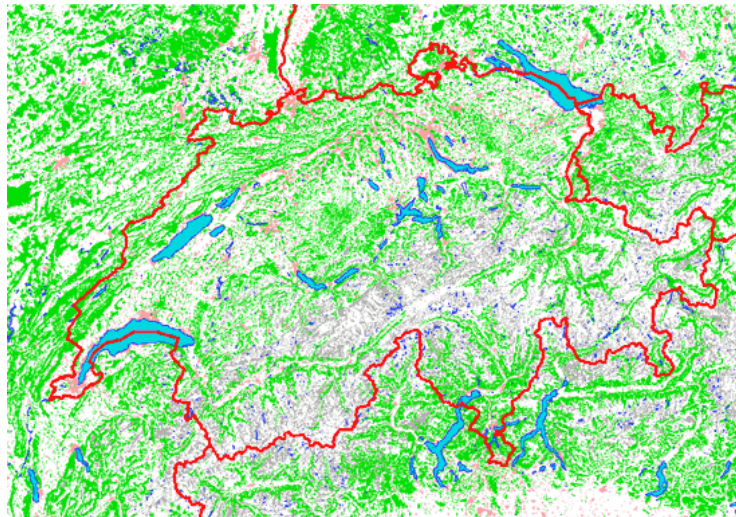


Billing Models for Geo Web Services – A Contribution to Create a Spatial Data Infrastructure in Switzerland

**By order of the Federal Office of Topography (swisstopo) and
Coordination of geographic information and geographic information systems
(COGIS)**



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Summary

The technical development of a national spatial data infrastructure is massively promoted at present in Switzerland as well as in some other countries. Such a project does in some areas not only present new ground from a technical point of view but also from an economic point of view. It is particularly important to mention that there do not exist any models defining the procedure of clearing between the different networked web services involved in a spatial data infrastructure. For this reason this study on billing models for geo web services has been drawn up by order of the Federal Office of Topography (swisstopo) and Coordination of geographic information and geographic information systems (COGIS) as a contribution to create a spatial data infrastructure in Switzerland.

The study shows that a persistently demand-oriented approach has to be chosen to develop billing models. In this context it shows that a product definition from a technical point of view, e.g. according to OGC or ISO definition, is not adequate for such a demand-oriented approach. Instead of this three product categories from the customer's point of view are defined: information, data, solutions.

When billing models are developed it has moreover to be taken into consideration that the product categories mentioned above are implemented in multi-level value-added chains in the context of a spatial data infrastructure.

On the basis of these considerations the study describes which principles are necessary and recommended to develop future billing models. The most important principle is to introduce reasonable market-oriented transfer prices.

The problem to develop a rating strategy is another matter which is closely connected to the billing model. Although it has in principle to be distinguished between the matter of clearing along the value-added chain and the pricing of the final products, it becomes nevertheless apparent that a utility-oriented rating strategy will be a decisive factor for economic success in view of the principle of demand orientation. For this reason the study develops appropriate rating structures for the three product categories, which mainly aim at minimizing the number of price-determining factors, in order to develop simple and transparent rating models.

A medium-term adjustment strategy is shown because cost-oriented fee models, which have been used up to now, may only be abandoned considering budgetary regulations. Furthermore, the study describes how a positive sales trend may be achieved by implementing this strategy.

Finally, the organisational concept outlines how the structures, which are necessary for billing control and for transparency between the affiliated web services, may be designed. The focus is put on setting up a "clearing office" which clears all the sales realised between the web services involved.

The results of the study constitute the basis for making an efficient distribution of the proceeds possible in federal structures with different decentralised parties involved. Therefore the study constitutes a fundamental contribution to implement a spatial data infrastructure not only with technical success but also with economic success. In this context it becomes apparent that the desired positive stimulus, which a spatial data infrastructure has on the spatial data market, will only appear under these conditions. Against this background it is advisable to apply the results of the study in practice in a pilot project as soon as possible and to test corresponding billing models.

1. Objectives and procedure

Context of the study

The study “Billing Models for Geo Web Services” is embedded in a general state initiative to activate the spatial data market in Switzerland with the aim to guarantee the optimum economic use of spatial information. Several studies have described the starting situation and the most important market barriers as well as the necessary measures at the spatial data market.

- A national spatial data strategy has been decided and the creation of the national spatial data infrastructure has been started.
- The stimulus programme e-geo.ch bundles up appropriate measures.
- There is a study on the structure and rating policy for spatial data in the federal administration, a guidance plan aiming at the harmonization of the rating strategy is worked out at present.
- The interdepartemental authority) Coordination of geographic information and geographic information systems (COGIS) serves as a platform for action.
- swisstopo has a series of digital products like some other federal and cantonal authorities, this range of products is to be supplemented by online services.

General conditions

The following general conditions were taken into consideration when the study was developed:

- legal basis: a spatial information law is being prepared
- budget: the MC¹ strategy will probably be put into practice by 2011 (“budget neutral” adjustment)
- federal structures: the 26 cantons partly pursue very different rating policies – this fact has to be taken into consideration when a national spatial data infrastructure is developed

Salient features

Against this background the salient features of the study are the following:

1. to categorise the different geo web services
2. to develop principles / mechanisms for clearing
3. to show different price and business models
4. to develop a