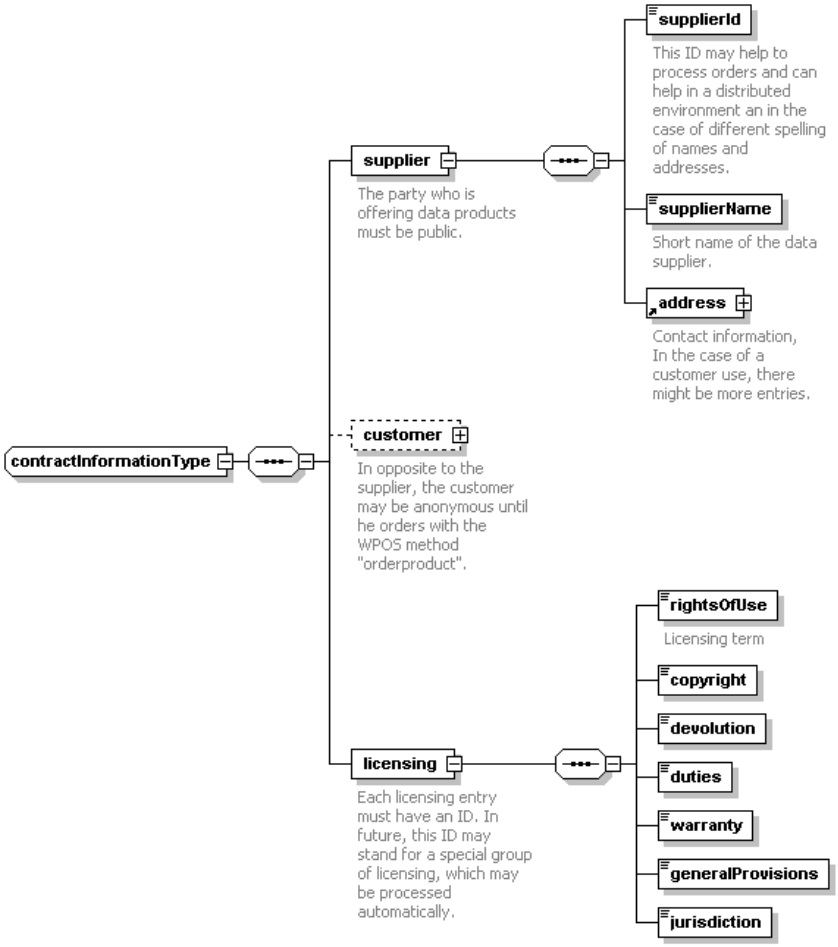


Figure 33 XCPF object “contactInformation”

4.3.2.3 XCPF Object "Calculation"

A "calculation" object contains all machine-readable information to determine a price given the configuration input by the user. This object is used in a "product" and in a "productGroup" environment. Depending on rebates, taxes or other pricing mechanisms, price models can be adjusted with a formula on each hierarchical step of the pricing catalogue.

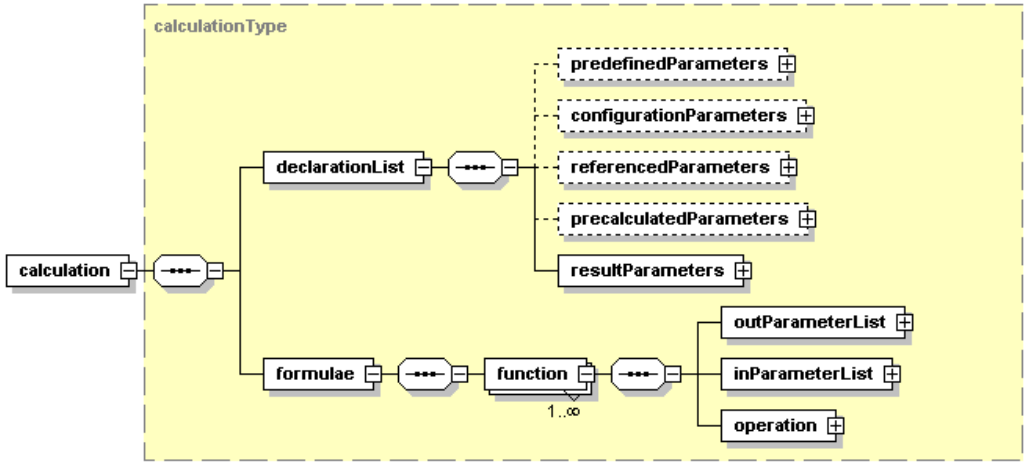


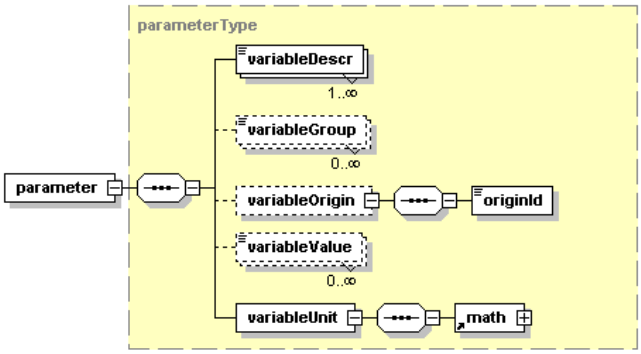
Figure 34 XCPF object "calculation"

All parameters need to be declared before calculation. Five categories are defined for the processing. Some parameters are necessary for the processing, but are constant, e.g. tax. These parameters can be declared as "predefined". Other parameter values need to be set first by the user.
These parameters are called "configurationParameters". All these parameters will be visualized in a WPOS client. Some of these may be used for pricing, e.g. Contract time, other may be used for data generation, e.g. style=red and some for both, e.g. data format= dxf.
Referenced parameters can only be used in "productGroup" environments, because they are needed for hierarchical calculations, where parameter values of previous calculated values can be accessed. An often-used example is the sum, wherein previous prices are summarized.
The "precalculatedParameters" are used to store the results of sub functions. These functions may be mathematical operations or XCPF Web Service Calls (XCPF-WSC) and only have values at runtime. The XCPF-WSCs are useful for access to mass storage, for complex calculations or for actual data. They are results of functions.
An often-used example is the calculation of the area of a polygon. The mandatory

"resultParameters" contains the parameter for the final result of all calculations. All parameters may be used in "functions". A function has output and input parameters and delivers a result value. The possible operation types are described in the next section.

4.3.2.4 XCPF Object "parameter"

The parameter object is the basic element for each calculation. Each parameter must have a logical name and for language reasons, one or more different descriptions. Spaces are allowed in the description.



Parameters can be arranged in groups by using the optional "variableGroup" element. A group of parameters is declared with identical strings in the "variableGroup" field. An example is the use of a set of parameters for data generation. All parameters must contain the same string in the "variableGroup", e.g. "geoserver". All the parameters, and their values with the same string, may be filtered and transferred as output parameters to the geo-data generation server.

Figure 35 XCPF "object parameter"

The element "variableOrigin" must only be used in the "referencedParameters" object, which occur in "productGroups". The hierarchical calculation process (see 4.2.2.4) uses parameters with "variableOrigin" elements to access other parameter values from a lower level. The required attribute "orginName" contains the original name of a low hierarchical parameter. A reference is only allowed to the next following level.
Referenced parameters can be used in two ways as:

- Multiple references, returning a list of parameter values
- Single references, returning a single value

An often-used multiple-reference example is the price calculation from a lower level to the higher level, which refers to the list of all price results from the lower level. Multiple references must have the character "*" as a wildcard in the element "originId", to access all parameter values with the same name, not depending on product entries. Single references must have the productId of the referenced product in the lower level. A reference to a "product" object on the same level is not allowed.

4.3.2.5 XCPF Object “operation”

There are two possible operations to achieve results with a list of output and input parameters: mathematical formulae and external XCPF Web Service Calls (XCPF WSC).

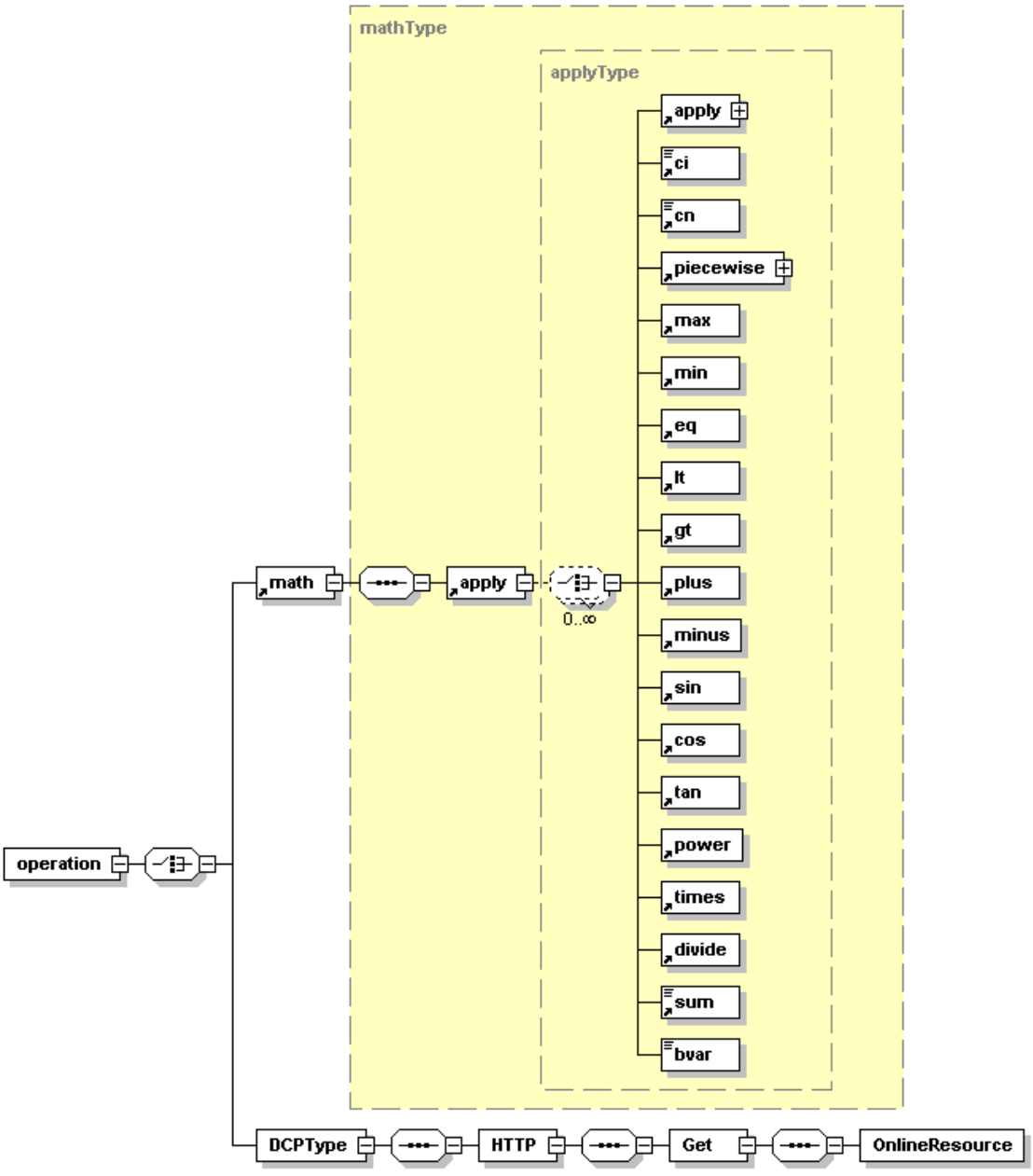


Figure 36 XCPF object operation

The mathematical formulae are encoded by using a subset of the Mathematical Mark-up Language (MathML) definition, recommended by the WWW-Consortium (W3C) (Carlisle, Ion, Miner, Poppelier, 2001). XCPF uses only basic operations, like plus, minus,

min and other (see Figure 36). Source 20 and Source 21 give an example of the formula encoding with MathML.

Source 20 price = pricePerSquareKilometer * surface

```
<math>
      <apply>
            <eq/>
                  <ci>price</ci>
                        <apply>
                           <times/>
                              <ci>pricePerSquareKilometer</ci>
                              <ci>surface</ci>
                        </apply>
      </apply>
</math>
```

Source 21 Encoding of formulae with MathML

The other possible operation is a XCPF Web Service Call. The element "OnlineResource" contains an absolute URL to a web service for external processing.

4.3.2.6 XCPF Object "productGroup"

With the use of these elements, "product" objects can be arranged into groups. The "productGroup" element contains almost the same elements as the "product" object. Therefore it is even possible to have some pricing calculations on product group level. This is required to price product constellations (see 3.1.4 use-case and 3.2.2 analysis). But it can also contain an "inheritance" object and one or more "product" objects. A "productGroup" can contain one or more other "productGroup" objects.

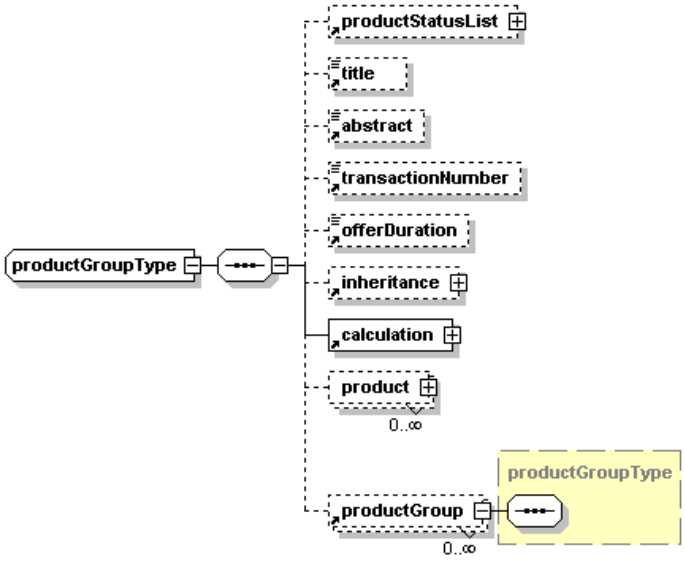


Figure 37 XCPF Object "productGroup"

4.3.2.7 XCPF Object “Inheritance”

The inheritance method provides an optimisation mechanism for large data entries. The “inheritance” object contains all elements that are allowed in the “product” and “productGroup” elements. Typical examples of inheritance are the contract information and calculation blocks. Inheritance can be overwritten in following “productGroups” or “products” as described in 4.2.2.5.

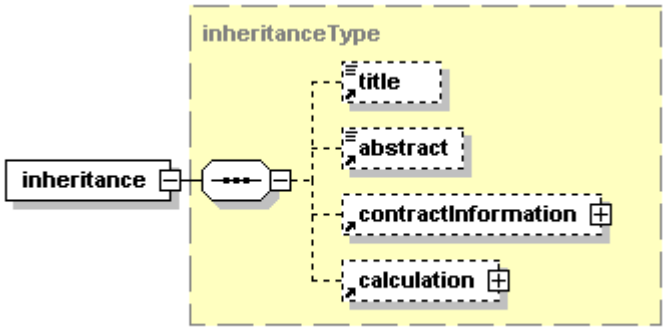


Figure 38 XCPF object “inheritance”

4.3.2.8 Main structure axes

The main axes in XCPF are “xcpfEnvelope”, “xcpfCatalog”, multiple “productGroup” objects and finally products (see 4.2.2.3).

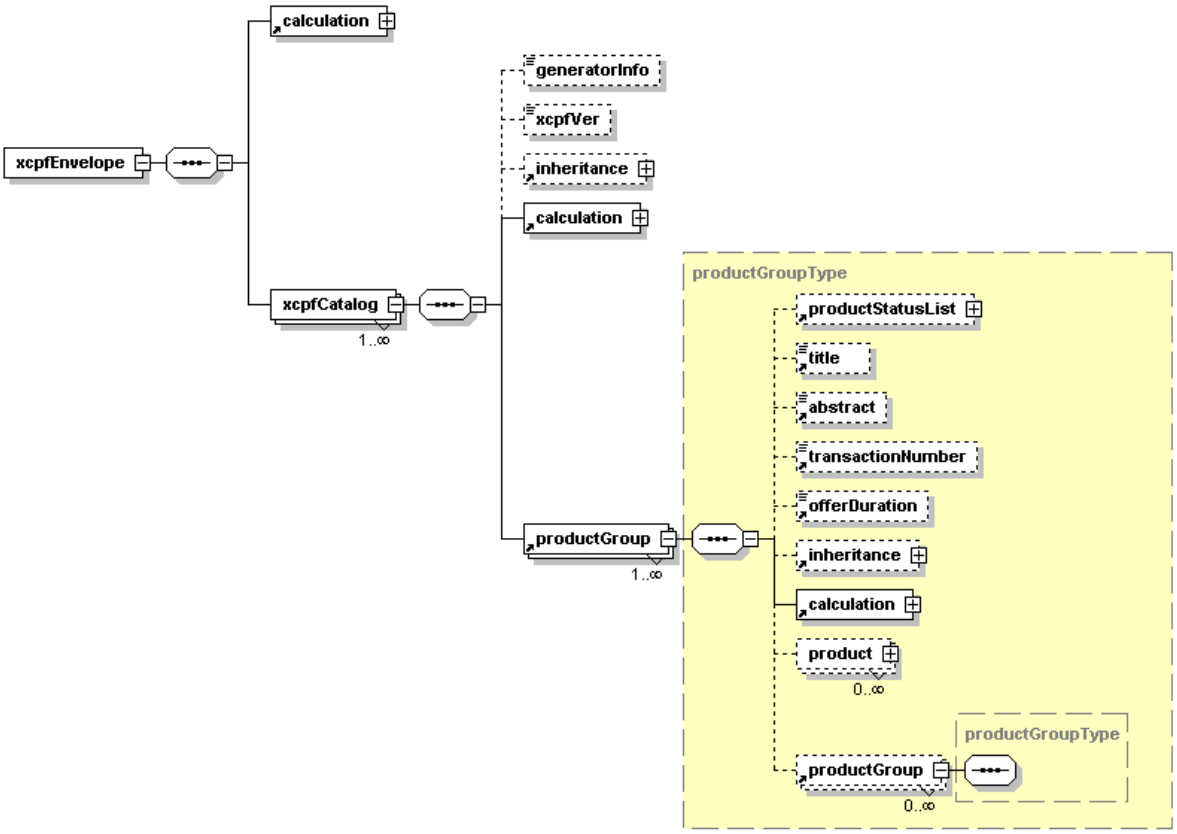


Figure 39 XCPF main axis

4.3.3 Applied Functionality: Web Pricing & Ordering Service (WPOS)

The WPOS has six methods for processing a complete pricing, ordering and delivery workflow for digital geo-data products. These products are defined as service requests, which may be created in specialized clients, and additional configuration parameters. Some requests may be repeated several times like the GetPrice request. The results may be stored in the WPOS client in a session. The familiar "shopping cart" is a good example.
The abstract section 4.2.4 describes the "protocol manipulation layering" method to solve interference problems with the geo-data service requests and the business service requests. In the case of the HTTP GET protocol the encoding for that mechanism uses the "escaping" mechanism of HTTP/HTML/XML. Defined characters will replace some characters prone to misinterpretation.

4.3.3.1 Method: GetCapabilities

Beyond the standard information, the OGC Basic Model GetCapabilities request delivers a list of all available products, including a short description and a unique identifier (the product ID) to the WPOS client.

4.3.3.1.1 HTTP Get Request

The request is designed according to the OGC Basic Service Model (see 4.3.1.3). Vendor specific parameters can be added to the specification described parameters that can be sent to the specialized service.

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
SERVICE=WPOS	R	Service Type
REQUEST=GetCapabilities	R	Request Capabilities
VERSION=version	O	Request version
VSP =value	O	Vendor-specific parameters
&	R	Separator between name=value pairs.

Table 4 Standard GetCapabilities Request

4.3.3.1.1.1 Request Example

This requests demands the capabilities of the service WPOS:

```
http://127.0.0.1/wpos/servlet/wpos.Controller?SERVICE=WPOS&REQUEST=getCapa
bilities
```

Source 22 HTTP GET request for service capabilities

4.3.3.1.2 Response

The response consists of the standard BSM "Service" element items and the WPOS specific "capability" elements (see 4.3.1.3). The "request" element shows the supported requests. The request "GetProduct" and "GetOrderList" are optional. Figure 40 shows the XML schema.

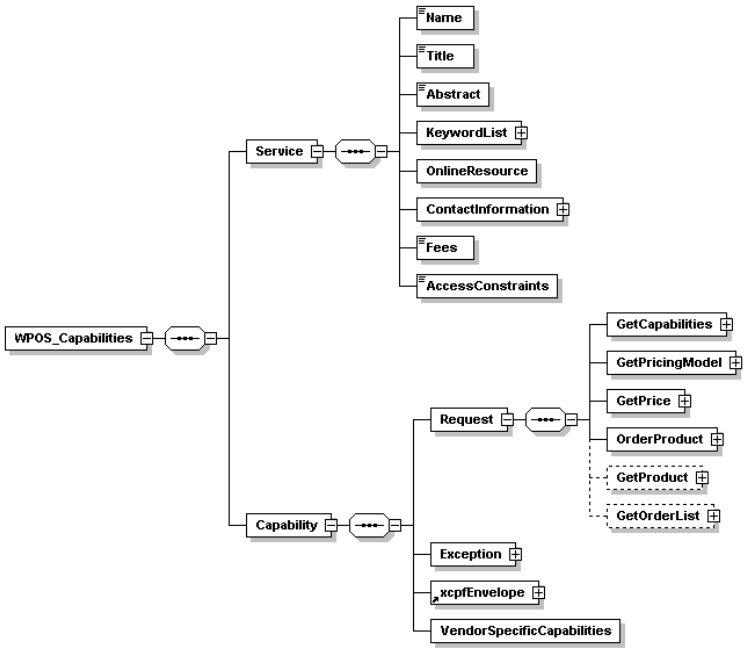


Figure 40 Getcapabilities Response

The element "xcpfEnvelope" contains the product list. Due to the hierarchical nature of the XML complex Configuration & Pricing Format (XCPF) the product catalogues and multiple product groups can group items. Catalogues are required in the cascading case for the independent data provider.

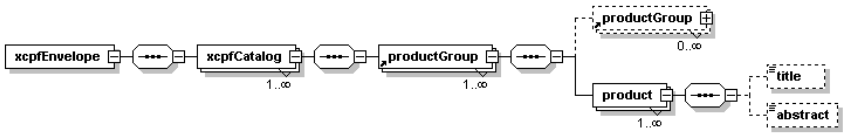


Figure 41 Sub-Element "xcpfEnvelope" of the Getcapabilities response schema.

The "product" element contains the unique identifier for all other methods, a title and an abstract element to describe the product is a compact way. ISO 19115 may be used for the complete description and be referenced by the product ID concerned. Figure 41 shows the list of products and the grouping mechanism. This representation does not show the product ID, because it is an attribute.

4.3.3.1.2.1 Response Example Fragment

The XML fragment at Source 23 gives an impression of the arrangement of product items. "productGroup" and "product" elements have an identifier and a name to show as an abbreviation. A title and an abstract can contain longer descriptions.

```
<xcpfEnvelope>
   <xcpfCatalog>
      <productGroup id="1000" name="Demo Productlist 1000">
         <product id="1005" name="Demo Product A1">
           <title> Demo Title of Product A1 </title>
         </product>
         <product id="1007" name="Demo Product B1"/>
         <product id="1009" name="Demo Product C1"/>
      </productGroup>
      <productGroup id="2000" name="Demo Productlist 2000">
         <product id="2001" name="Demo Product A2"/>
         <product id="2002" name="Demo Product B2"/>
      </productGroup>
   </xcpfCatalog>
</xcpfEnvelope>
```

Source 23 The list of products in a XML extract of the GetCapabilities response.

4.3.3.2 Method: GetPriceModel

The first method, GetCapabilities, gives a list of all product entries, which can be quite long. Products are often described in detail with the ISO 19115 standard and hosted in a meta-data catalog, which offers enhanced query capabilities. If the IDs in the meta-data catalogue correspond to the IDs in the pricing & ordering catalog, a user can be linked directly from the search result-list of the meta-data catalogue to the WPOS GetPriceModel request for pricing information.

4.3.3.2.1 HTTP GET Request

The request requires knowledge of the identifier of a product ("productID"). It is possible to request multiple product price models with a comma-separated list.

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
REQUEST=GetPriceModel	R	Request Price Model
VERSION=version	R	Request Version
PRODUCT=productid_list	R	Request Product Ids, separated by commas
VSP =value	O	Vendor-specific parameters
&	R	Separator between name=value pairs.

Source 24 GetPriceModel Request

4.3.3.2.1.1 Example

```
http://127.0.0.1/wpos/servlet/wpos.Controller?REQUEST=GetPriceModel&PRODUC
TID=1513
```

Source 25 Sample GetPriceModel HTTP Get request

4.3.3.2.2 Response

The response is an empty instance of a XCPF Object. It contains the desired "product" elements with contract information like provider address and licensing (See figure 22).

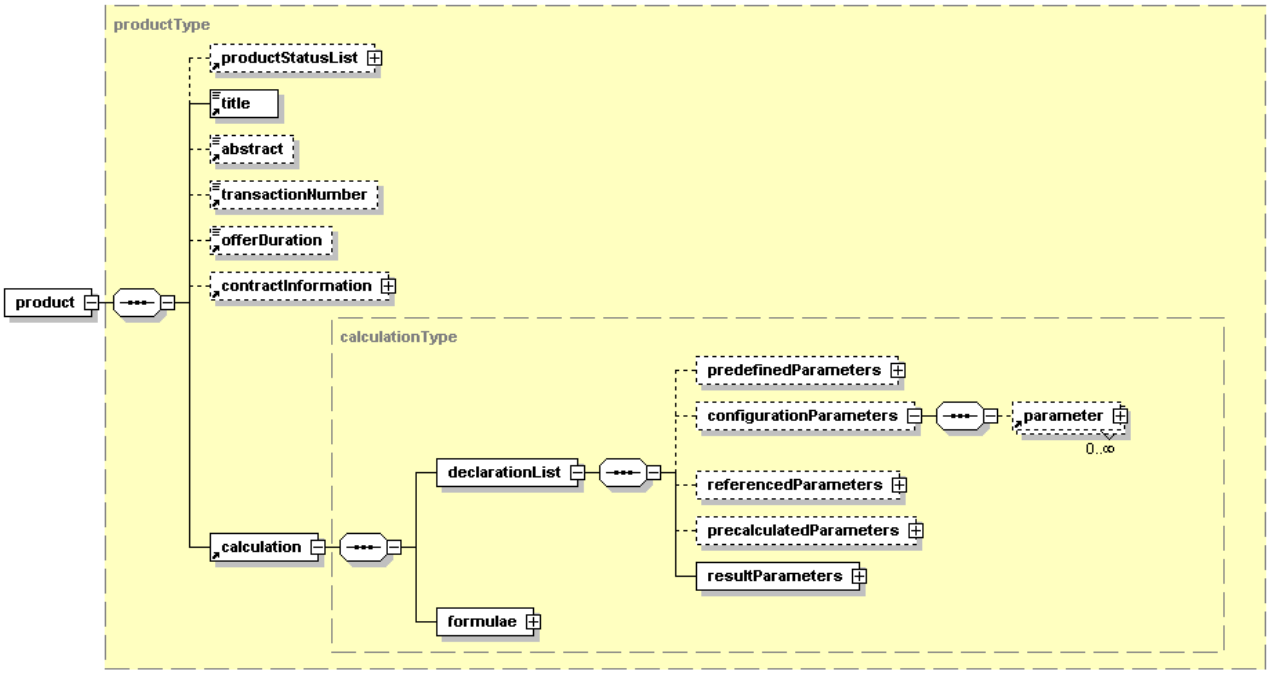


Figure 42 The important "product" element of a XCPF object in the GetPriceModel response

Therefore, the XCPF object provides all necessary information and even the price formula for pricing & ordering. It could be used for multiple purposes. In the case of a regular WPOS workflow it contains the important list of configuration parameters. These parameters need to be set by the user (or an equivalent engine) to configure the product for pricing & ordering. Figure 43 shows the sub-elements of parameters. Multiple "variableValue" elements can be presented as HTML lists. Missing or single "variableValue" elements can be presented as HTML text input fields. Boolean types of parameters can be represented as HTML checkboxes. All elements are covered in detail in the XCPF description (see attachment).

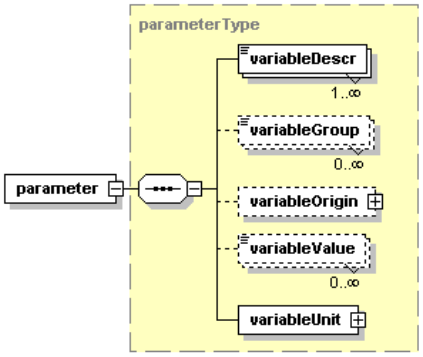


Figure 43 The configuration "parameter" element, which needs to be set by purchaser to configure the product

4.3.3.2.2.1 Example Fragment

The given example shows a simple parameter element with the mandatory name, the simple data type and the machine read-able and text-style unit. The empty "variableValue" element shows that it has to be set by the user.

```
<parameter name="ymin" type="real">
   <variableDescr lang="en">Southern Bounding</variableDescr>
      <variableValue/>
      <variableUnit textstyle="°">
         <math>
            <apply>
               <cn>1</cn>
            </apply>
         </math>
      </variableUnit>
</parameter>
```

Source 26 Sub-element „Parameter" with name and description

4.3.3.3 Method: GetPrice

After setting the configuration parameters with user defined values, the GetPrice method is able to calculate a price.

4.3.3.3.1 HTTP GET Request

WPOS is designed to support the pricing & ordering of known geo-data services, e.g. OGC WMS and of unknown data services or, in the simplest case, of data files. Price models may contain parameters, which are required:

- only for pricing, e.g. licensing time, or
- only for geo-data server configuration, e.g. picture pixels, or
- for both, e.g. dpi, if the price depends on the quality

Therefore the configuration parameters can be encoded as "configparams", as a "SERVICEREQUEST", which contains the original geo-data server requests, or both. The parameter values need to be "escaped".

For multiple pricing requests, the HTTP parameter "PRODUCTID", "CONFIGPARAMS", "SERVICEREQUEST" and "SERVICEPROTOCOL" can include comma separated lists. Three examples will help to explain these possibilities. The underlined sections are "escaped" strings.

All WPOS configuration parameters will be mapped to the XCPF configuration parameters.

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
VERSION=version	R	Request version
REQUEST=GetPrice	R	Request Price
PRODUCTID=productid_list	R	Product IDs, "escaped" Service prefix URLs are unique and can be therefore used as a Product ID
CONFIGPARAMS= escaped(keyA&valueA, keyAA&valueAA),	R	Each Product ID may have some configuration parameters. These are "key-value pair" encoded, separated by commas and as string "escaped";
SERVICEREQUEST= escaped(servicerequestA),	R	Original "escaped" data service request; Multiple service requests are comma separated
SERVICEPROTOCOL= escaped(ORGANISATION=abc& NAME=def&VERSION=x.x.x),	R	Description of protocol- releasing organization, -name and –version as escaped key-value pairs;
GENERALLICENCENO	O	Permit Customer Specific Pricing
VSP=value	O	Vendor-specific parameters
&	R	Separator between name=value pairs.

Table 5 GetPrice Request

4.3.3.3.1.1 Example HTTP GET Request for unknown Services

In this simple case, the product 1513 requires the configuration parameters xmin=5.67, ymin=50.3,xmax=5.913, ymax=52 and the Licensetime=1 for the price formula. The second product 1012 requires the other parameters and their values.

The key value pairs are separated using "&" and escaped. Given the multiplicity of configuration parameters, a comma separates the two strings.

```
http://127.0.0.1/wpos/servlet/wpos.Controller?
REQUEST=GetPrice&PRODUCTID=1513,1012&CONFIGPARAMS=xmin%3D5.67%26ymin%3D50.
3%26xmax%3D5.913%26ymax%3D52%26Licensetime%3D1,Pages%3D4%26Area%3D1000%26P
oints%3D3&SERVICEREQUEST=,&SERVICEPROTOCOL=,
```

Source 27 Sample HTTP Get Request for GetPrice for multiple products of an unknown Service

4.3.3.3.1.2 Example HTTP GET Request for known Services without additional Parameters

This example shows a known Web Mapping Service request wrapped for a pricing request. The price can be terminated only with the geo-data request. Therefore a mapping between geo service request and XCPF configparams is necessary. The service protocol parameter is designed to support this mapping.

```
http://127.0.0.1/wpos/servlet/wpos.Controller?
REQUEST=GetPrice&PRODUCTID=http%3A%2F%2Fwww.mywms.org/script&CONFIGPARAMS=
&SERVICEREQUEST=VERSION%3D1.1.0%26REQUEST%3DGetMap%26LAYERS%3DStrassen%26S
TYLES%3DStandard%26SRS%3DEPSG:31466%26FORMAT%3Dimage/png%26BGCOLOR%3D0xFFF
FFF%26TRANSPARENT%3DFALSE%26WIDTH%3D514%26HEIGHT%3D426%26BBOX%3D2465148.76
44131454,5576452,2764016.1155868545,5824151.4%26EXCEPTIONS%3Dapplication/v
nd.ogc.se_xml&SERVICEPROTOCOL=ORGANISATION%3DOGC%26NAME%3DWMS%26VERSION%3D
1.1.0
```

Source 28 Sample HTTP Get Request for GetPrice with a service request and without additional parameters

4.3.3.3.1.3 Example HTTP GET Request for known Services with additional Parameters

Pricing often depends on more than just the technical geo-service request. In this case the configuration parameters are given with the configparams and the geo-data request.

```
http://127.0.0.1/wpos/servlet/wpos.Controller?
REQUEST=GetPrice&PRODUCTID=http%3A%2F%2Fwww.mywms.org/script&CONFIGPARAMS=
Licensetime%3D1&SERVICEREQUEST=VERSION%3D1.1.0%26REQUEST%3DGetMap%26LAYERS
%3DStrassen%26STYLES%3DStandard%26SRS%3DEPSG:31466%26FORMAT%3Dimage/png%26
BGCOLOR%3D0xFFFFFF%26TRANSPARENT%3DFALSE%26WIDTH%3D514%26HEIGHT%3D426%26BB
OX%3D2465148.7644131454,5576452,2764016.1155868545,5824151.4%26EXCEPTIONS%
3Dapplication/vnd.ogc.se_xml&SERVICEPROTOCOL=ORGANISATION%3DOGC%26NAME%3DW
MS%26VERSION%3D1.1.0
```

Source 29 Sample HTTP Get Request for GetPrice with a service request and without additional parameters

4.3.3.3.2 Response

The response is a XCPF object with the given configuration parameters and the resulting price. The XCPF object contains the basic "product" element price, all group prices with summation or other calculations (e.g. minimum prices or tax) and the final result price over all selected products.

4.3.3.3.2.1 Example Response

The GetPrice Request transmits all necessary configuration parameters for the mathematical formulae. Figure 44 shows an XCPF example. The WPOS implementation first calculates the basic price at product level (step 1 & 2) for all selected products. The following steps calculate the intermediate prices (step 3 & 4) at product group level and finally at catalogue level (step 5).

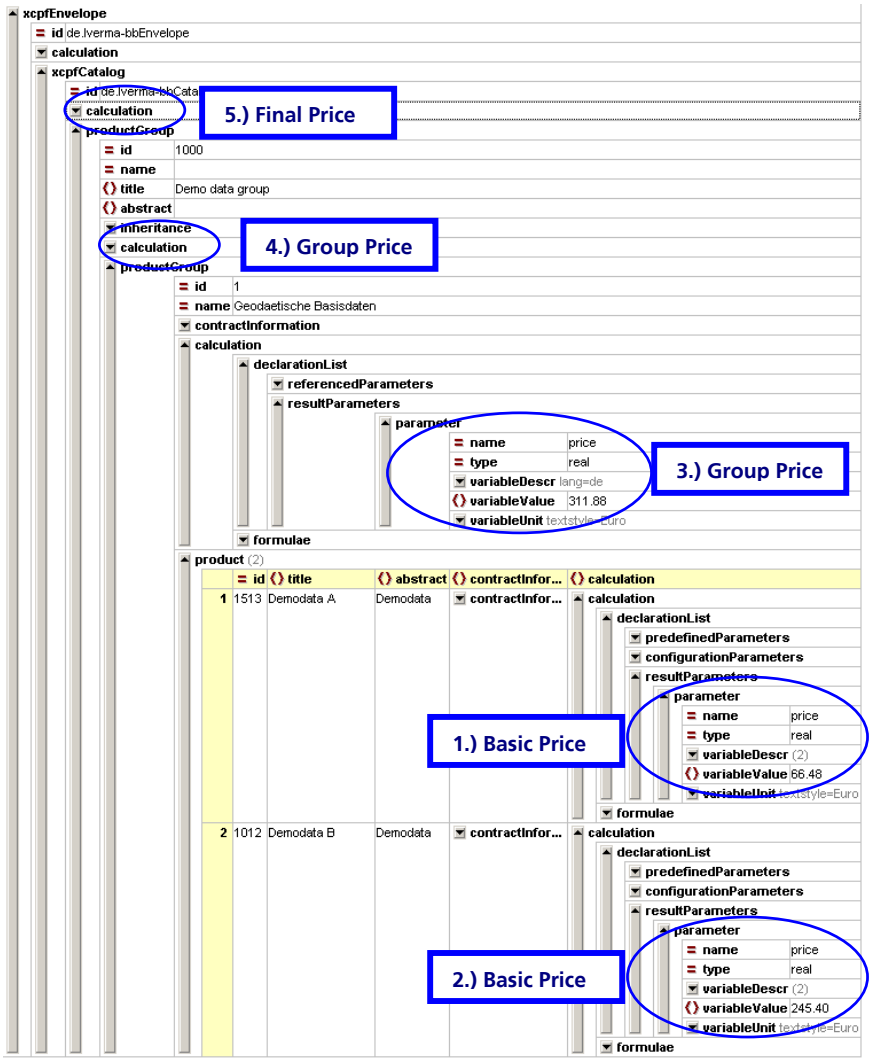


Figure 44 XCPF object filled with the calculated basic, intermediate and final prices.

4.3.3.4 Method: OrderProduct

The GetPrice method may be used in several iterations. The next step in the WPOS workflow is ordering, which demands the declaration of some knowledge. The purchaser needs to publish his identity.

4.3.3.4.1 HTTP GET Request

To validate the purchaser configuration and the resulting price, the OrderProduct method consists of the same parameters as GetPrice and additional purchaser contact information.

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
VERSION=version	R	Request version
REQUEST=OrderProduct	R	Orders a product
PRODUCTID=productid_list	R	Product IDs, "escaped" Service prefix URLs are unique and can be therefore used as a Product ID
CONFIGPARAMS= escaped(keyA&valueA, keyAA&valueAA),	R	Each Product ID may have some configuration parameters. These are "key-value pair" encoded, separated by commas and as string "escaped";
SERVICEREQUEST= escaped(servicerequestA),	R	Original "escaped" data service request; Multiple service requests are comma separated
SERVICEPROTOCOL= escaped(ORGANISATION=abc& NAME=def&VERSION=x.x.x),	R	Description of protocol- releasing organization, -name and –version as escaped key-value pairs;
GENERALLICENCENO	O	Permit Customer Specific Pricing
GENERALLICENCENO	E	Permit Customer Specific Pricing
CUSTOMERID	O	Customerid
DEFNAME1	R	Default contact information for accounting and billing.
DEFNAME2	O	
DEFSTREET	R	
DEFZIP	R	
DEFCITY	R	
DEFCOUNTRY	O	
DEFPHONE	O	
DEFFAX	O	
DEFEMAIL	R	
DEFURL	O	
DELNAME1	O	Delivery contact information, if different from default contact information
DELNAME2	O	
DELSTREET	O	
DELZIP	O	
DELCITY	O	
DELCOUNTRY	O	
DELPHONE	O	
DELFAX	O	
DELEMAIL	O	
DELURL	O	
BILNAME1	O	Billing contact information, if different from default contact information
BILNAME2	O	
BILSTREET	O	
BILZIP	O	
BILCITY	O	
BILCOUNTRY	O	

BILPHONE	O
BILFAX	O
BILEMAIL	O
BILURL	O

Table 6 HTTP GET OrderProduct request

4.3.3.4.1.1 Example

This example was derived from the third GetPrice example. The contact information is attached.

```
http://127.0.0.1/wpos/servlet/wpos.Controller?
REQUEST=OrderProduct&PRODUCTID=http%3A%2F%2Fwww.mywms.org/script&CONFIGPAR
AMS=Licensetime%3D1&serviceRequest=VERSION%3D1.1.0%26REQUEST%3DGetMap%26LA
YERS%3DStrassen%26STYLES%3DStandard%26SRS%3DEPSG:31466%26FORMAT%3Dimage/pn
g%26BGCOLOR%3D0xFFFFFF%26TRANSPARENT%3DFALSE%26WIDTH%3D514%26HEIGHT%3D426%
26BBOX%3D2465148.7644131454,5576452,2764016.1155868545,5824151.4%26EXCEPTI
ONS%3Dapplication/vnd.ogc.se_xml&SERVICEPROTOCOL=ORGANISATION%3DOGC%26NAME
%3DWMS%26VERSION%3D1.1.0&DEFNAME1=Wagner&DEFSTREET=Emil-Figge-
Str.91&DEFZIP=44227&DEFCITY=Dortmund&DEFMAIL=w@gner.org
```

Source 30 OrderProduct HTTP GET example

4.3.3.4.2 Response

The response is the XCPF object as from GetPrice, but in addition:

- transaction number ID (TAN)
- purchaser contact information
- customer ID
- status information

The transaction number is necessary to retrieve the desired, often binary, geo-data in the next WPOS step. The location used to store the transaction depends on the kind of delivery. If multiple product data is going to be integrated or compressed to a single delivery file, only a single transaction number is necessary for the package. This can be stored at catalogue level. If each sub product is to be downloadable, each product item needs a transaction number. The customerID is generated by the system to provide a digital handle for the customer.

4.3.3.5 Method: GetProduct

Some products are in binary form. Therefore an additional delivery method is necessary. The OrderProduct responses return one or more transaction-numbers (TANs) in the XCPF object. With that TAN, the download of the online product can be invoked.

4.3.3.5.1 HTTP GET Request

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
VERSION=version	R	Request version
REQUEST=GetProduct	R	Request Product
TAN=tan	R	Request Transaction number
VSP =value	O	Vendor-specific parameters
&	R	Separator between name=value pairs.

Table 7 HTTP Get Request

4.3.3.5.1.1 Request example

```
http://127.0.0.1/wpos/servlet/wpos.Controller?/wpos/servlet/
wpos.Controller?REQUEST=GetProduct&TAN=1616121821270866532
```

Source 31 HTTP GET GetProduct Example

4.3.3.5.1.2 Response

The response contains the desired product file. In the case of a compressed file, the mime type has to be set.

4.3.3.6 Method: GetOrderList

This option requests delivery of a valid XCPF object with all actual processed order items. It can be used to gather status information, e.g. if a product is generated and ready for download.

4.3.3.6.1 Request

URL Component	Required/ optional/ experimental	Description
http://server_address/path/script	R	URL prefix of service online resource.
?	R	Separator between prefix and query.
REQUEST=GetOrderList	R	Request Product
CUSTOMERID=	R	The customer ID, which was given in OrderProduct

4.3.3.6.1.1 Example

```
http://127.0.0.1/wpos/servlet/wpos.Controller?REQUEST=GetOrderList&CUSTOME
RID=14175479211139083 82
```

Source 32 HTTP GET request example of GetOrderList

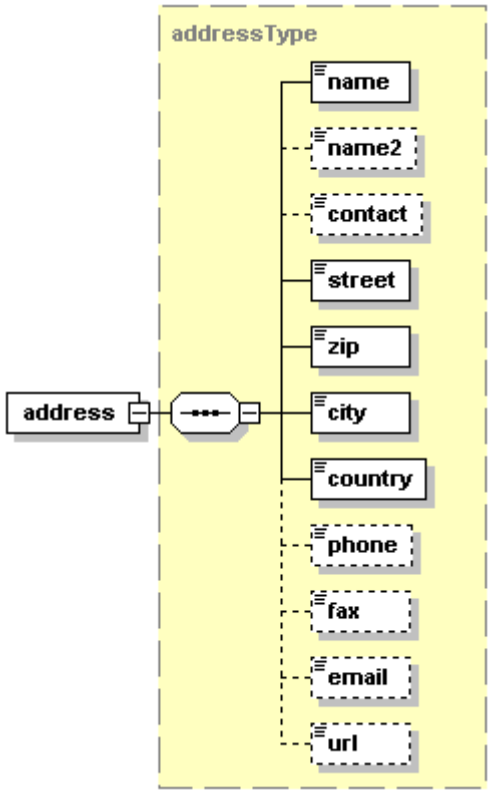
5 XCPF 1.0.0 Element Description

5.1 XCPF Object Description

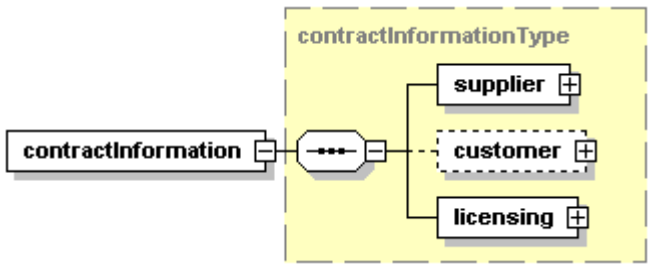
5.1.1 element abstract

Diagram		
Type	xs:string	
used by	complexTypes	inheritanceType productGroupType productType
Annotation	documentation	Abstracts may be used to give some more background information about the productGroup or the product. Complete product description may be made in an ISO19115 description and referenced by a productId.

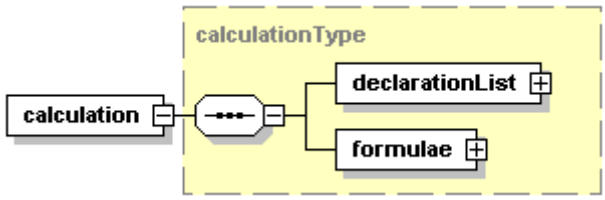
5.1.2 element address

Diagram					
Type	addressType				
Children	name name2 contact street zip city country phone fax email url				
used by	elements	contractInformationType/customer contractInformationType/supplier			
Attributes	Name	Type	Use	Default	Fixed
	role	xs:NMTOKEN	required		
	type	xs:NMTOKEN			
Annotation	documentation	Contact information, In the case of a customer use, there might be more entries.			

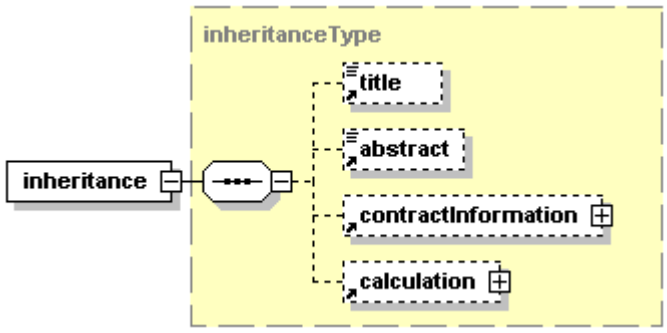
5.1.3 element contractInformation

Diagram		
Type	contractInformationType	
Children	supplier customer licensing	
used by	complexTypes	inheritanceType productType
Annotation	documentation	Orders can be processed under curtain circumstances, which must be declared in a contract.

5.1.4 element calculation

Diagram		
Type	calculationType	
Children	declarationList formulae	
used by	elements complexTypes	xcpfEnvelope/xcpfCatalog xcpfEnvelope inheritanceType productGroupType productType
annotation	documentation	Because of rebates, taxes or other pricing mechanisms, price models may be adjusted with a formula on each hierarchical step of the pricing catalog; At least, a simple sum formula must be calculated

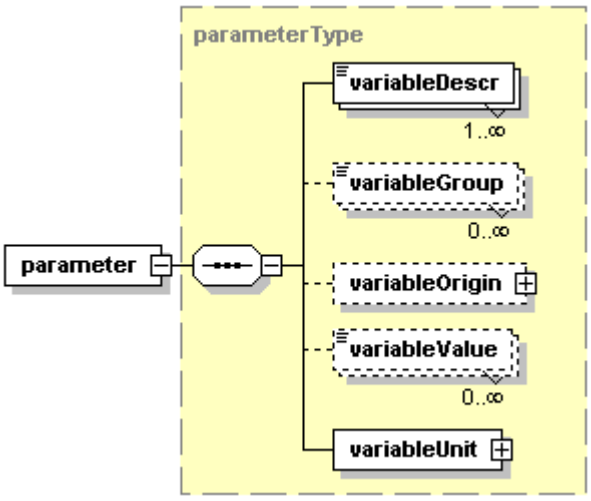
5.1.5 element inheritance

diagram		
type	inheritanceType	
children	title abstract contractInformation calculation	
used by	element complexType	xcpfEnvelope/xcpfCatalog productGroupType
annotation	documentation	The inheritance method provides a very powerful and useful optimisation for large data entries. It may contain most repeated XCPF elements for inheritance, e.g. contract information and calculation blocks. Inheritance can be overwritten in following productGroups or products

5.1.6 element offerDuration

Diagram					
Type	xs:string				
used by	complexTypes	productGroupType productType			
Annotation	documentation	Valid timeframe for that offer.			

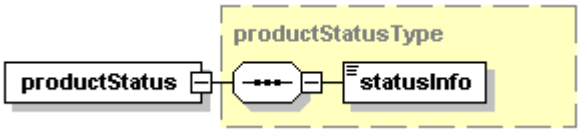
5.1.7 element parameter

Diagram					
Type	parameterType				
Children	variableDescr variableGroup variableOrigin variableValue variableUnit				
used by	elements	calculationType/declarationList/configurationParameters calculationType/declarationList/precalculatedParameters calculationType/declarationList/predefinedParameters calculationType/declarationList/referencedParameters calculationType/declarationList/resultParameters			
Attributes	Name	Type	Use	Default	Fixed
	name	xs:string	required		
	type	xs:NMTOKEN	required		
Annotation	documentation	The parameter object is the basic element for the calculation			

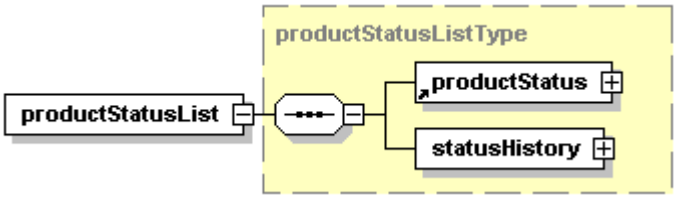
5.1.8 element parameterName

Diagram		
Type	**xs:string**	
used by	elements	***calculationType/formulae/function/inParameterList*** ***calculationType/formulae/function/outParameterList***
Annotation	documentation	All used parameter need to be declared in the declaration List block. Therefore they do not be completley redeclared by calling a function, but only be named.

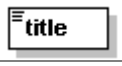
5.1.9 element productStatus

diagram					
type	***productStatusType***				
children	***statusInfo***				
used by	element ***productStatusListType/statusHistory*** complexType ***productStatusListType***				
Attributes	Name	Type	Use	Default	Fixed
	date	xs:string	required		
	time	xs:string	required		
	statusCode	xs:NMTOKEN	required		
Annotation	documentation	Current status with time, date and statuscode attributes. The status changes when a WPOS operation is processed			

5.1.10 element productStatusList

Diagram		
Type	***productStatusListType***	
Children	***productStatus statusHistory***	
used by	element ***xcpfEnvelope/xcpfCatalog*** complexTypes ***productGroupType productType***	
Annotation	documentation	The Web Pricing & Ordering Service uses an instance of the XCPF price model to store order process information into this status list.

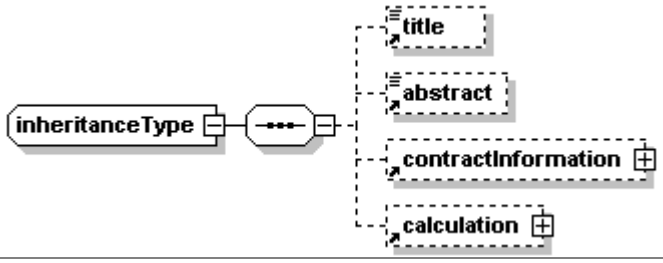
5.1.11 element title

Diagram		
Type	**xs:string**	
used by	complexTypes	***inheritanceType productGroupType productType***
Annotation	documentation	Each productGroup may have a title, but each product must have a title.

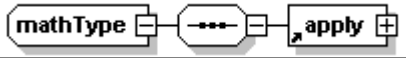
5.1.12 element transactionNumber

diagram		
type	**xs:string**	
used by	element ***xcpfEnvelope/xcpfCatalog*** complexTypes ***productGroupType productType***	
annotation	documentation	This number acts as an ID within processing steps. A transactionNumber may target to a productGroup, if a processing groups all "product" data files into one, e.g. zip compression, or in a "product", if each packet will be delivered separately. The WPOS "orderProduct" sets a transactionNumber in a XCPF instance and sends it to the client, who will request a data product file with the WPOS request "getProduct" and this transaction number.

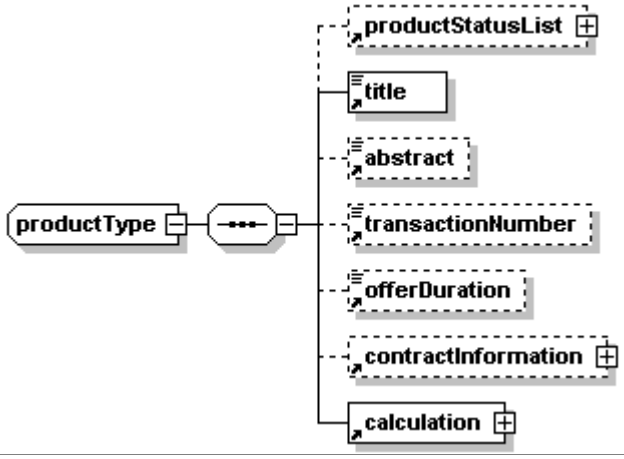
5.1.13 complexType inheritanceType

Diagram	
Children	***title abstract contractInformation calculation***
used by	element ***inheritance***

5.1.14 complexType mathType

Diagram	
Children	***apply***
used by	element ***math***

5.1.15 complexType productType

diagram					
children	***productStatusList title abstract transactionNumber offerDuration contractInformation calculation***				
used by	element ***productGroupType/product***				
Attributes	Name	Type	Use	Default	Fixed
	id	xs:string	required		
	name	xs:string			

5.1.16 simpleType xlink:actuateEnum

Namespace	http://www.w3.org/1999/xlink
type	restriction of **xs:string**
facets	enumeration onLoad enumeration onRequest enumeration other enumeration none

5.1.17 simpleType xlink:showEnum

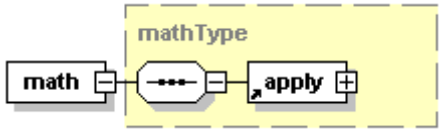
Namespace	http://www.w3.org/1999/xlink
Type	restriction of **xs:string**
Facets	enumeration new enumeration replace enumeration embed enumeration other enumeration none

5.1.18 simpleType xlink:typeEnum

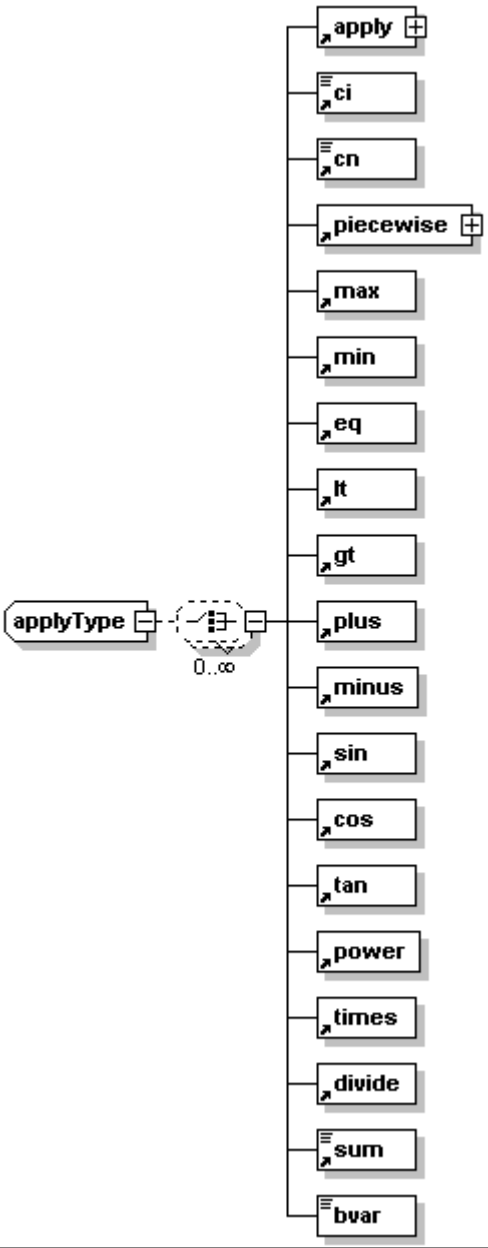
Namespace	http://www.w3.org/1999/xlink
type	restriction of **xs:string**
Facets	enumeration simple enumeration extended enumeration locator enumeration arc enumeration resource enumeration title

5.2 MathML elements

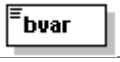
5.2.1 element math

Diagram	
type	***mathType***
children	***apply***
used by	elements ***calculationType/formulae/function/operation parameterType/variableUnit***
Annotation	documentation MathML block, within this block a subset of MathML is being used. More at http://www.w3c.org/math

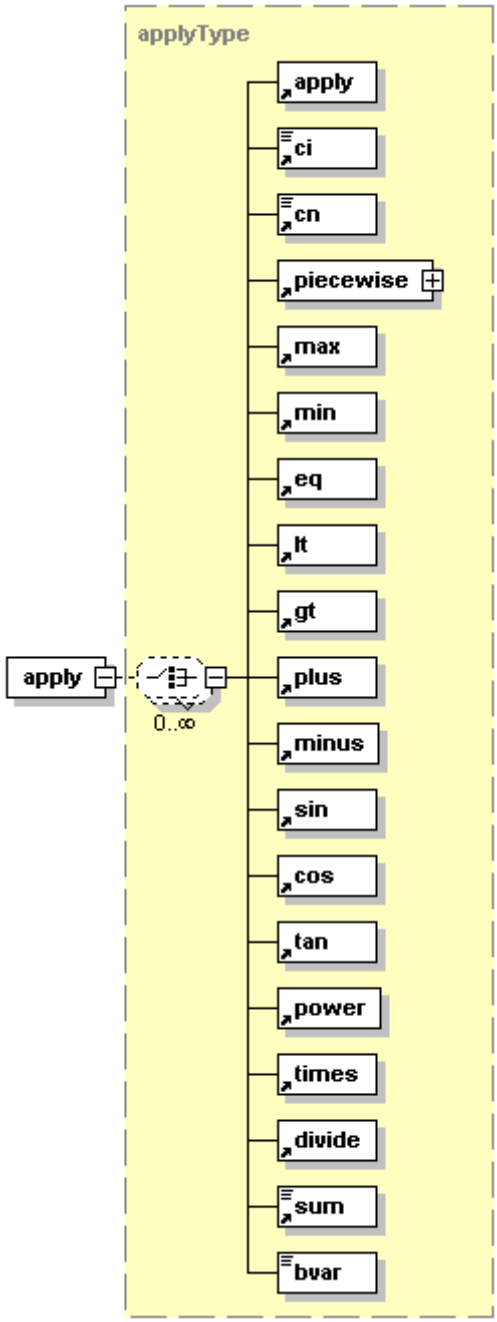
5.2.2 complexType applyType

diagram	
children	***apply ci cn piecewise max min eq lt gt plus minus sin cos tan power times divide sum bvar***
Used by	elements ***apply piecewise/otherwise/apply***

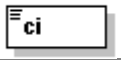
5.2.3 element applyType/bvar

Diagram	
Type	**xs:string**
annotation	documentation MathML: bounding variable, used by "sum" operation

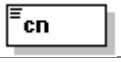
5.2.4 **element** apply

Diagram	
Type	***applyType***
Children	***apply ci cn piecewise max min eq lt gt plus minus sin cos tan power times divide sum bvar***
used by	element ***piecewise/piece*** complexTypes ***applyType mathType***
annotation	documentation MathML: Acts like a mathematical bracket

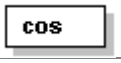
5.2.5 element ci

Diagram		
type	**xs:string**	
used by	elements	***piecewise/otherwise piecewise/otherwise piecewise/piece piecewise/piece***
	complexType	***applyType***
Annotation	documentation	MathML: Textfield for identifier, e.g. "price"

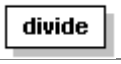
5.2.6 element cn

Diagram		
Type	**xs:string**	
used by	Elements	***piecewise/otherwise piecewise/otherwise piecewise/piece piecewise/piece***
	complexType	***applyType***
Annotation	documentation	MathML: Textfield for a number, e.g. 2.2345

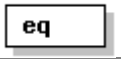
5.2.7 element cos

diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Cosinus operator

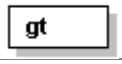
5.2.8 element divide

Diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Division operator

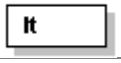
5.2.9 element eq

diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Equal operator

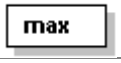
5.2.10 element gt

diagram		
used by	element	***piecewise/piece***
	complexType	***applyType***
annotation	documentation	MathML: "bigger than" operator

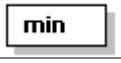
5.2.11 element lt

diagram		
used by	element complexType	***piecewise/piece*** ***applyType***
annotation	documentation	MathML: "Smaller then" operator

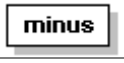
5.2.12 element max

diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Maximum operator

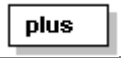
5.2.13 element min

Diagram		
used by	complexType	***applyType***
Annotation	documentation	MathML: Minimun operator

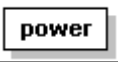
5.2.14 element minus

Diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Minus operator

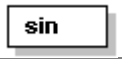
5.2.15 element plus

diagram		
used by	element complexType	***piecewise/piece*** ***applyType***
annotation	documentation	MathML: Plus operator

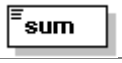
5.2.16 element power

Diagram		
used by	complexType	***applyType***
Annotation	documentation	MathML: Power operator

5.2.17 element sin

diagram		
used by	complexType	***applyType***
annotation	documentation	MathML: Sinus operator

5.2.18 element sum

Diagram		
Type	**xs:string**	
used by	complexType	***applyType***
Annotation	documentation	MathML: Sumeration operator

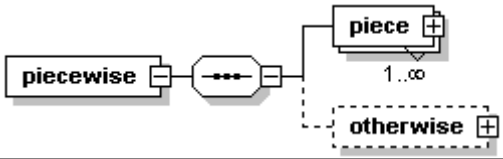
5.2.19 element tan

Diagram		
used by	complexType	***applyType***
Annotation	documentation	MathML: Tangence operator

5.2.20 element times

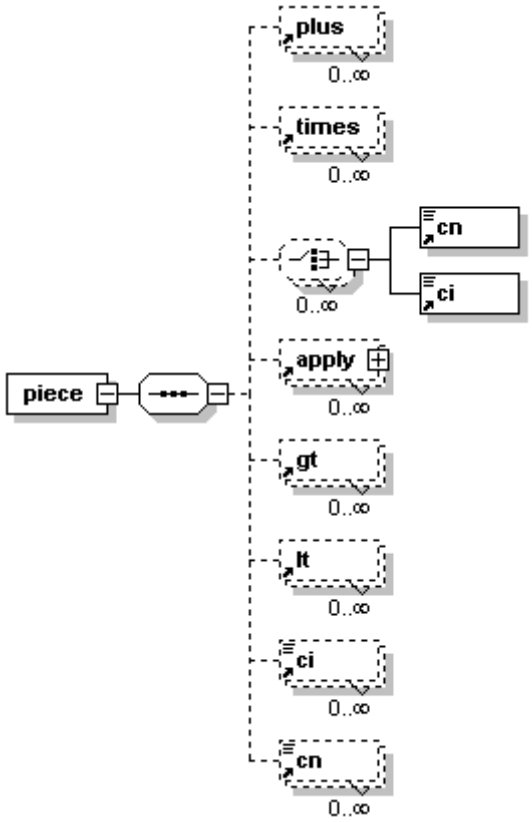
Diagram		
used by	elements complexType	***piecewise/otherwise piecewise/piece*** ***applyType***
Annotation	documentation	MathML: Times operator

5.2.21 element piecewise

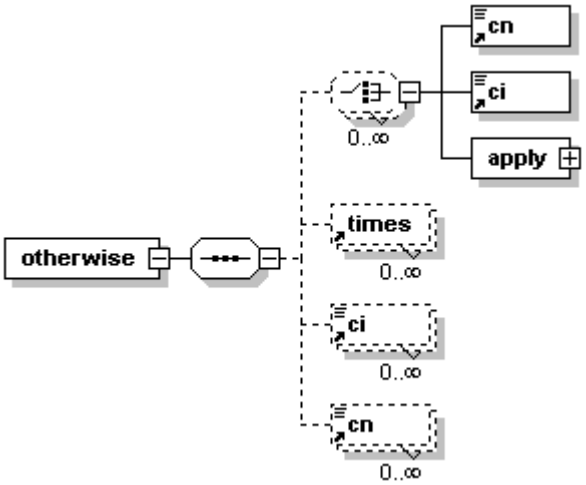
Diagram		
children	***piece otherwise***	
used by	complexType	***applyType***
annotation	documentation	MathML: mathematical "if..then" operator, example: <piecewise> <piece> <apply> <times/> <cn>15.34</cn> <ci>Punktanzahl</ci> </apply> <apply> <lt/> <ci>Punktanzahl</ci> <cn>2</cn> </apply>

```
                    </piece>
                    <otherwise>
                        <apply>
                            <plus/>
                            <apply>
                                <times/>
                                <cn>15.34</cn>
                                <ci>Punktanzahl</ci>
                            </apply>
                            <apply>
                                <times/>
                                <cn>10.23</cn>
                                <apply>
                                    <minus/>
                                    <ci>Punktanzahl</ci>
                                    <cn>1</cn>
                                </apply>
                            </apply>
                        </apply>
                    </otherwise>
                </piecewise>
```

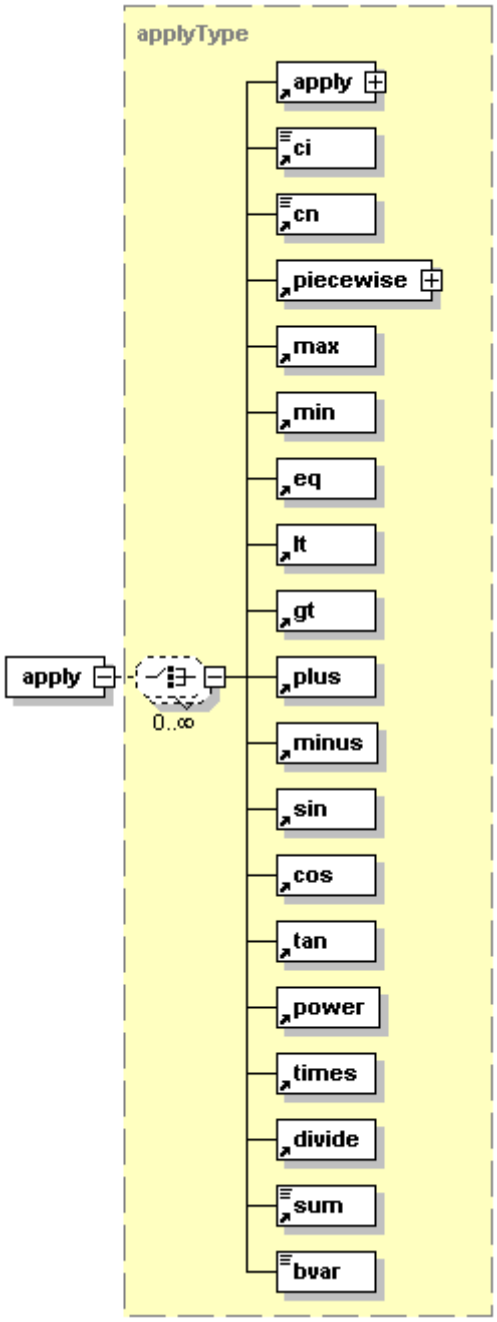
5.2.22 element piecewise/piece

Diagram	
Children	***plus times cn ci apply gt lt***

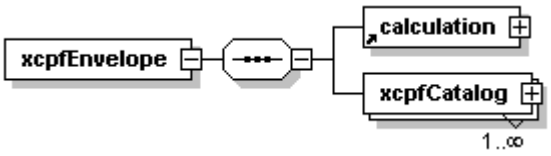
5.2.23 element piecewise/otherwise

Diagram	
Children	***cn ci apply times***

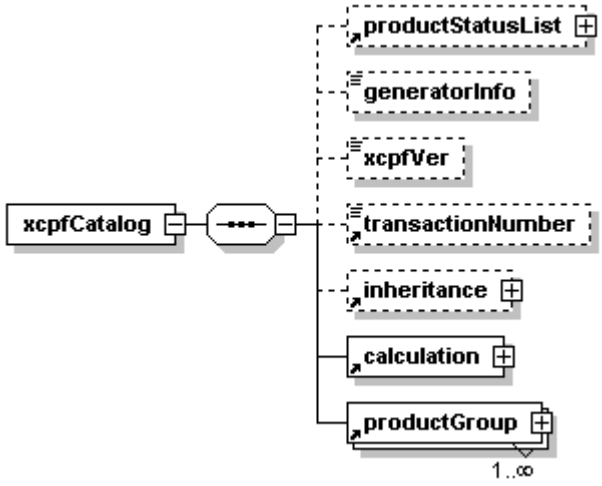
5.2.24 element piecewise/otherwise/apply

diagram	
type	***applyType***
children	***apply ci cn piecewise max min eq lt gt plus minus sin cos tan power times divide sum bvar***

5.3 element xcpfEnvelope

Diagram					
Children	***calculation xcpfCatalog***				
attributes	Name	Type	Use	Default	Fixed
	id	xs:string	required		
	name	xs:string			
annotation	documentation	Envelope for multiple catalogs, e.g. cascading			

5.3.1 element xcpfEnvelope/xcpfCatalog

Diagram					
Children	***productStatusList generatorInfo xcpfVer transactionNumber inheritance calculation productGroup***				
Attributes	Name	Type	Use	Default	Fixed
	id	xs:string	required		
	name	xs:string			
Annotation	documentation	Each supplier may have an own pricing catalog, wherein most standard entries may be inherited, e.g. contact address or licensing information			

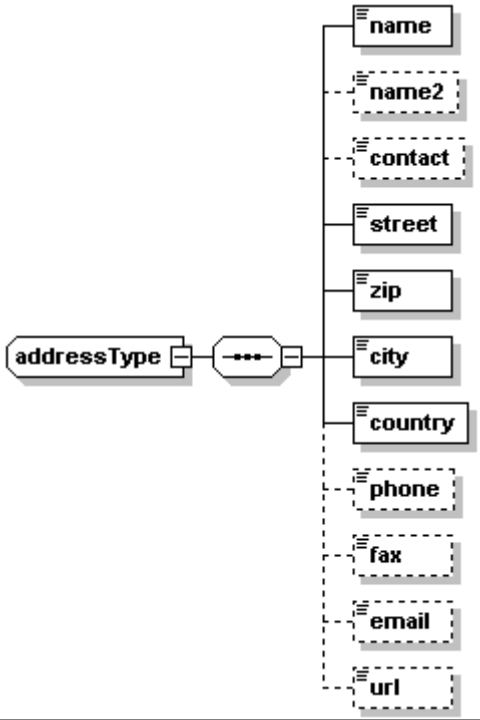
5.3.2 element xcpfEnvelope/xcpfCatalog/generatorInfo

diagram		
type	**xs:string**	
annotation	documentation	The editor or other information may be written down in this textfield

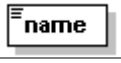
5.3.3 element xcpfEnvelope/xcpfCatalog/xcpfVer

Diagram		
type	**xs:string**	
annotation	documentation	Contains the used version of the XML complex Configuration & Pricing Format

5.4 complexType addressType

Diagram					
children	***name name2 contact street zip city country phone fax email url***				
used by	element ***address***				
Attributes	Name	Type	Use	Default	Fixed
	role	xs:NMTOKEN	required		
	type	xs:NMTOKEN			

5.4.1 element addressType/name

Diagram	
Type	**xs:string**
Annotation	documentation Name of person or institution.

5.4.2 element addressType/name2

Diagram	
Type	**xs:string**
Annotation	documentation Space for additional names.

5.4.3 element addressType/contact

Diagram	
type	**xs:string**
annotation	documentation This field may be use for personal names in institutions.

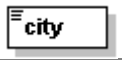
5.4.4 element addressType/street

diagram	
type	**xs:string**

5.4.5 element addressType/zip

Diagram	
Type	**xs:string**

5.4.6 element addressType/city

Diagram	
Type	**xs:string**

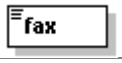
5.4.7 element addressType/country

diagram	
type	**xs:string**

5.4.8 element addressType/phone

Diagram	
Type	**xs:string**

5.4.9 element addressType/fax

diagram	
type	**xs:string**

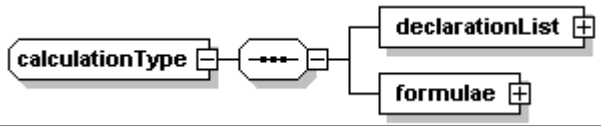
5.4.10 element addressType/email

Diagram	
Type	**xs:string**

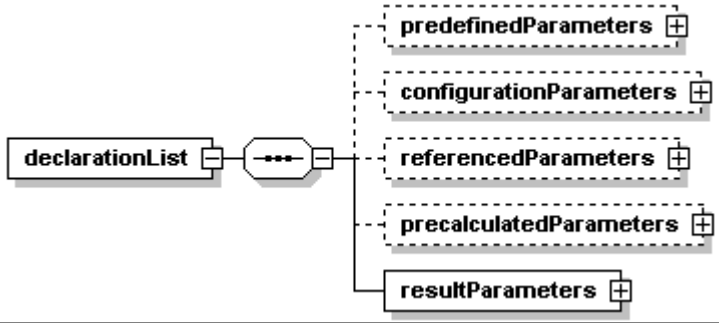
5.4.11 element addressType/url

Diagram	
Type	**xs:string**

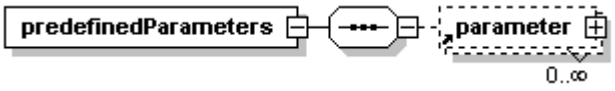
5.5 complexType calculationType

diagram	
Children	***declarationList formulae***
used by	element ***calculation***

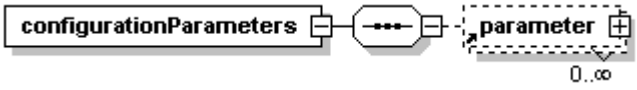
5.5.1 element calculationType/declarationList

Diagram		
Children	***predefinedParameters configurationParameters referencedParameters precalculatedParameters resultParameters***	
Annotation	documentation	Parameter need to be declared prior processing. The input and output workflows can be determined by using categories.

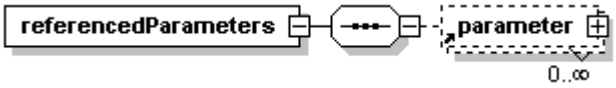
5.5.2 element calculationType/declarationList/predefinedParameters

Diagram		
Children	***parameter***	
Annotation	documentation	Some parameters are necessary for the processing, but are constant, e.g. tax. These parameter can be declared as "predefined".

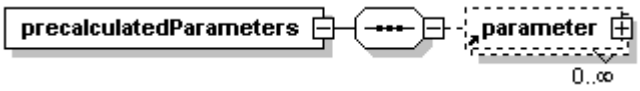
5.5.3 element calculationType/declarationList/configurationParameters

Diagram		
children	***parameter***	
annotation	documentation	Other parameter values need to be set by user. All these parameters will be visualized. Some of these may be used for pricing, e.g. Contract time, other may be used for data generation, e.g. style=red and some for both, e.g. data format= dxf.

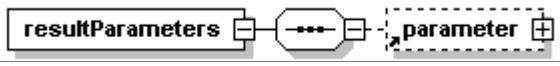
5.5.4 element calculationType/declarationList/referencedParameters

diagram		
children	***parameter***	
annotation	documentation	NOTE: Only used in productGroup! This parameter group is needed for hierarchical calculations, where parameter values of previous calculated values can be accessed. An often used example is the sum, where in previous prices are summarized.

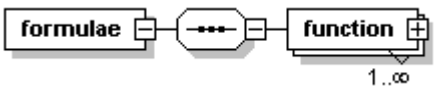
5.5.5 element calculationType/declarationList/precalculatedParameters

Diagram		
Children	***parameter***	
Annotation	documentation	This kind of parameter are being used as sub functions. These functions may be mathematical operations or XCPF Web Service Calls (XCPF-WSC) and have only values at runtime. The XCPF-WSC are useful for access to mass storage, for complex calculations or for actual data. They are results of functions. An often used example is the calculation of a surface of a polygon.

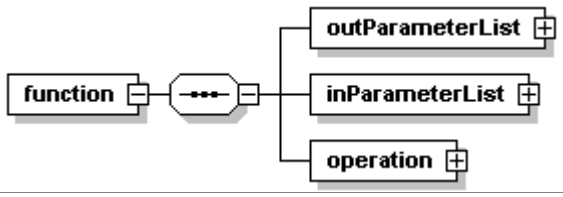
5.5.6 element calculationType/declarationList/resultParameters

Diagram		
Children	***parameter***	
Annotation	documentation	This textfield contains the parameter for the final result of all calculations. An example is: price

5.5.7 element calculationType/formulae

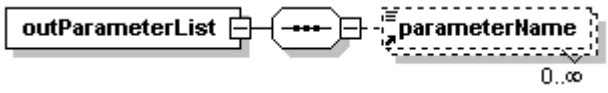
Diagram		
Children	***function***	
Annotation	documentation	All declared parameters may be processed by formulae in this block

5.5.8 element calculationType/formulae/function

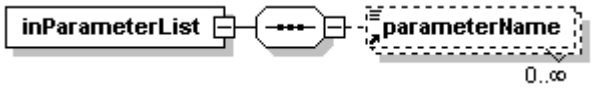
diagram		
children	***outParameterList inParameterList operation***	

attributes	Name	Type	Use	Default	Fixed
	name	xs:string			
annotation	documentation	The calculations may use several sub function or XPCF web Service Calls (XCPF-WSC) and a main function, which result need to be mapped to a parameter declared in the "resultParameters" block			

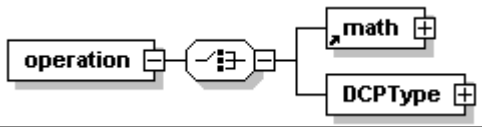
5.5.9 element calculationType/formulae/function/outParameterList

Diagram		
Children	***parameterName***	
Annotation	documentation	This list contains all parameters, which will be used in the formula or in the Web Service Call

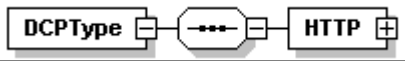
5.5.10 element calculationType/formulae/function/inParameterList

diagram		
children	***parameterName***	
annotation	documentation	This list contains the returned parameters, which are the results

5.5.11 element calculationType/formulae/function/operation

diagram		
children	***math DCPType***	
annotation	documentation	The operation Block contains a: -mathematical forumula or a -XCPF Web Service Call Url

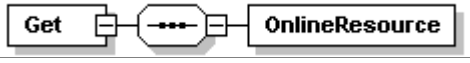
5.5.12 element calculationType/formulae/function/operation/DCPType

diagram		
children	***HTTP***	
annotation	documentation	XCPF Web Service Call for external processing

5.5.13 element calculationType/formulae/function/operation/DCPType/HTTP

diagram		
children	***Get***	

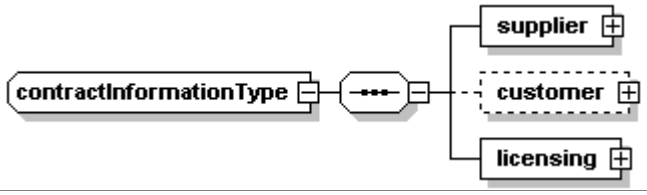
5.5.14 element calculationType/formulae/function/operation/DCPType/HTTP/Get

Diagram		
children	***OnlineResource***	
annotation	documentation	HTTP Get Method

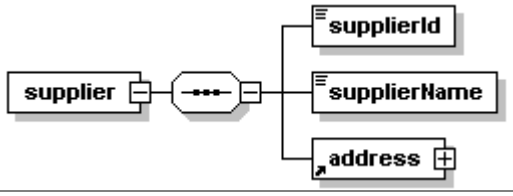
5.5.15 element calculationType/formulae/function/operation/DCPType/HTTP/Get/OnlineResource

diagram					
attributes	Name	Type	Use	Default	Fixed
	xlink:type	xlink:typeEnum			simple
	xlink:href	anyURI	required		
Annotation	documentation	URL, e.g. http://www.geo-ebusiness.de			

5.6 complexType contractInformationType

Diagram	
Children	***supplier customer licensing***
used by	element ***contractInformation***

5.6.1 element contractInformationType/supplier

diagram		
children	***supplierId supplierName address***	
annotation	documentation	The party who is offering data products must be public.

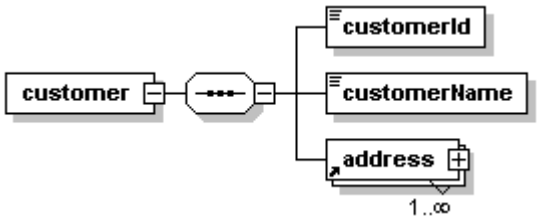
5.6.2 element contractInformationType/supplier/supplierId

diagram		
type	**xs:string**	
annotation	documentation	This ID may help to process orders and can help in a distributed environment an in the case of different spelling of names and addresses.

5.6.3 element contractInformationType/supplier/supplierName

diagram		
type	**xs:string**	
annotation	documentation	Short name of the data supplier.

5.6.4 element contractInformationType/customer

diagram			
children	***customerId customerName address***		
annotation	documentation	In opposite to the supplier, the customer may be anonymous until he orders with the WPOS method "orderproduct".	

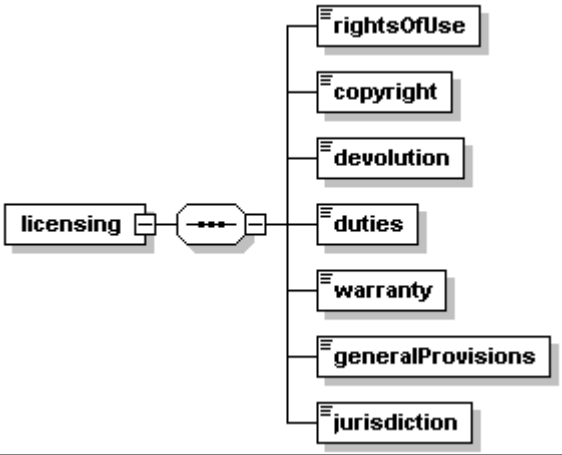
5.6.5 element contractInformationType/customer/customerId

Diagram		
type	**xs:string**	
annotation	documentation	Even customer must have an account ID. This is necessary to link the stack of orders to a customer.

5.6.6 element contractInformationType/customer/customerName

diagram		
type	**xs:string**	
annotation	documentation	Short name of customer.

5.6.7 element contractInformationType/licensing

diagram					
children	***rightsOfUse copyright devolution duties warranty generalProvisions jurisdiction***				
attributes	Name	Type	Use	Default	Fixed
	licensingCat	xs:string	required		
annotation	documentation	Each licensing entry must have an ID. In future, this ID may stand for a special group of licensing, which may be processed automatically.			

5.6.8 element contractInformationType/licensing/rightsOfUse

diagram	
type	**xs:string**
annotation	documentation Licensing term

5.6.9 element contractInformationType/licensing/copyright

diagram	
type	**xs:string**

5.6.10 element contractInformationType/licensing/devolution

diagram	
type	**xs:string**

5.6.11 element contractInformationType/licensing/duties

diagram	
type	**xs:string**

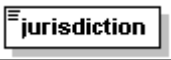
5.6.12 element contractInformationType/licensing/warranty

diagram	
type	**xs:string**

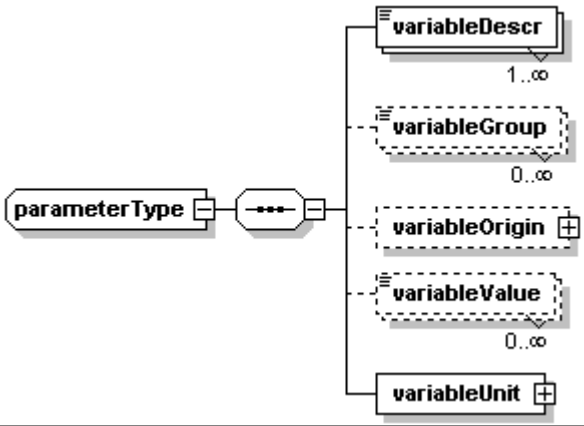
5.6.13 element contractInformationType/licensing/generalProvisions

diagram	
type	**xs:string**

5.6.14 element contractInformationType/licensing/jurisdiction

diagram	
type	**xs:string**

5.7 complexType parameterType

diagram					
children	***variableDescr variableGroup variableOrigin variableValue variableUnit***				
used by	element ***parameter***				
attributes	Name	Type	Use	Default	Fixed
	name	xs:string	required		
	type	xs:NMTOKEN	required		

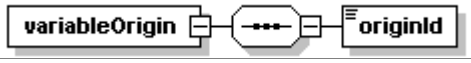
5.7.1 element parameterType/variableDescr

diagram		
type	extension of **xs:string**	
attributes	Name	Type	Use	Default	Fixed
	lang	xs:string	required		
annotation	documentation	Each parameter has a logical name. But at least for language reasons several different descriptions are useful. These descriptions may use white spaces and can contain sentences.

5.7.2 element parameterType/variableGroup

diagram		
type	**xs:string**	
annotation	documentation	Typical some parameters may be used for some reasons as groups. Equal strings in the variableGroup field will express the group relationship. Parameter may belong to more groups, e.g. for "pricing" and for generation "geoserver". An example is the use of a set of parameters for data generation. These parameters should contain a string, e.g. "geoserver". All the parameters with that string may be filtered and transferred to geo data generation server.

5.7.3 element parameterType/variableOrigin

diagram					
children	***originId***				
attributes	Name	Type	Use	Default	Fixed
	originName	xs:string	required		
annotation	documentation	NOTE: Variable Origin will only be used in "referencedParameters" blocks. The required attribute "orginName" contains the original name of a low hierarchical parameter. Referenced parameter can be used in to ways: -Multiple Reference with lists of parameter values -Single Reference An often used multiple examples is the price calculation, which refer to the list of all previous results.			

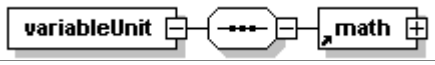
5.7.4 element parameterType/variableOrigin/originId

diagram		
type	**xs:string**	
annotation	documentation	Multiple references need a "*" as a wildcard for all parameter values with the in variable Origin used names, not depending on product entries

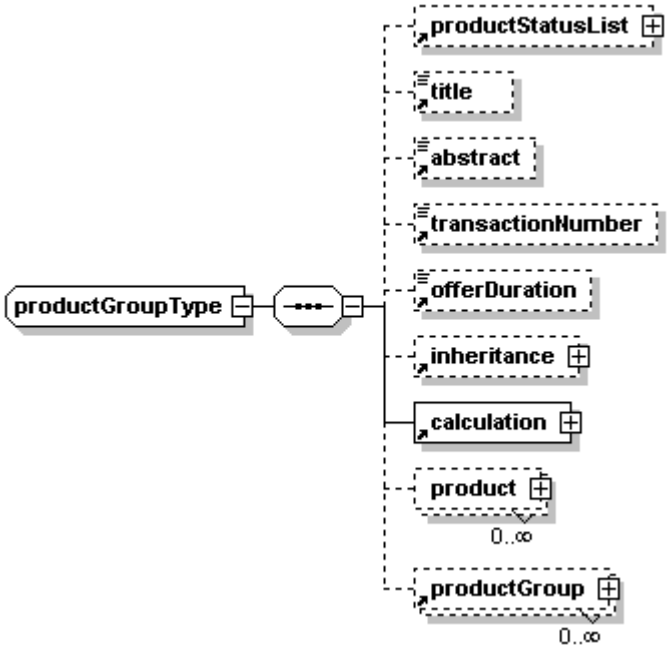
5.7.5 element parameterType/variableValue

diagram					
type	extension of **xs:string**				
attributes	Name	Type	Use	Default	Fixed
	condition	xs:string			
	selected	xs:string			
annotation	documentation	The need for a value is depending on the parametergroup of the declarationList: -predefinedParameters must a value, because they are constant -configurationParameters may have a value as a default -referencedParameters do not have a value -calcuationParameters do not have a value -resultParameters do not have a value			

5.7.6 element parameterType/variableUnit

diagram					
children	***math***				
attributes	Name	Type	Use	Default	Fixed
	textstyle	xs:string	required		
annotation	documentation	Units are important for a correct calcuation. Therefore they have to be set in an machine processable way with MathML. But it might be neutral with a "1". They attribute textstyle should be used for string expressions, which may easly displayed. An example is: km^2			

5.8 complexType productGroupType

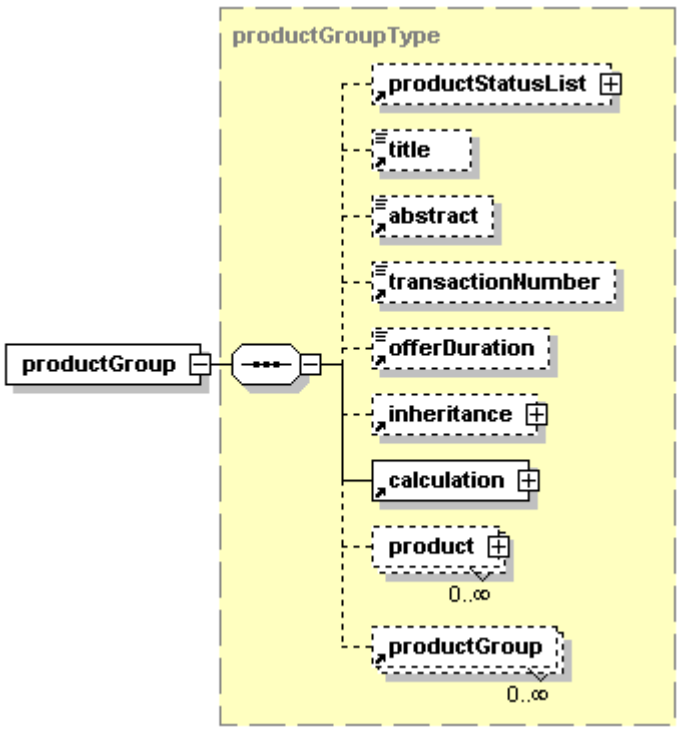
diagram	
children	***productStatusList title abstract transactionNumber offerDuration inheritance calculation product productGroup***
used by	element ***productGroup***

attributes

Name	Type	Use	Default	Fixed
id	xs:string	required		
name	xs:string			

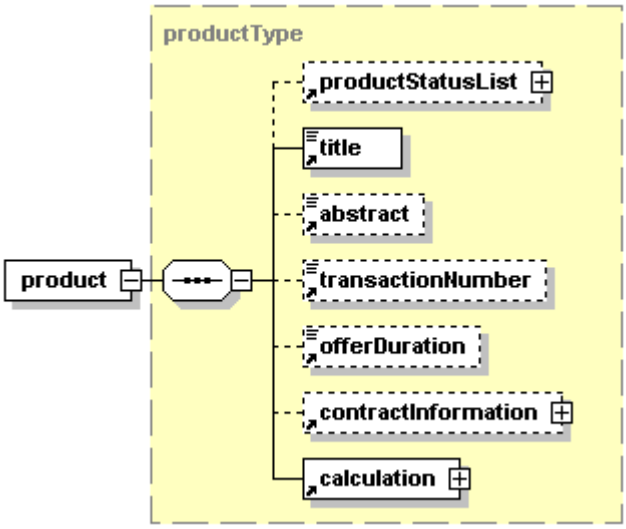
5.8.1 element productGroup

Diagram

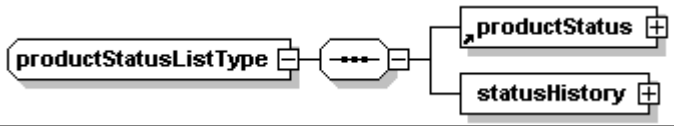


type	***productGroupType***				
children	***productStatusList title abstract transactionNumber offerDuration inheritance calculation product productGroup***				
used by	element ***xcpfEnvelope/xcpfCatalog*** complexType ***productGroupType***				
attributes	Name	Type	Use	Default	Fixed
	id	xs:string	required		
	name	xs:string			
annotation	documentation	With the use of productGroup elements, pricing catalog can be arranged. With the use of productGroup elements, pricing catalog can be arranged.			

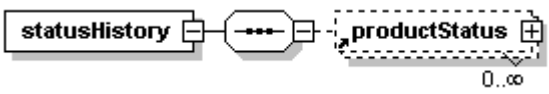
5.8.2 element productGroupType/product

diagram					
type	***productType***				
children	***productStatusList title abstract transactionNumber offerDuration contractInformation calculation***				
attributes	Name	Type	Use	Default	Fixed
	id	xs:string	required		
	name	xs:string			
annotation	documentation	Important structure of the smallest unit, which has a complete calculation environment. The product block corresponds directly to data product and to its metadata			

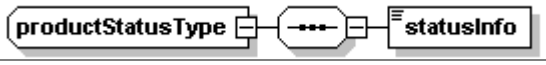
5.9 complexType productStatusListType

diagram					
children	***productStatus statusHistory***				
used by	element ***productStatusList***				

5.9.1 element productStatusListType/statusHistory

diagram					
children	***productStatus***				

5.9.2 complexType productStatusType

diagram					
children	***statusInfo***				
used by	element ***productStatus***				
attributes	Name	Type	Use	Default	Fixed
	date	xs:string	required		
	time	xs:string	required		
	statusCode	xs:NMTOKEN	required		

5.9.3 element productStatusType/statusInfo

diagram	
type	**xs:string**
annotation	documentation Textual information about a status.

6 Example

6.1 Pricing Model

This example shows the XCPF solution using the first use-case price model, ATKIS DLM (see 3.1.1).

6.1.1 Mathematical Formulae Approach

6.1.1.1 Basic Formulae Pattern

The business pricing formulae derived in 3.1.1 can be classified as an "area calculation" approach. Therefore, the basic price depends on the user-selected area multiplied by a price per area. Because of the fundamental effect of unit types, all variables need declared units. The variable values may be set as constant (predefined) or set by the price model developer, customer dependant (configuration) or resulting, e.g. the final price.

```
price = Area * price_per_area_unit

[price_per_area_unit] = EUR/km²
[Area]= km²
[price] = EUR
```

Source 33 Basic Area formula

The Source 33 shows the approach as in mathematical formulae including the declared units. The unit check determines EUR for the final value, which is correct.
In the next step the dependency of the price_per_area_unit will be investigated. The pricing table in 3.1.1 shows that the price_per_area_unit is not constant, rather depending on the customer selected Area. It is a function.

```
price_per_area_unit = price_per_area_unit (Area)

price_per_area_unit =[  1<Area<5000    = 7,50 EUR/km²,
                        5001<Area<25000   = 2,50 EUR/km²,
                        25001<Area        = 1,00 EUR/km²]
```

Source 34 Function price_per_area_unit

Source 34 shows the function to determine the price_per_area_unit. With this step, the price formula includes the area approach and the scaled pricing function. In section 3.1.1 of the business-price model, a 50 % rebate is offered for an export in the simple data format DXF. Therefore, the user may select this configuration option with a

Boolean variable "DXFformat". Because this element is only a small appendix to the basic area formula (see Source 33), it is added without another function.

```
price = Area * price_per_area_unit * (1- (DXFformat*0.5))
```

Source 35 Basic area formula enhanced by format rebate

The formula in Source 35 shows the appendix. The brackets are needed to achieve the desired result. If the configuration parameter "DXFformat" is set by the user, its value is "1". Therefore, the resulting factor of the brackets is 0.5 or 50% off.

Section 3.1.1 defines some more rebates depending on the customer geographic layer selections. The resulting factor interacts with the enhanced formula (see Source 35). Because of the resulting long expressions, a new function is a good choice.

```
layerrebatefactor=
 (0.25 * settlementlayer) + (0.4 * trafficlayer) + (0.2 * vegetationlayer)
+(0.1 * waterbodieslayer) + (0.05 * territorieslayer)
```

Source 36 Function of the layer rebate factor

If a customer selects the traffic and the territories layer, the price will be reduced to 45 %. The corresponding factor is therefore 0.45

There are also standard data encoding formats defined, which are not relevant for pricing.

Section 3.1.1 defines a rebate based on multiple usage. A customer may purchase a multiple usage license by selecting a user range, which corresponds to the factor "multipleusagefactor".

```
price = Area * price_per_area_unit * (1- (DXFformat*0.5))
        *  layerrebatefactor * multipleusagefactor
```

Source 37 Basic area formula enhanced by simple data format and multiple usage factors

The resulting formulae are shown in Source 34, Source 36 and Source 37. These formulae are required in the next step. Nevertheless the creation of pricing formulae is the most important one.

6.1.2 Embedding into a XCPF Object

The XCPF structure contains the element "product", which collects all required variables and formulae for a valid pricing calculation and for a product configuration. The first step is to classify the variables into:

- precalculated
- configurationParameters
- referencedParameters
- preCalcuatedParameters
- resultParameters

The Table 8 gives a parameter overview in this example:

			Type					Classification			
Description	Name	Unit	Real	Integer.	Boolean	String	result	predefined	configurat.	referenced	precalculated	result
Settlement Layer	settlementlayer	1			X				X			
Traffic Layer	trafficlayer	1			X				X			
Vegetation Layer	vegetationlayer	1			X				X			
Water bodies Layer	waterbodieslayer	1			X				X			
Territories Layer	territorieslayer	1			X				X			
The intermediate rebate factor for layer	layerrebatefactor	1	X								X	
Customer selected Area	Area	km²	X						x			
Price per area, depending on area	price_per_area_unit	EUR/ km²	X								X	
Data Format	DXFformat	1			x				X			
Multi usage factor	Multipleusagefactor	1	X						x			
Product price	Price	EUR	X									X

Table 8 Example parameter overview

All used parameters need to be declared in the XCPF "declarationList" of the product. A parameter object contains a unique name to be identified in the calculation. The attribute "type" describes the simple data type for input checks. The parameters need to be described (variableDescr), which helps the user to understand the meaning. Even long expressions are possible. Multiple descriptions for different languages are possible. Parameters must have a value (variableValue), if classified as a "predefined". If classified as "configParameters", a value is optional and acts as a default value. Multiple values can be used for lists. Unique "variableGroup" tags may group parameters. In this example, an implementation may take all parameters with the entry "geoserver" to the geo-data generation server interface. Parameters may belong to multiple groups. The unit defined with the "textstyle" element for textual presentation and with the "math" object as machine-readable. Source 38 shows the described elements in a XML representation.

```
<parameter name="settlementlayer" type="boolean">
   <variableDescr lang="de">Siedlungslayert</variableDescr>
   <variableDescr lang="en">Settlement Layer</variableDescr>
   <variableGroup>geoserver</variableGroup>
   <variableValue condition="Settlement Layer">true</variableValue>
   <variableValue condition="No Settlement Layer">false</variableValue>
   <variableUnit textstyle="">
   <math>
      <apply>
         <cn>1</cn>
      </apply>
   </math>
</variableUnit>
</parameter>
```

Source 38 Declaration of a parameter

The background of that declaration is the workflow. Predefined parameters can be used for internal calculation. Configuration parameters will be presented to the customer to be set. Referenced parameters cannot be used in a "product" element and resulting parameters may be a price. The pricing formula contains two auxiliary formulae, the results of which need to be declared as "precalculatedParameters".

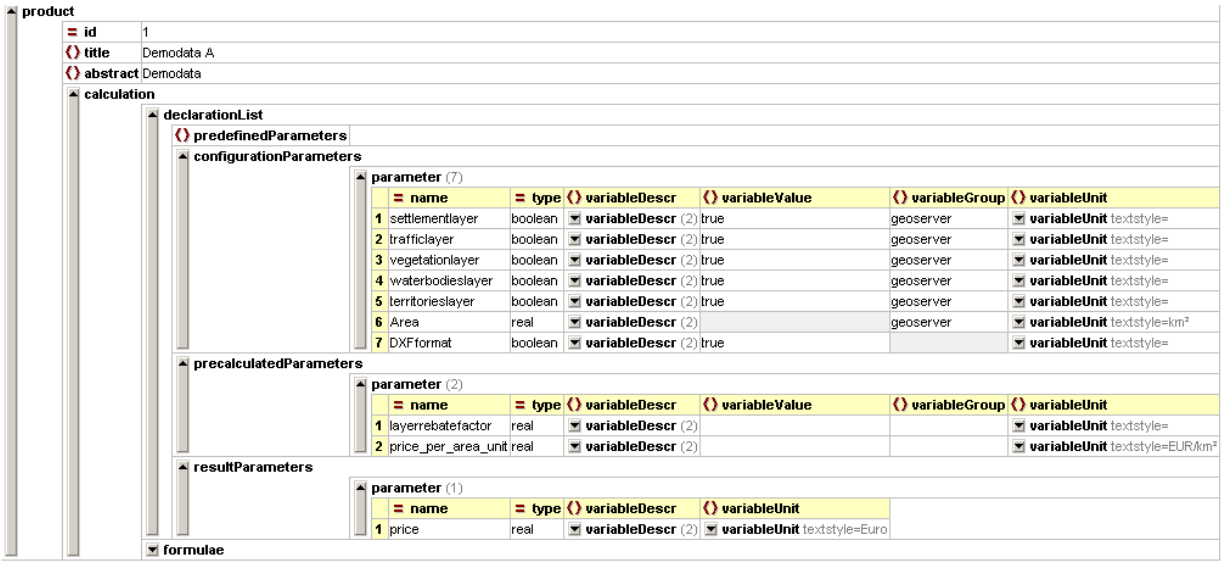


Figure 45 XCPF" Product" object example with declaration list

Figure 45 shows the grouped parameters in a "product" element. The "productID", the title and an abstract need to be set as well.

The next step is to encode the formulae from Source 34, Source 36 and Source 37 with MathML. It is highly recommended to read and to understand the MathML principle ideas in the MathML specification. MathML uses the "polish" notation system, which is very suitable for digital encoding. It encodes first the operation and then variables.

The scale price from Source 34 may be expressed with MathML with the use of the "piecewise" element. Source 39 shows the solution for a typical scale-pricing element. It contains the equal <eq> operation for the equation, <apply> for mathematical brackets, <ci> to mark variables and <cn> to mark numbers.
The result, in this example "price_per_area_unit", is dependant on the element "piece", which contains a condition, e.g. if Area < 5000 then the result is 7.5. If the first valid condition is found, the processing will be aborted. Therefore it is only necessary to express a single condition, e.g. Area < 25000, instead of 5000 < Area < 25000. If no valid condition can be found, then the solution is the value of "otherwise".

```
<math>
   <apply>
      <eq/>
      <ci>price_per_area_unit</ci>
      <piecewise>
         <piece>
            <cn>7.5</cn>
            <apply>
               <lt/>
               <ci>Area</ci>
               <cn>5000</cn>
            </apply>
         </piece>
         <piece>
            <cn>2.5</cn>
            <apply>
               <lt/>
               <ci>Area</ci>
               <cn>25000</cn>
            </apply>
         </piece>
         <otherwise>
            <cn>1</cn>
         </otherwise>
      </piecewise>
   </apply>
</math>
```

Source 39 Scaled Pricing with the piecewise MathML element

The formula "Layer Rebate Factor" from Source 36 can be encoded with MathML as shown in Source 39. The operators <plus> and <times> are used to express the given formula.

```
<math>
   <apply>
      <eq/>
      <ci> layerrebatefactor </ci>
      <apply>
         <plus/>
         <apply>
            <times/>
            <ci>settlementlayer</ci>
            <cn>0.25</cn>
         </apply>
         <apply>
```

```
            <times/>
            <ci>trafficlayer</ci>
            <cn>0.4</cn>
         </apply>
         <apply>
            <times/>
            <cn>0.2</cn>
            <ci>vegetationlayer</ci>
         </apply>
         <apply>
            <times/>
            <cn>0.1</cn>
            <ci>waterbodieslayer</ci>
         </apply>
         <apply>
            <times/>
            <cn>0.05</cn>
            <ci>territorieslayer</ci>
         </apply>
      </apply>
   </apply>
</math>
```

Source 40 Formula from source 4 encoded with MathML

After the encoding of the two help formulae, the main formula, which calculates the price, can be expressed. It contains "price" as the final value, which was declared as a "result" parameter. The result is dependant on a multiplication with Area, price_per_area_unit, the Simple Format Reduction bracket and two other factors.

```
<math>
   <apply>
      <eq/>
      <ci>price</ci>
      <apply>
         <times/>
         <ci>Area</ci>
         <ci>price_per_area_unit </ci>
         <apply>
            <minus/>
            <cn>1</cn>
            <apply>
               <times/>
               <ci>DXFformat</ci>
               <cn>0.5</cn>
            </apply>
         </apply>
         <ci>multipleusagefactor </ci>
         <ci>layerrebatefactor </ci>
      </apply>
   </apply>
</math>
```

Source 41 Main formula encoded with MathML

Finally the encoded product needs to be inserted into an XCPF catalogue. If the resulting parameter is declared with the name "price" and no other additional group calculations are needed, the "product" element can be directly inserted into a template XCPF catalogue.

In this case, the final result "price" of the "product" element is connected by the referenced parameter "singlePrice" and summarized until the final root element price. Figure 46 shows the "product" element embedded in a catalogue in step 1. Step 2 references the final result from the lower level and provides it with the alias name "singlePrice" for additional calculation on group level. Step 3 shows the result parameter. If it is named "price", the next hierarchic calculation can be analog encoded, which is shown in step 4. The steps 5 and 6 are the same, only on a higher level.

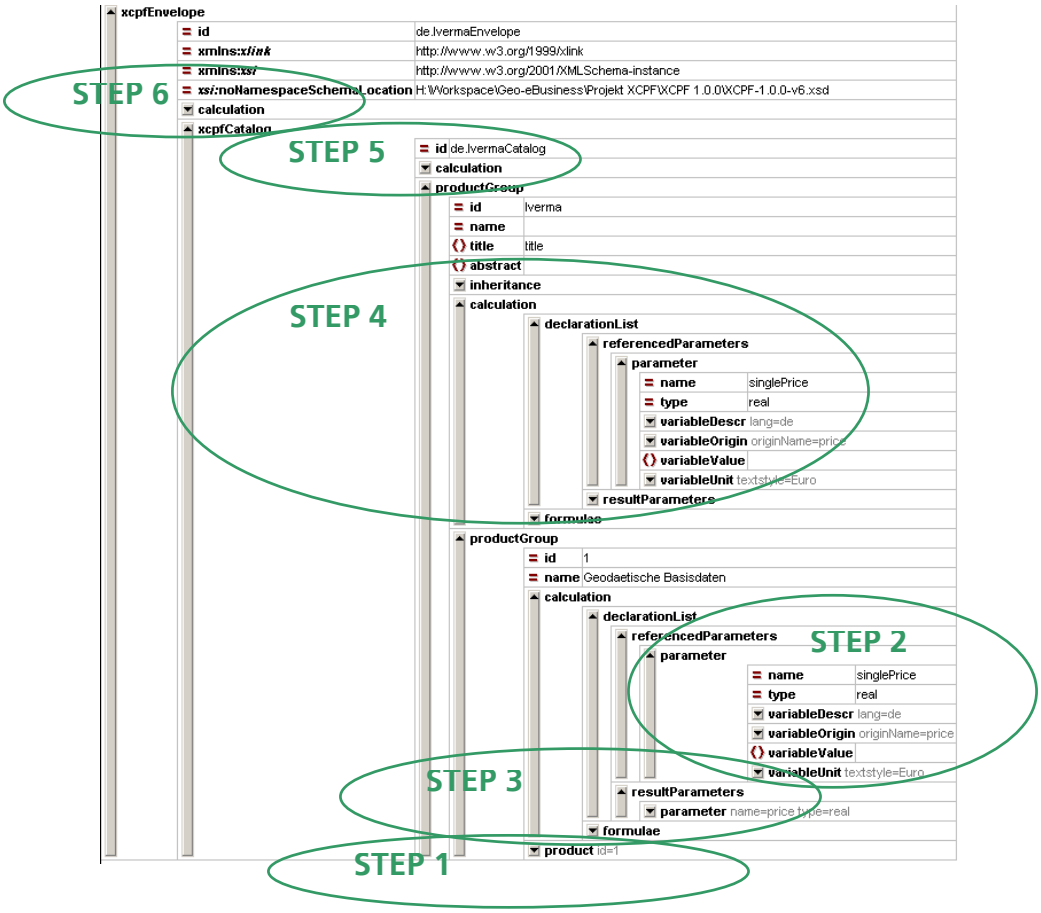


Figure 46 Insertation of a product element with following addaption steps

7 Applications and Projects

Some realized applications and projects with WPOS/XCPF are described in this chapter. Of course, this number of applications really demands more space to be described fully. But most projects are already described elsewhere or commercially confidential.

7.1 GeoMarkt.NRW

Principal:

- German State Northrhine-Westphalia (NRW)

Time period: 12/1999-9/2001

The German State Northrhine-Westphalia started the initiative Geo-data Infrastructure NRW (GDI NRW) in 1999 (Holtkamp, 2000). A project in this program was GeoMarkt.NRW to explore a distributed spatial data infrastructure technology from a business point of view. The use case was a Class C Portal with independent data suppliers.

International standards from OGC and ISO were tested at implementation level to give a proof-of-concept. GeoMarkt.NRW was implemented as a demonstrator with ISO19115 Metadata and OGC Web Mapping Services for navigation and product generation.

The feasibility exploration identified a lack of suitable e-Business service specifications for a realization of distributed geo-markets in fall 2000. The commonly used price models in the spatial sector are much more complex than off-the-shelf products. Investigations for capable solutions in the IT mainstream were unsuccessful. In January 2001, the Fraunhofer ISST opened a public discussion within the GDI NRW initiative (SiG Architecture and SiG eCommerce). No suitable solutions could be found.

In parallel to the public discussion, Roland M. Wagner took a generic approach to represent spatial domain specific complex price models with mathematical formulae. This approach was named later XML complex Configuration & Pricing Format (XCPF).

Papers for the AGILE 2001 and DigitalEarth2001 conference were posted to open a discussion in the technical Geo-eBusiness sector.

In parallel to the GDI NRW Testbed I, the API functionalities of a web interface were defined in April 2001. Different information streamed via web chaining required a much more complex interface than other known OGC solutions. This interface was named "Web Pricing & Ordering Service" (WPOS). This interface was implemented together with the first XCPF approach and demonstrated in GeoMarkt.NRW.

Results:

- Identification of the Geo-eBusiness gap
- Machine-readable generic approach for complex configuration & pricing representation
- Creation of the multi-protocol "Protocol Manipulation Layering" method and application in the "Web Pricing & Ordering Service" interface

7.2 GDI NRW Testbed I

Player:

- AED Graphics
- con terra
- CPA
- Fraunhofer ISST
- ibR
- Interactive-instruments
- LDS NRW
- Universität Münster (IFGI)

Time period: 03/-09/2001

In parallel to the GeoMarkt.NRW project (see 7.1), the testbed was set up to find a common interpretation of interoperable OGC and ISO standards and to demonstrate it with interoperable implementations (Remke, Bernard, 2001). Another goal was to offer a platform for further developments, to discuss the approaches and to show interoperable demonstrations. The testbed members agreed that there is a need for a pricing & ordering component in a spatial data infrastructure.

Result:

- The GDI NRW initiative accepted the WPOS approach and its interfaces as a GDI NRW standard in October 2001 (Wagner, 2001)
- Two WPOS implementations (Fraunhofer ISST and interactive instruments)

7.3 GeoBroker Brandenburg

Principal:

- German State Brandenburg, LGB

Player:

- AED Graphics
- Con terra
- Fraunhofer ISST

Time period: 12/2001-12/2002

The "Geobroker Brandenburg" is a class B project. The Brandenburg mapping agency LGB demanded an e-commerce platform for their very large data storage. The principal requested an ISO/OGC conformant solution and if no suitable standards existed, an ISO/OGC philosophy approach. This request should ensure a sustainable investment. AED Graphics acted as a prime contractor and developed the geo-data services. Con terra developed the ISO 19115/OGC Meta-data catalogue and the Fraunhofer ISST developed the e-Business component with WPOS.

This real world project was a good chance to prove and, where necessary enhance, the concepts. The WPOS interface had one new function, GetOrderList, added for documentation reasons. The concept was shown to be stable. Various business price models needed to be digitally represented and made machine-readable in the XCPF format. The basic approach was improved with a product group calculation and an inheritance mechanism for an optimized administration of very large product price model descriptions. The conceptual approach with generic mathematic price model representation was capable of representing the pricing catalog of the LGB.

Result:

- XCPF was improved
- WPOS was improved
- WPOS back-office interface to the geo-data management service was defined
- Proof-of-concept

7.4 GDI NRW Testbed II

Player (active):

- AED Graphics
- con terra
- Fraunhofer ISST
- ibR
- Interactive-instruments
- Universität Münster (IFGI)

Supporter:

- AK Regionale Kartographie
- Geoforschungszentrum Potsdam
- Infas GEOdaten
- LGB Brandenburg
- LDS NRW
- Stadt Dortmund
- Stadt Düsseldorf
- Straßen.NRW
- Terramapserver
- Vodaphone (without Logo)

Time period: 03/-10/2002

Prior the start of the second testbed, a public call-for-participation was released to invite NRW and non-NRW institutions to expand the community. OGC membership was mandatory for active participants. Supporters sponsored geo-data or other

elements. Several subgroups were founded to cover different topics, because of the growing complexity.
The complex Configuration & Pricing Format (XCPF) was discussed in this testbed in detail. Some new enhancements like group pricing and inheritance was accepted. The ServiceRequest of the WPOS HTTP Get interface was improved with some new parameters to describe the protocols explicitly. Two implementations were shown to demonstrate interoperability and the support for data and service (WMS).

Results:

- Enhanced proof-of-concept of with 5 price models of supporters from the private, public and science sector
- GDI NRW Testbed II WPOS/XCPF documentation for OGC process
- Demonstration with data and services

7.5 Test Installation for Marketing in the Satellite Data Industry (ongoing)

Player:
- Infoterra (Principal)
- Delphi IMM (catalogue, data server)
- Active-Knowledge (data server)
- Fraunhofer ISST (WPOS)

Time period: 08/2002-?

Satellites provide valuable data, which could be enriched to marketable products. An automated procurement system is recommended, because of very large databases (up to 1 petabyte).
The technical realization is similar to the Geobroker projects.

7.6 Test installation for an other National mapping agency in the EU (planned)

A progressive national state-mapping agency of a big European member state is going to test the WPOS development together with an OGC Web Feature Service environment. Therefore a WPOS POST profile and a WFS façade need be developed.

7.7 Requirements of Defense Industry (planned)

A player with high security standards would like to provide spatial data to partners via the Internet. Due to security reasons, the internal network needs to be physically separated from the Internet. Manual data exchange is allowed.
In this case the abilities of XCPF to store complete configurations within a file format is relevant. The WPOS component will run in the external network and provide pricing &

ordering. The user configured geo-data product orders will be stored as files in the XCPF format. These orders will be saved manually on disks and transferred into the internal system. After the generation of the requested data, it will be stored on disk and transferred back into the external network for download.

In this case the abstract configuration capabilities of XCPF is crucial.

7.8 XCPF Editor

XML is a human and machine-readable language. But complex expressions, which are dependent on each other, are difficult to create or to maintain in XML. XML Schemas do not offer the ability to check XCPF objects for validity. MathML is based on the polish notation system, which is different to the everyday notation of mathematical formulae.

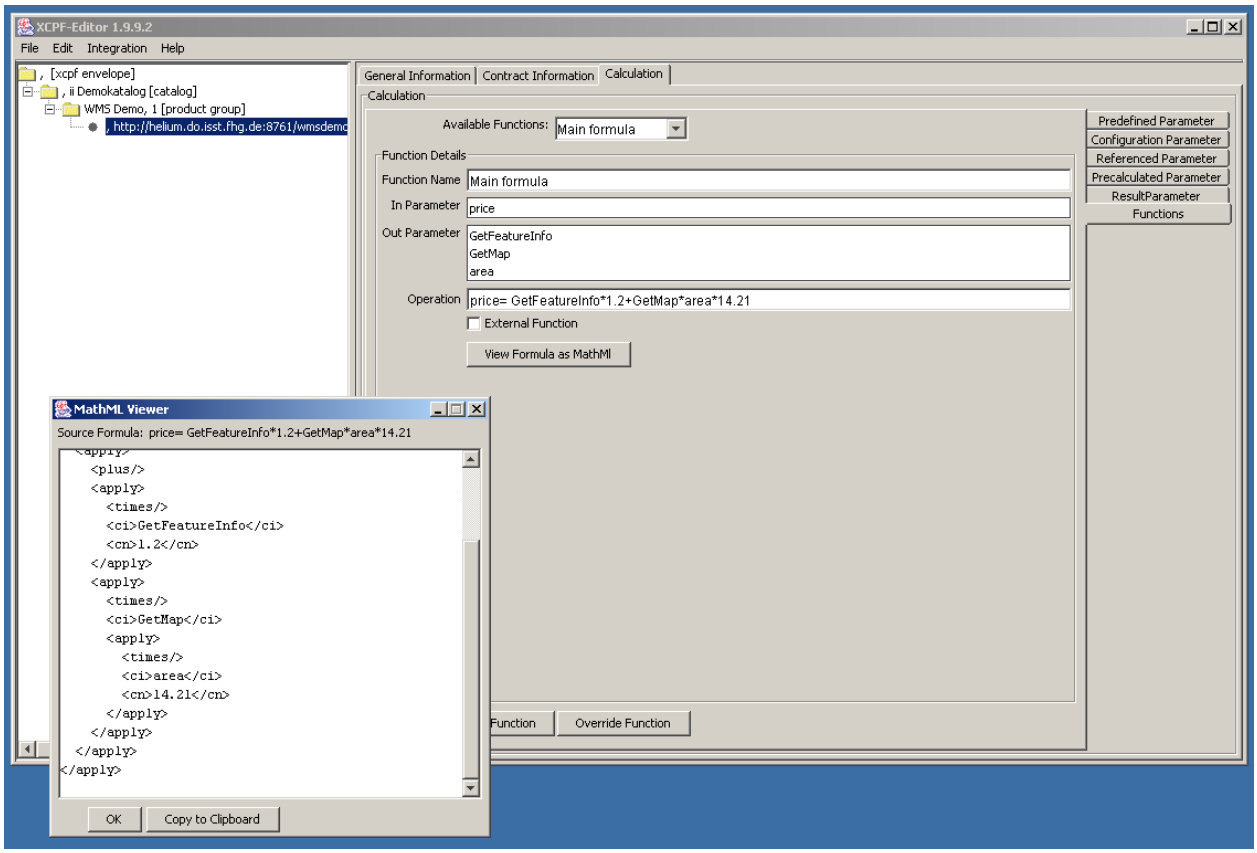


Figure 47 Screenshot of the XCPF Editor

The inheritance method optimizes the XCPF sub objects, but needs additional effort to edit them.

Altogether, there is a need for a XCPF Editor. Figure 47 shows a screen shot of the implemented Editor with a WMS pricing example in the main formula. The small window shows the MathML representation of the same formula.

8 Conclusion

There are several points of view for a conclusion about "a model for the representation and transaction of complex pricing and ordering for high-value digital products and services". The WPOS/XCPF developments are technological approaches. They offer solutions for real world needs as shown in the use-cases.
The technological dimension can be influenced. Other dimensions like the discussion and acceptance in the scientific community or in the business community may take much more time and are not certain. Figure 48 shows a mind map.
The WPOS/XCPF specification was the first interoperability proposal for the Geo-e-Business sub-domain submitted to OGC.
Although the introduction of Geo-eBusiness is about more than technology, the development is technology driven. And technology is the main topic of this thesis, which will be discussed in this chapter.

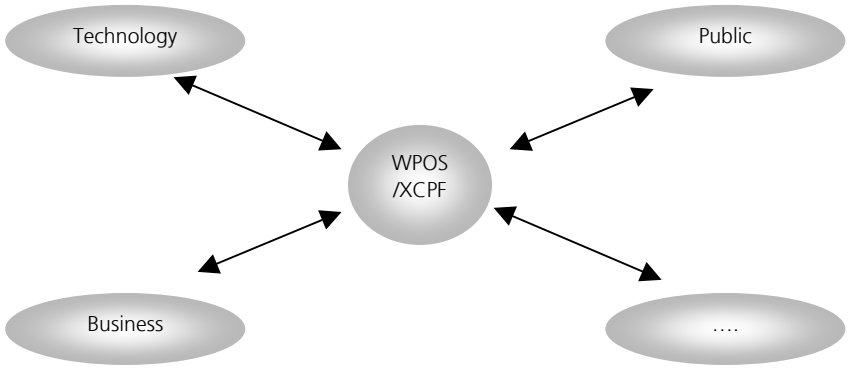


Figure 48 Multiples points of view for a conclusion

8.1 Representation of complex Pricing Models

The approach to representing complex business price models as digital, machine-readable and generic mathematical formulae is successful even for very complex business price models. The proof-of-concept was the development of the applications, shown in chapter 7.
The XML Configuration & Pricing Format (XCFP) contains more than 100 elements. The machine-readable elements need an exact encoding and cannot be expressed with XML schema. Therefore the use of validation tools helps in the case of many products. The relationships between configuration parameters in the same product may need some enhancements, which should be expressed in a future XCPF encoding version.

A standardization process just beginning may harmonize some names of the XCPF format, but the mechanism is stable and capable.

8.2 Transaction

The Web Pricing & Ordering Service (WPOS) was derived for the transaction. The façade interface and the protocol manipulation layering method solved the protocol-chaining problem. This approach can give a general method for service chaining, where protocols interfere. The concept also shows an elegant way of retrieving unknown façades with registry entries.
The encoding of the request with HTTP GET is limited. Therefore and for the support of HTTP POST application protocols, the development of a HTTP POST profile for WPOS is recommended.

8.3 Open Questions

An interoperable business service needs an interoperable authentication and authorization (WAAS) service. It seems that the protocol manipulation layering method can be used in analog mode for the problematic authorization functionalities.
The processing of basic SDI services, e.g. WPOS and WAAS, need to be declared in a machine-readable Meta-data description. The current ISO 19115 encoding is not sufficient and has to be extended.
The back-office interfaces of a WPOS implementation could be specified from some further research. There is an unpublished interface specification from the Geobroker project, which offers sufficient concepts for a discussion.

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Index

A Example Series

A.1.1 WPOS with Unknown Service Request

A.1.2 HTTP GET Request GetCapabilities

Service=WPOS&Request=getCapabilities

A.1.3 GetCapabilities Response

```
<?xml version="1.0" encoding="UTF-8"?>
<WPOS_Capabilities version="0.2.0" updateSequence="0">
    <Service>
        <Name>WPOS</Name>
        <Title>Web Pricing and Ordering Service</Title>
        <Abstract>Service for the configuration, pricing and ordering of geo products</Abstract>
        <KeywordList>
            <Keyword>price</Keyword>
            <Keyword>pricing</Keyword>
            <Keyword>order</Keyword>
        </KeywordList>
        <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple" xlink:href="http://www.geo-
ebusiness.de"/>
        <ContactInformation>
            <ContactPersonPrimary>
                <ContactPerson>Roland Wagner</ContactPerson>
                <ContactOrganization>Fraunhofer ISST</ContactOrganization>
            </ContactPersonPrimary>
            <ContactPosition>Scientific Assistant</ContactPosition>
            <ContactAddress>
                <AddressType>postal</AddressType>
                <Address>Fraunhofer ISST Emil-Figge-Str. 91</Address>
                <City>Dortmund</City>
                <StateOrProvince>NRW</StateOrProvince>
                <PostCode>44227</PostCode>
                <Country>Germany</Country>
            </ContactAddress>
            <ContactVoiceTelephone>+49 231 97 677 310</ContactVoiceTelephone>
            <ContactFacsimileTelephone>+49 231 97677 198 </ContactFacsimileTelephone>
            <ContactElectronicMailAddress>Roland.Wagner@isst.fhg.de</ContactElectronicMailAddress>
        </ContactInformation>
        <Fees>none</Fees>
        <AccessConstraints>Yes</AccessConstraints>
    </Service>
    <Capability>
        <Request>
            <GetCapabilities>
                <Format>only text</Format>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetCapabilities>
            <GetPricingModel>
                <Format>only text</Format>
                <DCPType>
                    <HTTP>
```

```
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetPricingModel>
            <GetPrice>
                <Format>only text</Format>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetPrice>
            <OrderProduct>
                <Format>only text</Format>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </OrderProduct>
            <GetProduct>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetProduct>
            <GetOrderList>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
xlink:href="http://127.0.0.1:8761/wpos/servlet/wpos.Controller?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetOrderList>
        </Request>
        <Exception>
            <Format>application/vnd.ogc.se_xml</Format>
        </Exception>
        <productGroup id="LVermA Brandenburg" name="Leistungs- und Entgeltverzeichnis von  LGB (Landesvermessung und
Geobasisinformation Brandenburg)">
            <productGroup id="1" name="">
                <product id="1513" name="Demodata A"/>
                <product id="1012" name="Demodata B"/>
            </productGroup>
            <productGroup id="2" name="">
                <product id="505" name="Demodata C"/>
            </productGroup>
        </productGroup>
        <VendorSpecificCapabilities/>
    </Capability>
</WPOS_Capabilities>
```

A.1.4 HTTP GET GetPriceModel Request

REQUEST=GetPriceModel&PRODUCTID=1513,1012

A.1.5 GetPriceModel Response XCPF

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.1 U (http://www.xmlspy.com) by Hr. Wagner (Fraunhofer Institut Software u. Systemtechnik) -->
<xcpfEnvelope id="de.lverma-bbEnvelope">
    <calculation>
        <declarationList>
            <referencedParameters>
                <parameter name="singlePrice" type="real">
                    <variableDescr lang="de">Preis</variableDescr>
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
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            </resultParameters>
        </declarationList>
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                </inParameterList>
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            </function>
        </formulae>
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                            <name2/>
                            <contact>Kundendienst</contact>
                            <street>Am Vermessungsamt 1</street>
```

```
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
                </address>
            </supplier>
            <licensing licensingCat="de.lverma-bb">
                <rightsOfUse>
```

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```
                </rightsOfUse>
                    <copyright>
```

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```
                </copyright>
                    <devolution>
```

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```
                </devolution>
                    <duties>
```

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```
                </duties>
                    <warranty>
```

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Richtigkeit und Vollst igkeit nicht gew leisten.

```
                </warranty>
                    <generalProvisions>
```

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Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
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```
                </generalProvisions>
                    <jurisdiction>
```

Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.

```
                </jurisdiction>
                </licensing>
            </contractInformation>
        </inheritance>
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            </referencedParameters>
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                    </variableUnit>
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            </resultParameters>
        </declarationList>
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                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci>price</ci>
                            <apply>
                                <sum/>
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                                <ci>singlePrice</ci>
                                <!--ci>singlePrice</ci-->
                            </apply>
                        </apply>
                    </math>
                </operation>
            </function>
        </formulae>
    </calculation>
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                <supplierName>Landesvermessungsamt Brandenburg</supplierName>
                <address role="supplier">
                    <name>Landesvermessungsamt Brandenburg</name>
                    <name2/>
                    <contact>Kundendienst</contact>
                    <street>Am Vermessungsamt 1</street>
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
                </address>
            </supplier>
```

```
                <licensing licensingCat="de.lverma-bb">
                    <rightsOfUse>
```
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```
    </rightsOfUse>
                    <copyright>
```
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```
    </copyright>
                    <devolution>
```
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```
    </devolution>
                    <duties>
```
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```
    </duties>
                    <warranty>
```
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Richtigkeit und Vollst igkeit nicht gew leisten.
```
    </warranty>
                    <generalProvisions>
```
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```
    </generalProvisions>
                    <jurisdiction>
```
Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.
```
    </jurisdiction>
                </licensing>
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                                </math>
```

```
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            </referencedParameters>
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                        </math>
                    </variableUnit>
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            </resultParameters>
        </declarationList>
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        </formulae>
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                <address role="supplier">
                    <name>Landesvermessungsamt Brandenburg</name>
                    <name2/>
                    <contact>Kundendienst</contact>
                    <street>Am Vermessungsamt 1</street>
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
                </address>
            </supplier>
            <licensing licensingCat="de.lverma-bb">
                <rightsOfUse>
```

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<copyright>
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</copyright>
<devolution>
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</devolution>
<duties>
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</duties>
<warranty>
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<generalProvisions>
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<jurisdiction>
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</jurisdiction>
</licensing>
</contractInformation>
<calculation>
<declarationList>
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</math>
</variableUnit>
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</predefinedParameters>
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                </math>
            </variableUnit>
        </parameter>
        <parameter name="ArtikelName" type="string">
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                </math>
            </variableUnit>
        </parameter>
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            <variableDescr lang="de"> Anzahl der Punkte </variableDescr>
            <variableDescr lang="en">Number of Points</variableDescr>
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            <variableDescr lang="en">Surface</variableDescr>
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```

```
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                    </function>
                </formulae>
            </calculation>
        </product>
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            <abstract>Demodata</abstract>
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                    <supplierId>de.lverma-bb</supplierId>
                    <supplierName>Landesvermessungsamt Brandenburg</supplierName>
                    <address role="supplier">
                        <name>Landesvermessungsamt Brandenburg</name>
```

```
                    <name2/>
                    <contact>Kundendienst</contact>
                    <street>Am Vermessungsamt 1</street>
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
                </address>
            </supplier>
            <licensing licensingCat="de.lverma-bb">
                <rightsOfUse>
```


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```
</rightsOfUse>
                <copyright>
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```
</copyright>
                <devolution>
```


Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.


```
</devolution>
                <duties>
```


Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten.
Die Nutzung der Daten im Internet gestattet ISST der Parnerfirma unter folgenden Voraussetzungen :
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- Link auf die Homepage vom ISST : www.isst.fhg.de
- Schutz der Daten gegen Auslesen / Downloaden

Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.


```
</duties>
                <warranty>
```


Das ISST garantiert nicht, dass die Datenprodukte den Bed□sen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte
u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.


```
</warranty>
                <generalProvisions>
```


Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die G□eit der □n
Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird.
M□he Nebenabreden haben die Parteien nicht getroffen. S liche erungen und Erg ungen dieser Vereinbarung bef□der Schriftform.
Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.


```
</generalProvisions>
                <jurisdiction>
```


Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.


```
</jurisdiction>
            </licensing>
        </contractInformation>
        <calculation>
            <declarationList>
                <predefinedParameters>
```

```
        <parameter name="kindofproduct" type="string">
            <variableDescr lang="de">Art des Produkts</variableDescr>
            <variableDescr lang="en">Kind of Product</variableDescr>
            <variableValue>analog</variableValue>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <divide/>
                        <ci>Euro</ci>
                        <ci>Punkt</ci>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="pricePerBlatt" type="real">
            <variableDescr lang="de"> Preis pro Blatt</variableDescr>
            <variableDescr lang="en"> Price per Page</variableDescr>
            <variableValue>20.45</variableValue>
            <variableUnit textstyle="Euro/Punkt">
                <math>
                    <apply>
                        <divide/>
                        <ci>Euro</ci>
                        <ci>Punkt</ci>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
    </predefinedParameters>
    <configurationParameters>
        <parameter name="ArtikelID" type="string">
            <variableDescr lang="de">ArtikelID</variableDescr>
            <variableDescr lang="en">ArticelID</variableDescr>
            <variableValue/>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="ArtikelName" type="string">
            <variableDescr lang="de">ArtikelName</variableDescr>
            <variableDescr lang="en">Articelname</variableDescr>
            <variableValue/>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="Polygon" type="string">
            <variableGroup>server</variableGroup>
            <variableDescr lang="de">Polygon</variableDescr>
            <variableDescr lang="en">Polygon</variableDescr>
            <variableValue/>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="Area" type="real">
            <variableGroup>server</variableGroup>
            <variableDescr lang="de">Fl  e</variableDescr>
            <variableDescr lang="en">Surface</variableDescr>
```

```
                    <variableValue/>
                    <variableUnit textstyle="m²">
                        <math>
                            <apply>
                                <power/>
                                <ci>m</ci>
                                <cn>2</cn>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
                <parameter name="Punktanzahl" type="integer">
                    <variableGroup>server</variableGroup>
                    <variableDescr lang="de">Anzahl der Punkte </variableDescr>
                    <variableDescr lang="en">Number of Points </variableDescr>
                    <variableValue/>
                    <variableUnit textstyle="">
                        <math>
                            <apply>
                                <cn>1</cn>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
                <parameter name="Blaetteranzahl" type="integer">
                    <variableGroup>server</variableGroup>
                    <variableDescr lang="de">Anzahl der Blaetter </variableDescr>
                    <variableDescr lang="en">Number of Pages</variableDescr>
                    <variableValue/>
                    <variableUnit textstyle="">
                        <math>
                            <apply>
                                <cn>1</cn>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </configurationParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de">Preis </variableDescr>
                    <variableDescr lang="en">Price </variableDescr>
                    <variableValue/>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Hauptformel20">
                <outParameterList>
                    <parameterName>Blaetteranzahl</parameterName>
                    <parameterName>pricePerBlatt</parameterName>
                    <parameterName>Punktanzahl</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci> price </ci>
                            <apply>
                                <times/>
```

```
                                        <ci>pricePerBlatt</ci>
                                        <ci>Blaetteranzahl</ci>
                                        <ci>Punktanzahl</ci>
                                    </apply>
                                </apply>
                            </math>
                        </operation>
                    </function>
                </formulae>
            </calculation>
        </product>
    </productGroup>
</productGroup>
</xcpfCatalog>
</xcpfEnvelope>
```

A.1.6 HTTP GET GetPrice Request

REQUEST=GetPrice&**PRODUCTID**=1513,1012&**SERVICEREQUEST**=,&**CONFIGPARAMS**=ArtikelID%3D1513%26Polygon%3D330850%3A5763900%2C3330950%3A5763900%2C3330950%3A5764000%2C3330850%3A5764000%2C3330850%3A576390%26Area%3D1000%26ArtikelName%3Dtest%26Punktanzahl%3D25,ArtikelID%3D1012%26Blaetteranzahl%3D3%26Polygon%3D3330850%3A5763900%2C3330950%3A5763900%2C3330950%3A5764000%2C3330850%3A5764000%2C3330850%3A576390%26Area%3D1000%26ArtikelName%3D test%26Punktanzahl%3D25 **SERVICEPROTOCOL=**,

A.1.7 GetPrice Response XCPF

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.1 U (http://www.xmlspy.com) by Hr. Wagner (Fraunhofer Institut Software u. Systemtechnik) -->
<xcpfEnvelope id="de.lverma-bbEnvelope">
    <calculation>
        <declarationList>
            <referencedParameters>
                <parameter name="singlePrice" type="real">
                    <variableDescr lang="de">Preis</variableDescr>
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </referencedParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de"> Preis </variableDescr>
                    <variableValue>2162.77</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Gesamtsumme">
                <outParameterList>
                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci>price</ci>
                            <apply>
                                <sum/>
                                <bvar>singlePrice</bvar>
                                <ci>singlePrice</ci>
                                <!--ci>singlePrice</ci-->
```

```
                        </apply>
                    </apply>
                </math>
            </operation>
        </function>
    </formulae>
</calculation>
<xcpfCatalog id="de.lverma-bbCatalog">
    <calculation>
        <declarationList>
            <referencedParameters>
                <parameter name="singlePrice" type="real">
                    <variableDescr lang="de">Preis</variableDescr>
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </referencedParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de"> Preis </variableDescr>
                    <variableValue>2162.77</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Gesamtsumme">
                <outParameterList>
                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci>price</ci>
                            <apply>
                                <sum/>
                                <bvar>singlePrice</bvar>
                                <ci>singlePrice</ci>
                                <!--ci>singlePrice</ci-->
                            </apply>
                        </apply>
                    </math>
                </operation>
            </function>
        </formulae>
    </calculation>
    <productGroup id="LVermA Brandenburg" name="">
        <generatorInfo>Roland Wagner</generatorInfo>
        <xcpfVer>0.3.0</xcpfVer>
        <title>Leistungs- und Entgeltverzeichnis von LGB (Landesvermessung und Geobasisinformation
Brandenburg)</title>
        <abstract/>
```

```
<inheritance>
    <contractInformation>
        <supplier>
            <supplierId>de.lverma-bb</supplierId>
            <supplierName>Landesvermessungsamt Brandenburg</supplierName>
            <address role="supplier">
                <name>Landesvermessungsamt Brandenburg</name>
                <name2/>
                <contact>Kundendienst</contact>
                <street>Am Vermessungsamt 1</street>
                <zip>44227</zip>
                <city>Potsdam</city>
                <country>Germany</country>
                <phone>+49 231 97 00 7 00</phone>
                <fax>+49 231 97 00 798</fax>
                <email>info@lverm-bb.de</email>
                <url>http://www.lverm-bb.de</url>
            </address>
        </supplier>
        <licensing licensingCat="de.lverma-bb">
            <rightsOfUse>
```

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Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.

```
</rightsOfUse>
            <copyright>
```

Das ISST versichert, dass an den von ISST zur Verf□gestellten Daten keine Rechte Dritter im Sinner eines
Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Anspr□Dritter frei.
Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.

```
</copyright>
            <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
</devolution>
            <duties>
```

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Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.

```
</duties>
            <warranty>
```

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u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
</warranty>
            <generalProvisions>
```

Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die G□eit der □n
Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird.
M□he Nebenabreden haben die Parteien nicht getroffen. S liche erungen und Erg ungen dieser Vereinbarung bef□der Schriftform.
Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.

```
</generalProvisions>
            <jurisdiction>
```

```
    Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.
</jurisdiction>
                    </licensing>
                </contractInformation>
            </inheritance>
            <calculation>
                <declarationList>
                    <referencedParameters>
                        <parameter name="singlePrice" type="real">
                            <variableDescr lang="de">Preis</variableDescr>
                            <variableOrigin originName="price">
                                <originId>*</originId>
                            </variableOrigin>
                            <variableValue>2</variableValue>
                            <variableUnit textstyle="Euro">
                                <math>
                                    <apply>
                                        <ci>Euro</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                    </referencedParameters>
                    <resultParameters>
                        <parameter name="price" type="real">
                            <variableDescr lang="de"> Preis </variableDescr>
                            <variableValue>2162.77</variableValue>
                            <variableUnit textstyle="Euro">
                                <math>
                                    <apply>
                                        <ci>Euro</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                    </resultParameters>
                </declarationList>
                <formulae>
                    <function name="Gesamtsumme">
                        <outParameterList>
                            <parameterName>singlePrice</parameterName>
                        </outParameterList>
                        <inParameterList>
                            <parameterName>price</parameterName>
                        </inParameterList>
                        <operation>
                            <math>
                                <apply>
                                    <eq/>
                                    <ci>price</ci>
                                    <apply>
                                        <sum/>
                                        <bvar>singlePrice</bvar>
                                        <ci>singlePrice</ci>
                                        <!--ci>singlePrice</ci-->
                                    </apply>
                                </apply>
                            </math>
                        </operation>
                    </function>
                </formulae>
            </calculation>
            <productGroup id="1" name="Geodaetische Basisdaten">
                <contractInformation>
                    <supplier>
                        <supplierId>de.lverma-bb</supplierId>
                        <supplierName>Landesvermessungsamt Brandenburg</supplierName>
                        <address role="supplier">
                            <name>Landesvermessungsamt Brandenburg</name>
                            <name2/>
                            <contact>Kundendienst</contact>
```

```
                    <street>Am Vermessungsamt 1</street>
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
                </address>
            </supplier>
            <licensing licensingCat="de.lverma-bb">
                <rightsOfUse>
```

Die Institution ISST gew t der Partnerfirma eine unbefristete, nicht ausschliessliche, eingeschr te Nutzung.
Hierzu r t das ISST einer Partnerfirma das Recht ein, die Demodaten in Datenbanken zu speichern, zu bearbeiten,
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Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.

```
                </rightsOfUse>
                <copyright>
```

Das ISST versichert, dass an den von ISST zur Verf□gestellten Daten keine Rechte Dritter im Sinner eines
Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Anspr□Dritter frei.
Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.

```
                </copyright>
                <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
                </devolution>
                <duties>
```

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```
                </duties>
                <warranty>
```

Das ISST garantiert nicht, dass die Datenprodukte den Bed□sen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte
u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
                </warranty>
                <generalProvisions>
```

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```
                </generalProvisions>
                <jurisdiction>
```

Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.

```
                </jurisdiction>
            </licensing>
        </contractInformation>
        <calculation>
            <declarationList>
                <referencedParameters>
                    <parameter name="singlePrice" type="real">
                        <variableDescr lang="de">Preis</variableDescr>
```

```
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </referencedParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de"> Preis </variableDescr>
                    <variableValue>2162.77</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Gesamtsumme">
                <outParameterList>
                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci>price</ci>
                            <apply>
                                <sum/>
                                <bvar>singlePrice</bvar>
                                <ci>singlePrice</ci>
                                <!--ci>singlePrice</ci-->
                            </apply>
                        </apply>
                    </math>
                </operation>
            </function>
        </formulae>
    </calculation>
    <product id="1513">
        <title>Demodata A</title>
        <abstract>Demodata</abstract>
        <contractInformation>
            <supplier>
                <supplierId>de.lverma-bb</supplierId>
                <supplierName>Landesvermessungsamt Brandenburg</supplierName>
                <address role="supplier">
                    <name>Landesvermessungsamt Brandenburg</name>
                    <name2/>
                    <contact>Kundendienst</contact>
                    <street>Am Vermessungsamt 1</street>
                    <zip>44227</zip>
                    <city>Potsdam</city>
                    <country>Germany</country>
                    <phone>+49 231 97 00 7 00</phone>
                    <fax>+49 231 97 00 798</fax>
                    <email>info@lverm-bb.de</email>
                    <url>http://www.lverm-bb.de</url>
```

```
                    </address>
                </supplier>
                <licensing licensingCat="de.lverma-bb">
                    <rightsOfUse>
```

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```
    </rightsOfUse>
                    <copyright>
```

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```
    </copyright>
                    <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
    </devolution>
                    <duties>
```

Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten.
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- Link auf die Homepage vom ISST : www.isst.fhg.de
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Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.

```
    </duties>
                    <warranty>
```

Das ISST garantiert nicht, dass die Datenprodukte den Bed□sen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte
u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
    </warranty>
                    <generalProvisions>
```

Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die G□eit der □n
Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird.
M□he Nebenabreden haben die Parteien nicht getroffen. S liche erungen und Erg ungen dieser Vereinbarung bef□der Schriftform.
Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.

```
    </generalProvisions>
                    <jurisdiction>
```

Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.

```
    </jurisdiction>
                </licensing>
            </contractInformation>
            <calculation>
                <declarationList>
                    <predefinedParameters>
                        <parameter name="pricePerPunkt" type="real">
                            <variableDescr lang="de"> Preis pro Punkt</variableDescr>
                            <variableDescr lang="en"> Price per Point</variableDescr>
                            <variableValue>15.34</variableValue>
                            <variableUnit textstyle="Euro/Punkt">
                                <math>
                                    <apply>
                                        <divide/>
                                        <ci>Euro</ci>
                                        <ci>Punkt</ci>
```

```
                    </apply>
                </math>
            </variableUnit>
        </parameter>
    </predefinedParameters>
    <configurationParameters>
        <parameter name="ArtikelID" type="string">
            <variableDescr lang="de">ArtikelID</variableDescr>
            <variableDescr lang="en">ArticelID</variableDescr>
            <variableValue>1513</variableValue>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="ArtikelName" type="string">
            <variableDescr lang="de">ArtikelName</variableDescr>
            <variableDescr lang="en">Articelname</variableDescr>
            <variableValue>test</variableValue>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="Punktanzahl" type="integer">
            <variableGroup>server</variableGroup>
            <variableDescr lang="de"> Anzahl der Punkte </variableDescr>
            <variableDescr lang="en">Number of Points</variableDescr>
            <variableValue>25</variableValue>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="Polygon" type="string">
            <variableGroup>server</variableGroup>
            <variableDescr lang="de">Polygon</variableDescr>
            <variableDescr lang="en">Polygon</variableDescr>

<variableValue>3330850:5763900,3330950:5763900,3330950:5764000,3330850:5764000,3330850:576390</variableValue>
            <variableUnit textstyle="">
                <math>
                    <apply>
                        <cn>1</cn>
                    </apply>
                </math>
            </variableUnit>
        </parameter>
        <parameter name="Area" type="real">
            <variableGroup>server</variableGroup>
            <variableDescr lang="de">Fl  e</variableDescr>
            <variableDescr lang="en">Surface</variableDescr>
            <variableValue>1000</variableValue>
            <variableUnit textstyle="m²">
                <math>
                    <apply>
                        <power/>
                        <ci>m</ci>
                        <cn>2</cn>
                    </apply>
                </math>
            </variableUnit>
```

```
                    </parameter>
                </configurationParameters>
                <resultParameters>
                    <parameter name="price" type="real">
                        <variableDescr lang="de"> Preis </variableDescr>
                        <variableDescr lang="en">Price</variableDescr>
                        <variableValue>629.02</variableValue>
                        <variableUnit textstyle="Euro">
                            <math>
                                <apply>
                                    <ci>Euro</ci>
                                </apply>
                            </math>
                        </variableUnit>
                    </parameter>
                </resultParameters>
            </declarationList>
            <formulae>
                <function name="Hauptformel19">
                    <outParameterList>
                        <parameterName>Punktanzahl</parameterName>
                        <parameterName>pricePerPunkt</parameterName>
                    </outParameterList>
                    <inParameterList>
                        <parameterName>price</parameterName>
                    </inParameterList>
                    <operation>
                        <math>
                            <apply>
                                <eq/>
                                <ci> price </ci>
                                <piecewise>
                                    <piece>
                                        <apply>
                                            <times/>
                                            <cn>15.34</cn>
                                            <ci>Punktanzahl</ci>
                                        </apply>
                                        <apply>
                                            <lt/>
                                            <ci>Punktanzahl</ci>
                                            <cn>2</cn>
                                        </apply>
                                    </piece>
                                    <otherwise>
                                        <apply>
                                            <plus/>
                                            <apply>
                                                <times/>
                                                <cn>15.34</cn>
                                                <ci>Punktanzahl</ci>
                                            </apply>
                                            <apply>
                                                <times/>
                                                <cn>10.23</cn>
                                                <apply>
                                                    <minus/>
                                                    <ci>Punktanzahl</ci>
                                                    <cn>1</cn>
                                                </apply>
                                            </apply>
                                        </apply>
                                    </otherwise>
                                </piecewise>
                            </apply>
                        </math>
                    </operation>
                </function>
            </formulae>
        </calculation>
    </product>
```

```
<product id="1012">
    <title>Demodata B</title>
    <abstract>Demodata</abstract>
    <contractInformation>
        <supplier>
            <supplierId>de.lverma-bb</supplierId>
            <supplierName>Landesvermessungsamt Brandenburg</supplierName>
            <address role="supplier">
                <name>Landesvermessungsamt Brandenburg</name>
                <name2/>
                <contact>Kundendienst</contact>
                <street>Am Vermessungsamt 1</street>
                <zip>44227</zip>
                <city>Potsdam</city>
                <country>Germany</country>
                <phone>+49 231 97 00 7 00</phone>
                <fax>+49 231 97 00 798</fax>
                <email>info@lverm-bb.de</email>
                <url>http://www.lverm-bb.de</url>
            </address>
        </supplier>
        <licensing licensingCat="de.lverma-bb">
            <rightsOfUse>
```

Die Institution ISST gew t der Partnerfirma eine unbefristete, nicht ausschliessliche, eingeschr te Nutzung.
Hierzu r t das ISST einer Partnerfirma das Recht ein, die Demodaten in Datenbanken zu speichern, zu bearbeiten,
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Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.

```
            </rightsOfUse>
                <copyright>
```

Das ISST versichert, dass an den von ISST zur Verf□gestellten Daten keine Rechte Dritter im Sinner eines
Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Anspr□Dritter frei.
Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.

```
            </copyright>
                <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
            </devolution>
                <duties>
```

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```
            </duties>
                <warranty>
```

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u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
            </warranty>
                <generalProvisions>
```

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Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
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Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.

```
</generalProvisions>
                    <jurisdiction>
    Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.
</jurisdiction>
                </licensing>
            </contractInformation>
            <calculation>
                <declarationList>
                    <predefinedParameters>
                        <parameter name="kindofproduct" type="string">
                            <variableDescr lang="de">Art des Produkts</variableDescr>
                            <variableDescr lang="en">Kind of Product</variableDescr>
                            <variableValue>analog</variableValue>
                            <variableUnit textstyle="">
                                <math>
                                    <apply>
                                        <divide/>
                                        <ci>Euro</ci>
                                        <ci>Punkt</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                        <parameter name="pricePerBlatt" type="real">
                            <variableDescr lang="de"> Preis pro Blatt</variableDescr>
                            <variableDescr lang="en"> Price per Page</variableDescr>
                            <variableValue>20.45</variableValue>
                            <variableUnit textstyle="Euro/Punkt">
                                <math>
                                    <apply>
                                        <divide/>
                                        <ci>Euro</ci>
                                        <ci>Punkt</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                    </predefinedParameters>
                    <configurationParameters>
                        <parameter name="ArtikelID" type="string">
                            <variableDescr lang="de">ArtikelID</variableDescr>
                            <variableDescr lang="en">ArticelID</variableDescr>
                            <variableValue>1012</variableValue>
                            <variableUnit textstyle="">
                                <math>
                                    <apply>
                                        <cn>1</cn>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                        <parameter name="ArtikelName" type="string">
                            <variableDescr lang="de">ArtikelName</variableDescr>
                            <variableDescr lang="en">Articelname</variableDescr>
                            <variableValue>test</variableValue>
                            <variableUnit textstyle="">
                                <math>
                                    <apply>
                                        <cn>1</cn>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                        <parameter name="Polygon" type="string">
                            <variableGroup>server</variableGroup>
                            <variableDescr lang="de">Polygon</variableDescr>
                            <variableDescr lang="en">Polygon</variableDescr>

  <variableValue>3330850:5763900,3330950:5763900,3330950:5764000,3330850:5764000,3330850:576390</variableValue>
                            <variableUnit textstyle="">
                                <math>
```

```
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Area" type="real">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Fl  e</variableDescr>
                <variableDescr lang="en">Surface</variableDescr>
                <variableValue>1000</variableValue>
                <variableUnit textstyle="m²">
                    <math>
                        <apply>
                            <power/>
                            <ci>m</ci>
                            <cn>2</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Punktanzahl" type="integer">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Anzahl der Punkte </variableDescr>
                <variableDescr lang="en">Number of Points </variableDescr>
                <variableValue>25</variableValue>
                <variableUnit textstyle="">
                    <math>
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Blaetteranzahl" type="integer">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Anzahl der Blaetter </variableDescr>
                <variableDescr lang="en">Number of Pages</variableDescr>
                <variableValue>3</variableValue>
                <variableUnit textstyle="">
                    <math>
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
        </configurationParameters>
        <resultParameters>
            <parameter name="price" type="real">
                <variableDescr lang="de">Preis </variableDescr>
                <variableDescr lang="en">Price </variableDescr>
                <variableValue>1533.75</variableValue>
                <variableUnit textstyle="Euro">
                    <math>
                        <apply>
                            <ci>Euro</ci>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
        </resultParameters>
    </declarationList>
    <formulae>
        <function name="Hauptformel20">
            <outParameterList>
                <parameterName>Blaetteranzahl</parameterName>
                <parameterName>pricePerBlatt</parameterName>
                <parameterName>Punktanzahl</parameterName>
            </outParameterList>
            <inParameterList>
```

```
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci> price </ci>
                            <apply>
                                <times/>
                                <ci>pricePerBlatt</ci>
                                <ci>BlaetteranzahI</ci>
                                <ci>PunktanzahI</ci>
                            </apply>
                        </apply>
                    </math>
                </operation>
            </function>
        </formulae>
    </calculation>
</product>
</productGroup>
</productGroup>
</xcpfCatalog>
</xcpfEnvelope>
```

A.1.8 HTTP GET OrderProduct Request

```
REQUEST=OrderProduct&PRODUCTID=1513,1012&SERVICEREQUEST=,&CONFIGPARAMS=Art
ikelID%3D1513%26Polygon%3D330850%3A5763900%2C3330950%3A5763900%2C3330950%3
A5764000%2C3330850%3A5764000%2C3330850%3A576390%26Area%3D1000%26ArtikelNam
e%3Dtest%26Punktanzahl%3D25,ArtikelID%3D1012%26Blaetteranzahl%3D3%26Polygo
n%3D3330850%3A5763900%2C3330950%3A5763900%2C3330950%3A5764000%2C3330850%3A
5764000%2C3330850%3A576390%26Area%3D1000%26ArtikelName%3D
test%26Punktanzahl%3D25 SERVICEPROTOCOL=,&DEFNAME1=Wagner&DEFSTREET=Emil-
Figge-Str.91&DEFZIP=44227&DEFCITY=Dortmund&DEFMAIL=w@gner.org
```

A.1.9 OrderProduct Response XCPF

```
<?xml version="1.0" encoding="UTF-8"?>
<xcpfEnvelope id="de.lverma-bbEnvelope">
    <calculation>
        <declarationList>
            <referencedParameters>
                <parameter name="singlePrice" type="real">
                    <variableDescr lang="de">Preis</variableDescr>
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </referencedParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de"> Preis </variableDescr>
                    <variableValue/>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Gesamtsumme">
                <outParameterList>
                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
                <operation>
                    <math>
                        <apply>
                            <eq/>
                            <ci>price</ci>
                            <apply>
                                <sum/>
                                <bvar>singlePrice</bvar>
                                <ci>singlePrice</ci>
```

```
                        <!--ci>singlePrice</ci-->
                    </apply>
                </apply>
            </math>
        </operation>
    </function>
</formulae>
</calculation>
<xcpfCatalog id="1351494981980061781">
    <transactionNumber>1351494981980061781</transactionNumber>
    <inheritance>
        <contractInformation>
            <customer>
                <customerId>1739384622094560325</customerId>
                <customerName/>
                <address role="customer" type="default">
                    <name>Roland M. Wagner</name>
                    <name2/>
                    <contact/>
                    <street>Emil-Figge-Strasse 91</street>
                    <zip>44227</zip>
                    <city>Dortmund</city>
                    <country/>
                    <phone/>
                    <fax/>
                    <email>wagner@do.isst.fhg.de</email>
                    <url/>
                </address>
            </customer>
        </contractInformation>
    </inheritance>
    <calculation>
        <declarationList>
            <referencedParameters>
                <parameter name="singlePrice" type="real">
                    <variableDescr lang="de">Preis</variableDescr>
                    <variableOrigin originName="price">
                        <originId>*</originId>
                    </variableOrigin>
                    <variableValue>2</variableValue>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </referencedParameters>
            <resultParameters>
                <parameter name="price" type="real">
                    <variableDescr lang="de"> Preis </variableDescr>
                    <variableValue/>
                    <variableUnit textstyle="Euro">
                        <math>
                            <apply>
                                <ci>Euro</ci>
                            </apply>
                        </math>
                    </variableUnit>
                </parameter>
            </resultParameters>
        </declarationList>
        <formulae>
            <function name="Gesamtsumme">
                <outParameterList>
                    <parameterName>singlePrice</parameterName>
                </outParameterList>
                <inParameterList>
                    <parameterName>price</parameterName>
                </inParameterList>
```

```
                    <operation>
                        <math>
                            <apply>
                                <eq/>
                                <ci>price</ci>
                                <apply>
                                    <sum/>
                                    <bvar>singlePrice</bvar>
                                    <ci>singlePrice</ci>
                                    <!--ci>singlePrice</ci-->
                                </apply>
                            </apply>
                        </math>
                    </operation>
                </function>
            </formulae>
        </calculation>
        <productGroup id="LVermA Brandenburg" name="">
            <generatorInfo>Roland Wagner</generatorInfo>
            <xcpfVer>0.3.0</xcpfVer>
            <title>Leistungs- und Entgeltverzeichnis von LGB (Landesvermessung und Geobasisinformation
Brandenburg)</title>
            <abstract/>
            <calculation>
                <declarationList>
                    <referencedParameters>
                        <parameter name="singlePrice" type="real">
                            <variableDescr lang="de">Preis</variableDescr>
                            <variableOrigin originName="price">
                                <originId>*</originId>
                            </variableOrigin>
                            <variableValue>2</variableValue>
                            <variableUnit textstyle="Euro">
                                <math>
                                    <apply>
                                        <ci>Euro</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                    </referencedParameters>
                    <resultParameters>
                        <parameter name="price" type="real">
                            <variableDescr lang="de"> Preis </variableDescr>
                            <variableValue/>
                            <variableUnit textstyle="Euro">
                                <math>
                                    <apply>
                                        <ci>Euro</ci>
                                    </apply>
                                </math>
                            </variableUnit>
                        </parameter>
                    </resultParameters>
                </declarationList>
                <formulae>
                    <function name="Gesamtsumme">
                        <outParameterList>
                            <parameterName>singlePrice</parameterName>
                        </outParameterList>
                        <inParameterList>
                            <parameterName>price</parameterName>
                        </inParameterList>
                        <operation>
                            <math>
                                <apply>
                                    <eq/>
                                    <ci>price</ci>
                                    <apply>
                                        <sum/>
                                        <bvar>singlePrice</bvar>
```

```
                                    <ci>singlePrice</ci>
                                    <!--ci>singlePrice</ci-->
                                </apply>
                            </apply>
                        </math>
                    </operation>
                </function>
            </formulae>
        </calculation>
        <productGroup id="1" name="Geodaetische Basisdaten">
            <contractInformation>
                <supplier>
                    <supplierId>de.lverma-bb</supplierId>
                    <supplierName>Landesvermessungsamt Brandenburg</supplierName>
                    <address role="supplier">
                        <name>Landesvermessungsamt Brandenburg</name>
                        <name2/>
                        <contact>Kundendienst</contact>
                        <street>Am Vermessungsamt 1</street>
                        <zip>44227</zip>
                        <city>Potsdam</city>
                        <country>Germany</country>
                        <phone>+49 231 97 00 7 00</phone>
                        <fax>+49 231 97 00 798</fax>
                        <email>info@lverm-bb.de</email>
                        <url>http://www.lverm-bb.de</url>
                    </address>
                </supplier>
                <licensing licensingCat="de.lverma-bb">
                    <rightsOfUse>
```

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```
                    </rightsOfUse>
                    <copyright>
```

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Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.

```
                    </copyright>
                    <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
                    </devolution>
                    <duties>
```

Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten.
Die Nutzung der Daten im Internet gestattet ISST der Parnerfirma unter folgenden Voraussetzungen :
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```
                    </duties>
                    <warranty>
```

Das ISST garantiert nicht, dass die Datenprodukte den Bed□sen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte
u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
                    </warranty>
                    <generalProvisions>
```

Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die G□eit der □n
Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird.
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Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.
</generalProvisions>
<jurisdiction>
Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.
</jurisdiction>

```
            </licensing>
        </contractInformation>
        <calculation>
            <declarationList>
                <referencedParameters>
                    <parameter name="singlePrice" type="real">
                        <variableDescr lang="de">Preis</variableDescr>
                        <variableOrigin originName="price">
                            <originId>*</originId>
                        </variableOrigin>
                        <variableValue>2</variableValue>
                        <variableUnit textstyle="Euro">
                            <math>
                                <apply>
                                    <ci>Euro</ci>
                                </apply>
                            </math>
                        </variableUnit>
                    </parameter>
                </referencedParameters>
                <resultParameters>
                    <parameter name="price" type="real">
                        <variableDescr lang="de"> Preis </variableDescr>
                        <variableValue/>
                        <variableUnit textstyle="Euro">
                            <math>
                                <apply>
                                    <ci>Euro</ci>
                                </apply>
                            </math>
                        </variableUnit>
                    </parameter>
                </resultParameters>
            </declarationList>
            <formulae>
                <function name="Gesamtsumme">
                    <outParameterList>
                        <parameterName>singlePrice</parameterName>
                    </outParameterList>
                    <inParameterList>
                        <parameterName>price</parameterName>
                    </inParameterList>
                    <operation>
                        <math>
                            <apply>
                                <eq/>
                                <ci>price</ci>
                                <apply>
                                    <sum/>
                                    <bvar>singlePrice</bvar>
                                    <ci>singlePrice</ci>
                                    <!--ci>singlePrice</ci-->
                                </apply>
                            </apply>
                        </math>
                    </operation>
                </function>
            </formulae>
        </calculation>
```

```
<product id="1012">
    <title>Demodata B</title>
    <abstract>Demodata</abstract>
    <contractInformation>
        <supplier>
            <supplierId>de.lverma-bb</supplierId>
            <supplierName>Landesvermessungsamt Brandenburg</supplierName>
            <address role="supplier">
                <name>Landesvermessungsamt Brandenburg</name>
                <name2/>
                <contact>Kundendienst</contact>
                <street>Am Vermessungsamt 1</street>
                <zip>44227</zip>
                <city>Potsdam</city>
                <country>Germany</country>
                <phone>+49 231 97 00 7 00</phone>
                <fax>+49 231 97 00 798</fax>
                <email>info@lverm-bb.de</email>
                <url>http://www.lverm-bb.de</url>
            </address>
        </supplier>
        <licensing licensingCat="de.lverma-bb">
            <rightsOfUse>
```


Die Institution ISST gew t der Partnerfirma eine unbefristete, nicht ausschliessliche, eingeschr te Nutzung.
Hierzu r t das ISST einer Partnerfirma das Recht ein, die Demodaten in Datenbanken zu speichern, zu bearbeiten,
zu kopieren und ausschliesslich im Internet zu nutzen.
Die Demodaten sind ausschliesslich zu eigenen Nutzung bestimmt. Der Erwerb oder Dienstleistung f□tte ist ausgeschlossen.
Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.

```
            </rightsOfUse>
                <copyright>
```

Das ISST versichert, dass an den von ISST zur Verf□gestellten Daten keine Rechte Dritter im Sinner eines
Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Anspr□Dritter frei.
Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.

```
            </copyright>
                <devolution>
```

Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu □agen, sofern dies nicht ausdr□h genhemigt ist.
F□ Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.

```
            </devolution>
                <duties>
```

Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten.
Die Nutzung der Daten im Internet gestattet ISST der Parnerfirma unter folgenden Voraussetzungen :
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- Link auf die Homepage vom ISST : www.isst.fhg.de
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Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.

```
            </duties>
                <warranty>
```

Das ISST garantiert nicht, dass die Datenprodukte den Bed□sen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte
u.a. auch aus □ntlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz st iger Vergleichskontrollen die
Richtigkeit und Vollst igkeit nicht gew leisten.

```
            </warranty>
                <generalProvisions>
```

Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die G□eit der □n
Bestimmungen nicht ber□Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten,
die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird.
M□he Nebenabreden haben die Parteien nicht getroffen. S liche erungen und Erg ungen dieser Vereinbarung bef□der Schriftform.
Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.

```
</generalProvisions>
                        <jurisdiction>
    Ist der Kunde Vollkaufmann, so wird f□e Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.
</jurisdiction>
                    </licensing>
                </contractInformation>
                <calculation>
                    <declarationList>
                        <predefinedParameters>
                            <parameter name="kindofproduct" type="string">
                                <variableDescr lang="de">Art des Produkts</variableDescr>
                                <variableDescr lang="en">Kind of Product</variableDescr>
                                <variableValue>analog</variableValue>
                                <variableUnit textstyle="">
                                    <math>
                                        <apply>
                                            <divide/>
                                            <ci>Euro</ci>
                                            <ci>Punkt</ci>
                                        </apply>
                                    </math>
                                </variableUnit>
                            </parameter>
                            <parameter name="pricePerBlatt" type="real">
                                <variableDescr lang="de"> Preis pro Blatt</variableDescr>
                                <variableDescr lang="en"> Price per Page</variableDescr>
                                <variableValue>20.45</variableValue>
                                <variableUnit textstyle="Euro/Punkt">
                                    <math>
                                        <apply>
                                            <divide/>
                                            <ci>Euro</ci>
                                            <ci>Punkt</ci>
                                        </apply>
                                    </math>
                                </variableUnit>
                            </parameter>
                        </predefinedParameters>
                        <configurationParameters>
                            <parameter name="ArtikelID" type="string">
                                <variableDescr lang="de">ArtikelID</variableDescr>
                                <variableDescr lang="en">ArticelID</variableDescr>
                                <variableValue>1012</variableValue>
                                <variableUnit textstyle="">
                                    <math>
                                        <apply>
                                            <cn>1</cn>
                                        </apply>
                                    </math>
                                </variableUnit>
                            </parameter>
                            <parameter name="ArtikelName" type="string">
                                <variableDescr lang="de">ArtikelName</variableDescr>
                                <variableDescr lang="en">Articelname</variableDescr>
                                <variableValue>test</variableValue>
                                <variableUnit textstyle="">
                                    <math>
                                        <apply>
                                            <cn>1</cn>
                                        </apply>
                                    </math>
                                </variableUnit>
                            </parameter>
                            <parameter name="Polygon" type="string">
                                <variableGroup>server</variableGroup>
                                <variableDescr lang="de">Polygon</variableDescr>
                                <variableDescr lang="en">Polygon</variableDescr>

  <variableValue>3330850:5763900,3330950:5763900,3330950:5764000,3330850:5764000,3330850:576390</variableValue>
                                <variableUnit textstyle="">
                                    <math>
```

```
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Area" type="real">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Fl  e</variableDescr>
                <variableDescr lang="en">Surface</variableDescr>
                <variableValue>1000</variableValue>
                <variableUnit textstyle="m²">
                    <math>
                        <apply>
                            <power/>
                            <ci>m</ci>
                            <cn>2</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Punktanzahl" type="integer">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Anzahl der Punkte </variableDescr>
                <variableDescr lang="en">Number of Points </variableDescr>
                <variableValue>25</variableValue>
                <variableUnit textstyle="">
                    <math>
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
            <parameter name="Blaetteranzahl" type="integer">
                <variableGroup>server</variableGroup>
                <variableDescr lang="de">Anzahl der Blaetter </variableDescr>
                <variableDescr lang="en">Number of Pages</variableDescr>
                <variableValue>3</variableValue>
                <variableUnit textstyle="">
                    <math>
                        <apply>
                            <cn>1</cn>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
        </configurationParameters>
        <resultParameters>
            <parameter name="price" type="real">
                <variableDescr lang="de">Preis </variableDescr>
                <variableDescr lang="en">Price </variableDescr>
                <variableValue/>
                <variableUnit textstyle="Euro">
                    <math>
                        <apply>
                            <ci>Euro</ci>
                        </apply>
                    </math>
                </variableUnit>
            </parameter>
        </resultParameters>
    </declarationList>
    <formulae>
        <function name="Hauptformel20">
            <outParameterList>
                <parameterName>Blaetteranzahl</parameterName>
                <parameterName>pricePerBlatt</parameterName>
                <parameterName>Punktanzahl</parameterName>
            </outParameterList>
```

```
                                <inParameterList>
                                    <parameterName>price</parameterName>
                                </inParameterList>
                                <operation>
                                    <math>
                                        <apply>
                                            <eq/>
                                            <ci> price </ci>
                                            <apply>
                                                <times/>
                                                <ci>pricePerBlatt</ci>
                                                <ci>Blaetteranzahl</ci>
                                                <ci>Punktanzahl</ci>
                                            </apply>
                                        </apply>
                                    </math>
                                </operation>
                            </function>
                        </formulae>
                    </calculation>
                </product>
            </productGroup>
        </productGroup>
    </xcpfCatalog>
</xcpfEnvelope>
```

A.2 WPOS with OGC WMS Service Request

A.2.1 HTTP GET GetPrice Request

```
http://azreal:8761/wpos/servlet/wpos.Controller?Request=getPrice&productId
=1005,http%3A%2F%2Fxtra.interactive-instruments.de%2Fcgi-
bin%2FXtraWMS&serviceRequest=,VERSION%3D1.1.0%26REQUEST%3DGetMap%26LAYERS%
3DStrassen%26STYLES%3DStandard%26SRS%3DEPSG%3A31466%26FORMAT%3Dimage%2Fpng
%26BGCOLOR%3D0xFFFFFF%26TRANSPARENT%3DFALSE%26WIDTH%3D514%26HEIGHT%3D426%2
6BBOX%3D2465148.7644131454%2C5576452%2C2764016.1155868545%2C5824151.4%26EX
CEPTIONS%3Dapplication%2Fvnd.ogc.se_xml&serviceProtocol=,Organisation%3DOG
C%26Name%3DWMS%26Version%3D1.0&Config=Area%3D1000%26xmax%3D3%26ymax%3D4%26
Polygon%3D3330850%3A5763900%2C3330950%3A5763900%2C3330950%3A5764000%2C3330
850%3A5764000%2C3330850%3A576390%26xmin%3D1%26ymin%3D2%26height%3D5%26widt
h%3D6,
```

A.2.2 XCPF Response Object

```
<?xml version="1.0" encoding="ISO-8859-1"?>

<xcpfEnvelope id="tms">
 <calculation>
  <declarationList>
   <referencedParameters>
    <parameter name="singlePrice" type="real">
     <variableDescr lang="de">Preis</variableDescr>
     <variableOrigin originName="price">
      <originId>*</originId>
     </variableOrigin>
     <variableValue>2</variableValue>
     <variableUnit textstyle="Euro">
      <math>
       <apply>
        <ci>Euro</ci>
       </apply>
      </math>
     </variableUnit>
    </parameter>
   </referencedParameters>
   <resultParameters>
    <parameter name="price" type="real">
     <variableDescr lang="de">Preis</variableDescr>
     <variableValue>986300.00</variableValue>
     <variableUnit textstyle="Euro">
      <math>
       <apply>
        <ci>Euro</ci>
       </apply>
      </math>
     </variableUnit>
    </parameter>
   </resultParameters>
  </declarationList>
  <formulae>
   <function name="Gesamtsumme">
    <outParameterList>
     <parameterName>singlePrice</parameterName>
    </outParameterList>
    <inParameterList>
     <parameterName>price</parameterName>
    </inParameterList>
    <operation>
```

```
      <math>
       <apply>
        <eq/>
        <ci>price</ci>
        <apply>
         <sum/>
         <bvar>singlePrice</bvar>
         <ci>singlePrice</ci>
         <!--ci>singlePrice</ci-->

        </apply>
       </apply>
      </math>
     </operation>
    </function>
   </formulae>
  </calculation>
  <xcpfCatalog id="tms">
   <calculation>
    <declarationList>
     <referencedParameters>
      <parameter name="singlePrice" type="real">
       <variableDescr lang="de">Preis</variableDescr>
       <variableOrigin originName="price">
        <originId>*</originId>
       </variableOrigin>
       <variableValue>2</variableValue>
       <variableUnit textstyle="Euro">
        <math>
         <apply>
          <ci>Euro</ci>
         </apply>
        </math>
       </variableUnit>
      </parameter>
     </referencedParameters>
     <resultParameters>
      <parameter name="price" type="real">
       <variableDescr lang="de">Preis</variableDescr>
       <variableValue>986300.00</variableValue>
       <variableUnit textstyle="Euro">
        <math>
         <apply>
          <ci>Euro</ci>
         </apply>
        </math>
       </variableUnit>
      </parameter>
     </resultParameters>
    </declarationList>
    <formulae>
     <function name="Gesamtsumme">
      <outParameterList>
       <parameterName>singlePrice</parameterName>
      </outParameterList>
      <inParameterList>
       <parameterName>price</parameterName>
      </inParameterList>
      <operation>
       <math>
        <apply>
         <eq/>
         <ci>price</ci>
         <apply>
          <sum/>
          <bvar>singlePrice</bvar>
          <ci>singlePrice</ci>
          <!--ci>singlePrice</ci-->

         </apply>
        </apply>
```

```
        </math>
       </operation>
      </function>
     </formulae>
    </calculation>
    <productGroup id="gdms" name="">
     <generatorInfo>Roland M Wagner</generatorInfo>
     <xcpfVer>0.4.3</xcpfVer>
     <title>Leistungs- und Entgeltverzeichnis von LGB (Landesvermessung und Geobasisinformation Brandenburg)</title>
     <abstract/>
     <inheritance>
      <contractInformation>
       <supplier>
        <supplierId>de.lverma-bb</supplierId>
        <supplierName>Landesvermessungsamt Brandenburg</supplierName>
        <address role="supplier">
         <name>Landesvermessungsamt Brandenburg</name>
         <name2/>
         <contact>Kundendienst</contact>
         <street>Am Vermessungsamt 1</street>
         <zip>44227</zip>
         <city>Potsdam</city>
         <country>Germany</country>
         <phone>+49 231 97 00 7 00</phone>
         <fax>+49 231 97 00 798</fax>
         <email>info@lverm-bb.de</email>
         <url>http://www.lverm-bb.de</url>
        </address>
       </supplier>
       <licensing licensingCat="de.lverma-bb">
        <rightsOfUse>Die Institution ISST gewährt der Partnerfirma eine unbefristete, nicht ausschliessliche, eingeschränkte Nutzung. Hierzu räumt das ISST einer Partnerfirma das Recht ein, die Demodaten in Datenbanken zu speichern, zu bearbeiten, zu kopieren und ausschliesslich im Internet zu nutzen. Die Demodaten sind ausschliesslich zu eigenen Nutzung bestimmt. Der Erwerb oder Dienstleistung für Dritte ist ausgeschlossen. Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.</rightsOfUse>
        <copyright>Das ISST versichert, dass an den von ISST zur Verfügung gestellten Daten keine Rechte Dritter im Sinner eines Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Ansprüchen Dritter frei. Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.</copyright>
        <devolution>Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu übertragen, sofern dies nicht ausdrücklich genhemigt ist. Für den Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.</devolution>
        <duties>Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten. Die Nutzung der Daten im Internet gestattet ISST der Parnerfirma unter folgenden Voraussetzungen : - Quellenangabe : © ? ? Jahr ? ? ISST, Berlin/Dortmund - Link auf die Homepage vom ISST : www.isst.fhg.de - Schutz der Daten gegen Auslesen / Downloaden Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.</duties>
        <warranty>Das ISST garantiert nicht, dass die Datenprodukte den Bedürfnissen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte u.a. auch aus öffentlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz ständiger Vergleichskontrollen die Richtigkeit und Vollständigkeit nicht gewährleisten.</warranty>
        <generalProvisions>Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die Gültigkeit der übrigen Bestimmungen nicht berührt. Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten, die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird. Mündliche Nebenabreden haben die Parteien nicht getroffen. Sämtliche änderungen und Ergänzungen dieser Vereinbarung befürfen der Schriftform. Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.</generalProvisions>
        <jurisdiction>Ist der Kunde Vollkaufmann, so wird für alle Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.</jurisdiction>
       </licensing>
      </contractInformation>
     </inheritance>
     <calculation>
      <declarationList>
       <referencedParameters>
        <parameter name="singlePrice" type="real">
         <variableDescr lang="de">Preis</variableDescr>
         <variableOrigin originName="price">
          <originId>*</originId>
         </variableOrigin>
         <variableValue>2</variableValue>
         <variableUnit textstyle="Euro">
```

```
          <math>
            <apply>
              <ci>Euro</ci>
            </apply>
          </math>
        </variableUnit>
      </parameter>
    </referencedParameters>
    <resultParameters>
      <parameter name="price" type="real">
        <variableDescr lang="de">Preis</variableDescr>
        <variableValue>986300.00</variableValue>
        <variableUnit textstyle="Euro">
          <math>
            <apply>
              <ci>Euro</ci>
            </apply>
          </math>
        </variableUnit>
      </parameter>
    </resultParameters>
  </declarationList>
  <formulae>
    <function name="Gesamtsumme">
      <outParameterList>
        <parameterName>singlePrice</parameterName>
      </outParameterList>
      <inParameterList>
        <parameterName>price</parameterName>
      </inParameterList>
      <operation>
        <math>
          <apply>
            <eq/>
            <ci>price</ci>
            <apply>
              <sum/>
              <bvar>singlePrice</bvar>
              <ci>singlePrice</ci>
              <!--ci>singlePrice</ci-->

            </apply>
          </apply>
        </math>
      </operation>
    </function>
  </formulae>
</calculation>
<product id="1005">
  <title>GDMS Demo</title>
  <abstract>GDMS Demo</abstract>
  <contractInformation>
    <supplier>
      <supplierId>de.lverma-bb</supplierId>
      <supplierName>Landesvermessungsamt Brandenburg</supplierName>
      <address role="supplier">
        <name>Landesvermessungsamt Brandenburg</name>
        <name2/>
        <contact>Kundendienst</contact>
        <street>Am Vermessungsamt 1</street>
        <zip>44227</zip>
        <city>Potsdam</city>
        <country>Germany</country>
        <phone>+49 231 97 00 7 00</phone>
        <fax>+49 231 97 00 798</fax>
        <email>info@lverm-bb.de</email>
        <url>http://www.lverm-bb.de</url>
      </address>
    </supplier>
    <licensing licensingCat="de.lverma-bb">
```

```
        <rightsOfUse>Die Institution ISST gewährt der Partnerfirma eine unbefristete, nicht ausschliessliche, eingeschränkte Nutzung. Hierzu räumt das ISST einer Partnerfirma das Recht ein, die Demodaten in Datenbanken zu speichern, zu bearbeiten, zu kopieren und ausschliesslich im Internet zu nutzen. Die Demodaten sind ausschliesslich zu eigenen Nutzung bestimmt. Der Erwerb oder Dienstleistung für Dritte ist ausgeschlossen. Die Nutzungsrechte beziehen sich ausschliesslich auf die Nutzing der o.g. Daten.</rightsOfUse>
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        <devolution>Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu übertragen, sofern dies nicht ausdrücklich genhemigt ist. Für den Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.</devolution>
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        <warranty>Das ISST garantiert nicht, dass die Datenprodukte den Bedürfnissen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte u.a. auch aus öffentlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz ständiger Vergleichskontrollen die Richtigkeit und Vollständigkeit nicht gewährleisten.</warranty>
        <generalProvisions>Sollte eine der vorstehenden Bestimmungen aus irgendeinem Rechtsgrund unwirksam sein, so wird dadurch die Gültigkeit der übrigen Bestimmungen nicht berührt. Die Parteien sind in diesem Falle verpflichtet, die unwirksame Bestimmung durch eine solche zu ersetzten, die den beiderseitigen Interessen und dem wirtschaftlichen Zweck weitestgehend gerecht wird. Mündliche Nebenabreden haben die Parteien nicht getroffen. Sämtliche änderungen und Ergänzungen dieser Vereinbarung befürfen der Schriftform. Auf alle Rechtsbeziehungen zu uns findet ausschliesslich deutsches Recht Anwendung.</generalProvisions>
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         <country>Germany</country>
         <phone>+49 231 97 00 7 00</phone>
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      <copyright>Das ISST versichert, dass an den von ISST zur Verfügung gestellten Daten keine Rechte Dritter im Sinner eines Datenbankurheberrechtsschutzes gem. § 87 a ff. UrhG bestehen. Das ISSt stellt der Partnerfirma insoweit von Ansprüchen Dritter frei. Sollte ein ordentliches Gericht oder ein gerichtlicher oder aussergerichtlicher Vergleich zu einer anderen Auffassung kommen, haftet das ISST nicht.</copyright>
      <devolution>Die Partnerfirma ist nicht berechtigt, Aufgaben und Pflichten aus dieser Vereinbarung auf Dritte zu übertragen, sofern dies nicht ausdrücklich genhemigt ist. Für den Fall der Zuwiderhandlung gegen das vorstehende Verbot hat die Partnerfirma ISST eine Vertragsstrafe von DM 50.000,- zu zahlen.</devolution>
      <duties>Die Parnerfirma verpflichtet sich, auf ihrer Homepage inen Link zur Homepage vom ISST dauerhaft einzurichten und aufrecht zu halten. Die Nutzung der Daten im Internet gestattet ISST der Parnerfirma unter folgenden Voraussetzungen : - Quellenangabe : © ? ? Jahr ? ? ISST, Berlin/Dortmund - Link auf die Homepage vom ISST : www.isst.fhg.de - Schutz der Daten gegen Auslesen / Downloaden Eine Weitergabe an Kunden zwecks Internetnutzung bedarf der vorherigen individuellen Vereinbarung mit dem ISST.</duties>
      <warranty>Das ISST garantiert nicht, dass die Datenprodukte den Bedürfnissen oder Erwartungen des Endnutzers entsprechen werden. Da die Datenprodukte u.a. auch aus öffentlichen Verzeichnissen und Registern zusammengestllt werden, kann das ISST trotz ständiger Vergleichskontrollen die Richtigkeit und Vollständigkeit nicht gewährleisten.</warranty>
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      <jurisdiction>Ist der Kunde Vollkaufmann, so wird für alle Rechtsstreitigkeiten aus dieser Vereinbarung Berlin als Gerichtsstand vereinbart.</jurisdiction>
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 </productGroup>
</xcpfCatalog>
</xcpfEnvelope>
```

B XCPF Schema

```
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<!-- edited with XML Spy v4.1 U (http://www.xmlspy.com) by Hr. Wagner (Fraunhofer Institut Software u. Systemtechnik) -->
<!--W3C Schema generated by XML Spy v4.1 U (http://www.xmlspy.com)-->
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:xlink="http://www.w3.org/1999/xlink" elementFormDefault="qualified">
    <!--======================Main structur=====================-->
    <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="xlink.xsd"/>
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        </xs:annotation>
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                <xs:element name="xcpfCatalog" maxOccurs="unbounded">
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                    </xs:annotation>
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                </xs:annotation>
            </xs:element>
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            <xs:element ref="contractInformation" minOccurs="0"/>
            <xs:element ref="calculation"/>
        </xs:sequence>
        <xs:attribute name="id" type="xs:string" use="required"/>
        <xs:attribute name="name" type="xs:string"/>
    </xs:complexType>
    <!--====================Contract information====================-->
    <xs:complexType name="addressType">
        <xs:sequence>
            <xs:element name="name" type="xs:string">
                <xs:annotation>
                    <xs:documentation>Name of person or institution.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="name2" type="xs:string" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Space for additional names.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="contact" type="xs:string" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>This field may be use for personal names in institutions.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="street" type="xs:string"/>
            <xs:element name="zip" type="xs:string"/>
            <xs:element name="city" type="xs:string"/>
            <xs:element name="country" type="xs:string"/>
            <xs:element name="phone" type="xs:string" minOccurs="0"/>
            <xs:element name="fax" type="xs:string" minOccurs="0"/>
            <xs:element name="email" type="xs:string" minOccurs="0"/>
            <xs:element name="url" type="xs:string" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="role" use="required">
            <xs:simpleType>
                <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="customer"/>
                    <xs:enumeration value="supplier"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="type">
            <xs:simpleType>
                <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="billing"/>
                    <xs:enumeration value="default"/>
                    <xs:enumeration value="delivery"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:attribute>
    </xs:complexType>
    <xs:complexType name="contractInformationType">
        <xs:sequence>
            <xs:element name="supplier">
                <xs:annotation>
                    <xs:documentation>The party who is offering data products must be public.</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="supplierId" type="xs:string">
                            <xs:annotation>
```

```
                                <xs:documentation>This ID may help to process orders and can help in a distributed environment an in the case of different spelling of names and addresses.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element name="supplierName" type="xs:string">
                            <xs:annotation>
                                <xs:documentation>Short name of the data supplier.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element ref="address"/>
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="customer" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>In opposite to the supplier, the customer may be anonymous until he orders with the WPOS method "orderproduct".</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="customerId" type="xs:string">
                            <xs:annotation>
                                <xs:documentation>Even customer must have an account ID. This is necessary to link the stack of orders to a customer.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element name="customerName" type="xs:string">
                            <xs:annotation>
                                <xs:documentation>Short name of customer.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element ref="address" maxOccurs="unbounded"/>
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="licensing">
                <xs:annotation>
                    <xs:documentation>Each licensing entry must have an ID. In future, this ID may stand for a special group of licensing, which may be processed automatically.</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="rightsOfUse" type="xs:string">
                            <xs:annotation>
                                <xs:documentation>Licensing term</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element name="copyright" type="xs:string"/>
                        <xs:element name="devolution" type="xs:string"/>
                        <xs:element name="duties" type="xs:string"/>
                        <xs:element name="warranty" type="xs:string"/>
                        <xs:element name="generalProvisions" type="xs:string"/>
                        <xs:element name="jurisdiction" type="xs:string"/>
                    </xs:sequence>
                    <xs:attribute name="licensingCat" type="xs:string" use="required"/>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
    <!--====================Calculation elements====================-->
    <xs:complexType name="calculationType">
        <xs:sequence>
            <xs:element name="declarationList">
                <xs:annotation>
                    <xs:documentation>Parameter need to be declared prior processing.  The input and output workflows can be determined by using categories.</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="predefinedParameters" minOccurs="0">
                            <xs:annotation>
```

```
                        <xs:documentation>Some parameters are necessary for the processing, but are constant, e.g. tax. These parameter can be declared as "predefined".</xs:documentation>
                    </xs:annotation>
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element ref="parameter" minOccurs="0" maxOccurs="unbounded"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="configurationParameters" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Other parameter values need to be set by user. All these parameters will be visualized. Some of these may be used for pricing, e.g. Contract time, other may be used for data generation, e.g. style=red and some for both, e.g. data format= dxf.</xs:documentation>
                    </xs:annotation>
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element ref="parameter" minOccurs="0" maxOccurs="unbounded"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="referencedParameters" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>NOTE: Only used in productGroup!

This parameter group is needed for hierarchical calculations, where parameter values of previous calculated values can be accessed.

An often used example is the sum, where in previous prices are summarized.</xs:documentation>
                    </xs:annotation>
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element ref="parameter" minOccurs="0" maxOccurs="unbounded"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="precalculatedParameters" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>This kind of parameter are being used as sub functions. These functions may be mathematical operations or XCPF Web Service Calls (XCPF-WSC) and have only values at runtime.
The XCPF-WSC are useful for access to mass storage, for complex calculations or for actual data.
They are results of functions.

An often used example is the calculation of a surface of a polygon.</xs:documentation>
                    </xs:annotation>
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element ref="parameter" minOccurs="0" maxOccurs="unbounded"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="resultParameters">
                    <xs:annotation>
                        <xs:documentation>This textfield contains the parameter for the final result of all calculations.

An example is: price</xs:documentation>
                    </xs:annotation>
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element ref="parameter" minOccurs="0"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
    </xs:element>
    <xs:element name="formulae">
        <xs:annotation>
            <xs:documentation>All declared parameters may be processed by formulae in this block</xs:documentation>
        </xs:annotation>
```

```
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="function" maxOccurs="unbounded">
                            <xs:annotation>
                                <xs:documentation>The calculations may use several sub function or XPCF web Service Calls (XCPF-WSC) and a main function, which result need to be mapped to a parameter declared in the "resultParameters" block</xs:documentation>
                            </xs:annotation>
                            <xs:complexType>
                                <xs:sequence>
                                    <xs:element name="outParameterList">
                                        <xs:annotation>
                                            <xs:documentation>This list contains all parameters, which will be used in the formula or in the Web Service Call</xs:documentation>
                                        </xs:annotation>
                                        <xs:complexType>
                                            <xs:sequence>
                                                <xs:element ref="parameterName" minOccurs="0" maxOccurs="unbounded"/>
                                            </xs:sequence>
                                        </xs:complexType>
                                    </xs:element>
                                    <xs:element name="inParameterList">
                                        <xs:annotation>
                                            <xs:documentation>This list contains the returned parameters, which are the results</xs:documentation>
                                        </xs:annotation>
                                        <xs:complexType>
                                            <xs:sequence>
                                                <xs:element ref="parameterName" minOccurs="0" maxOccurs="unbounded"/>
                                            </xs:sequence>
                                        </xs:complexType>
                                    </xs:element>
                                    <xs:element name="operation">
                                        <xs:annotation>
                                            <xs:documentation>The operation Block contains a:
-mathematical forumula or a
-XCPF Web Service Call Url</xs:documentation>
                                        </xs:annotation>
                                        <xs:complexType>
                                            <xs:choice>
                                                <xs:element ref="math"/>
                                                <xs:element name="DCPType">
                                                    <xs:annotation>
                                                        <xs:documentation>XCPF Web Service Call for external processing</xs:documentation>
                                                    </xs:annotation>
                                                    <xs:complexType>
                                                        <xs:sequence>
                                                            <xs:element name="HTTP">
                                                                <xs:complexType>
                                                                    <xs:sequence>
                                                                        <xs:element name="Get">
                                                                            <xs:annotation>
                                                                                <xs:documentation>HTTP Get Method</xs:documentation>
                                                                            </xs:annotation>
                                                                            <xs:complexType>
                                                                                <xs:sequence>
                                                                                    <xs:element name="OnlineResource">
                                                                                        <xs:annotation>
                                                                                            <xs:documentation>URL, e.g. http://www.geo-ebusiness.de</xs:documentation>
                                                                                        </xs:annotation>
                                                                                        <xs:complexType>
                                                                                            <xs:attribute ref="xlink:type" fixed="simple"/>
                                                                                            <xs:attribute ref="xlink:href" use="required"/>
                                                                                        </xs:complexType>
                                                                                    </xs:element>
                                                                                </xs:sequence>
```

```
                                                                    </xs:complexType>
                                                                </xs:element>
                                                            </xs:sequence>
                                                        </xs:complexType>
                                                    </xs:element>
                                                </xs:sequence>
                                            </xs:complexType>
                                        </xs:element>
                                    </xs:choice>
                                </xs:complexType>
                            </xs:element>
                        </xs:sequence>
                        <xs:attribute name="name" type="xs:string"/>
                    </xs:complexType>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
    </xs:element>
</xs:sequence>
</xs:complexType>
<xs:element name="calculation" type="calculationType">
    <xs:annotation>
        <xs:documentation>Because of rebates, taxes or other pricing mechanisms, price models may be adjusted with a formula on each hierarchical step of the pricing catalog; At least, a simple sum formula must be calculated</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:complexType name="parameterType">
    <xs:sequence>
        <xs:element name="variableDescr" maxOccurs="unbounded">
            <xs:annotation>
                <xs:documentation>Each parameter has a logical name. But at least for language reasons several different descriptions are useful. These descriptions may use white spaces and can contain sentences.</xs:documentation>
            </xs:annotation>
            <xs:complexType>
                <xs:simpleContent>
                    <xs:extension base="xs:string">
                        <xs:attribute name="lang" type="xs:string" use="required"/>
                    </xs:extension>
                </xs:simpleContent>
            </xs:complexType>
        </xs:element>
        <xs:element name="variableGroup" type="xs:string" minOccurs="0" maxOccurs="unbounded">
            <xs:annotation>
                <xs:documentation>Typical some parameters may be used for some reasons as groups. The group relationship will be expressed by equal strings in the variableGroup field.
Parameter may belong to more groups, e.g. for "pricing" and for generation "geoserver".

An example is the use of a set of parameters for data generation. These parameters should contain a string, e.g. "geoserver". All the parameters with that string may be filtered and transferred to geo data generation server.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="variableOrigin" minOccurs="0">
            <xs:annotation>
                <xs:documentation>NOTE: Variable Origin will only be used in "referencedParameters" blocks. The required attribute "orginName" contains the original name of a low hierarchical parameter.

Referenced parameter can be used in to ways:
-Multiple Reference with lists of parameter values
-Single Reference

An often used multiple example is the price calculation, which refer to the list of all previous results.</xs:documentation>
            </xs:annotation>
            <xs:complexType>
                <xs:sequence>
                    <xs:element name="originId" type="xs:string">
                        <xs:annotation>
                            <xs:documentation>Multiple references need a "*" as a wildcard for all parameter values with the in variable Origin used names, not depending on product entries</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
```

```
                    <xs:attribute name="originName" type="xs:string" use="required"/>
                </xs:complexType>
            </xs:element>
            <xs:element name="variableValue" minOccurs="0" maxOccurs="unbounded">
                <xs:annotation>
                    <xs:documentation>The need for a value is depending on the parametergroup of the declarationList:
-predefinedParameters must a value, because they are constant
-configurationParameters may have a value as a default
-referencedParameters do not have a value
-calcuationParameters do not have a value
-resultParameters do not have a value</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:simpleContent>
                        <xs:extension base="xs:string">
                            <xs:attribute name="condition" type="xs:string"/>
                            <xs:attribute name="selected" type="xs:string"/>
                        </xs:extension>
                    </xs:simpleContent>
                </xs:complexType>
            </xs:element>
            <xs:element name="variableUnit">
                <xs:annotation>
                    <xs:documentation>Units are important for a correct calcuation. Therefore they have to be set in an machine processable way with MathML. But it might be neutral with a "1". They attribute textstyle should be used for string expressions, which may easly displayed. An example is: km^2</xs:documentation>
                </xs:annotation>
                <xs:complexType>
                    <xs:sequence>
                        <xs:element ref="math"/>
                    </xs:sequence>
                    <xs:attribute name="textstyle" type="xs:string" use="required"/>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
        <xs:attribute name="name" type="xs:string" use="required">
            <xs:annotation>
                <xs:documentation source="Source" xml:lang="en">The name of a parameter has the function to access the parameter and its values for processing. Therefore it need to "machine readable". That means typically, that it should only contain ASCII127 letters. Other letters, like ä,ü or ê may be treated on different computer platforms is a different way. White space are not allowed for naming. Names are case-sensitive.</xs:documentation>
            </xs:annotation>
        </xs:attribute>
        <xs:attribute name="type" use="required">
            <xs:simpleType>
                <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="boolean"/>
                    <xs:enumeration value="integer"/>
                    <xs:enumeration value="real"/>
                    <xs:enumeration value="string"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:attribute>
    </xs:complexType>
    <xs:element name="parameter" type="parameterType">
        <xs:annotation>
            <xs:documentation>The parameter object is the basic element for the calculation</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="parameterName" type="xs:string">
        <xs:annotation>
            <xs:documentation>All used parameter need to be declared in the declaration List block. Therefore they do not be completley redeclared by calling a function, but only be named.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:complexType name="mathType">
        <xs:sequence>
            <xs:element ref="apply"/>
        </xs:sequence>
    </xs:complexType>
    <xs:element name="math" type="mathType">
```

```
        <xs:annotation>
            <xs:documentation>MathML block, within this block a subset of MathML is being used. More at http://www.w3c.org/math</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="apply" type="applyType">
        <xs:annotation>
            <xs:documentation>MathML: Acts like a mathematical bracket</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:complexType name="applyType">
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element ref="apply"/>
            <xs:element ref="ci"/>
            <xs:element ref="cn"/>
            <xs:element ref="piecewise"/>
            <xs:element ref="max"/>
            <xs:element ref="min"/>
            <xs:element ref="eq"/>
            <xs:element ref="lt"/>
            <xs:element ref="gt"/>
            <xs:element ref="plus"/>
            <xs:element ref="minus"/>
            <xs:element ref="sin"/>
            <xs:element ref="cos"/>
            <xs:element ref="tan"/>
            <xs:element ref="power"/>
            <xs:element ref="times"/>
            <xs:element ref="divide"/>
            <xs:element ref="sum"/>
            <xs:element name="bvar" type="xs:string">
                <xs:annotation>
                    <xs:documentation>MathML: bounding variable, used by "sum" operation</xs:documentation>
                </xs:annotation>
            </xs:element>
        </xs:choice>
    </xs:complexType>
    <xs:element name="piecewise">
        <xs:annotation>
            <xs:documentation>MathML: mathematical "if..then" operator, example:
<piecewise>
                    <piece>
                        <apply>
                            <times/>
                            <cn>15.34</cn>
                            <ci>Punktanzahl</ci>
                        </apply>
                        <apply>
                            <lt/>
                            <ci>Punktanzahl</ci>
                            <cn>2</cn>
                        </apply>
                    </piece>
                    <otherwise>
                        <apply>
                            <plus/>
                            <apply>
                                <times/>
                                <cn>15.34</cn>
                                <ci>Punktanzahl</ci>
                            </apply>
                            <apply>
                                <times/>
                                <cn>10.23</cn>
                                <apply>
                                    <minus/>
                                    <ci>Punktanzahl</ci>
                                    <cn>1</cn>
                                </apply>
                            </apply>
                        </apply>
```

```
                </otherwise>
            </piecewise>
        </xs:documentation>
    </xs:annotation>
    <xs:complexType>
        <xs:sequence>
            <xs:element name="piece" maxOccurs="unbounded">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element ref="plus" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="times" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:choice minOccurs="0" maxOccurs="unbounded">
                            <xs:element ref="cn"/>
                            <xs:element ref="ci"/>
                        </xs:choice>
                        <xs:element ref="apply" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="gt" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="lt" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="ci" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="cn" minOccurs="0" maxOccurs="unbounded"/>
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="otherwise" minOccurs="0">
                <xs:complexType>
                    <xs:sequence>
                        <xs:choice minOccurs="0" maxOccurs="unbounded">
                            <xs:element ref="cn"/>
                            <xs:element ref="ci"/>
                            <xs:element name="apply" type="applyType"/>
                        </xs:choice>
                        <xs:element ref="times" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="ci" minOccurs="0" maxOccurs="unbounded"/>
                        <xs:element ref="cn" minOccurs="0" maxOccurs="unbounded"/>
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
</xs:element>
<xs:element name="cn" type="xs:string">
    <xs:annotation>
        <xs:documentation>MathML: Textfield for a number, e.g. 2.2345</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="ci" type="xs:string">
    <xs:annotation>
        <xs:documentation>MathML: Textfield for identifier, e.g. "price"</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="gt">
    <xs:annotation>
        <xs:documentation>MathML: "bigger than" operator</xs:documentation>
    </xs:annotation>
    <xs:complexType/>
</xs:element>
<xs:element name="lt">
    <xs:annotation>
        <xs:documentation>MathML: "Smaller then" operator</xs:documentation>
    </xs:annotation>
    <xs:complexType/>
</xs:element>
<xs:element name="times">
    <xs:annotation>
        <xs:documentation>MathML: Times operator</xs:documentation>
    </xs:annotation>
    <xs:complexType/>
</xs:element>
<xs:element name="divide">
    <xs:annotation>
        <xs:documentation>MathML: Division operator</xs:documentation>
```

```
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="minus">
        <xs:annotation>
            <xs:documentation>MathML: Minus operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="plus">
        <xs:annotation>
            <xs:documentation>MathML: Plus operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="max">
        <xs:annotation>
            <xs:documentation>MathML: Maximum operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="min">
        <xs:annotation>
            <xs:documentation>MathML: Minimun operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="eq">
        <xs:annotation>
            <xs:documentation>MathML: Equal operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="sin">
        <xs:annotation>
            <xs:documentation>MathML: Sinus operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="cos">
        <xs:annotation>
            <xs:documentation>MathML: Cosinus operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="tan">
        <xs:annotation>
            <xs:documentation>MathML: Tangence operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="power">
        <xs:annotation>
            <xs:documentation>MathML: Power operator</xs:documentation>
        </xs:annotation>
        <xs:complexType/>
    </xs:element>
    <xs:element name="sum" type="xs:string">
        <xs:annotation>
            <xs:documentation>MathML: Sumeration operator</xs:documentation>
        </xs:annotation>
    </xs:element>
    <!--====================other elements====================-->
    <xs:element name="title" type="xs:string">
        <xs:annotation>
            <xs:documentation>Each productGroup may have a title, but each product must have a title.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="abstract" type="xs:string">
        <xs:annotation>
```

```
            <xs:documentation>Abstracts may be used to give some more background information about the productGroup or the product. Complete product description may be made in an ISO19115 description and referenced by a productId.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="offerDuration" type="xs:string">
        <xs:annotation>
            <xs:documentation>Valid timeframe for that offer.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:complexType name="productStatusType">
        <xs:sequence>
            <xs:element name="statusInfo" type="xs:string">
                <xs:annotation>
                    <xs:documentation>Textual information about a status.</xs:documentation>
                </xs:annotation>
            </xs:element>
        </xs:sequence>
        <xs:attribute name="date" type="xs:string" use="required"/>
        <xs:attribute name="time" type="xs:string" use="required"/>
        <xs:attribute name="statusCode" use="required">
            <xs:simpleType>
                <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="createOfOffer"/>
                    <xs:enumeration value="analogDelivery"/>
                    <xs:enumeration value="ordered"/>
                    <xs:enumeration value="orderProcessingFailed"/>
                    <xs:enumeration value="readyForDelivery"/>
                    <xs:enumeration value="delivered"/>
                    <xs:enumeration value="accounting"/>
                    <xs:enumeration value="endOfTransaction"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:attribute>
    </xs:complexType>
    <xs:complexType name="productStatusListType">
        <xs:sequence>
            <xs:element ref="productStatus"/>
            <xs:element name="statusHistory">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element ref="productStatus" minOccurs="0" maxOccurs="unbounded"/>
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
    <xs:element name="transactionNumber" type="xs:string">
        <xs:annotation>
            <xs:documentation>This number acts as an ID within processing steps. A transactionNumber may target to a productGroup, if a processing groups all "product" data files into one, e.g. zip compression, or in a "product", if each packet will be delivered separately.

The WPOS "orderProduct" sets a transactionNumber in a XCPF instance and sends it to the client, who will request a data product file with the WPOS request "getProduct" and this transaction number.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="inheritance" type="inheritanceType">
        <xs:annotation>
            <xs:documentation>The inheritance method provides a very powerful and useful optimisation for large data entries. It may contain most repeated XCPF elements for inheritance, e.g. contract information and calculation blocks. Inheritance can be overwritten in following productGroups or products</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:complexType name="inheritanceType">
        <xs:sequence>
            <xs:element ref="title" minOccurs="0"/>
            <xs:element ref="abstract" minOccurs="0"/>
            <xs:element ref="contractInformation" minOccurs="0"/>
            <xs:element ref="calculation" minOccurs="0"/>
        </xs:sequence>
```

```
    </xs:complexType>
    <xs:element name="contractInformation" type="contractInformationType">
        <xs:annotation>
            <xs:documentation>Orders can be processed under curtain circumstances, which must be declared in a contract.</xs:documentation>
            <xs:documentation>Orders can be processed under curtain circumstances, which must be declared in a contract.</xs:documentation>
            <xs:documentation>Orders can be processed under curtain circumstances, which must be declared in a contract.</xs:documentation>
            <xs:documentation>Orders can be processed under curtain circumstances, which must be declared in a contract.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="address" type="addressType">
        <xs:annotation>
            <xs:documentation>Contact information,
In the case of a customer use, there might be more entries.</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="productStatus" type="productStatusType">
        <xs:annotation>
            <xs:documentation>Current status with time, date and statuscode attributes. The status changes when a WPOS operation is processed</xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="productGroup" type="productGroupType">
        <xs:annotation>
            <xs:documentation>With the use of productGroup elements, pricing catalog can be arranged. </xs:documentation>
            <xs:documentation>With the use of productGroup elements, pricing catalog can be arranged. </xs:documentation>
        </xs:annotation>
    </xs:element>
    <xs:element name="productStatusList" type="productStatusListType">
        <xs:annotation>
            <xs:documentation>The Web Pricing &amp;amp; Ordering Service uses an instance of the XCPF price model to store order process information into this status list. </xs:documentation>
        </xs:annotation>
    </xs:element>
</xs:schema>
```

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Frankfurt, 17.10.2002

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15.) Wagner, Roland-M.:
Current Policies for Information Distribution, State of Development and Business Diversity in a SDI with WPOS,
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Munich, 21-23.01.2003

C.2 Papers

1.) Wagner, Roland-M.; Gabriel, Peter; Dr. Holtkamp, Bernhard:
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(AGILE Konferenz, <4, Brünn / Tschechische Republik>)
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2.) Wagner, Roland-M.; Gabriel, Peter:
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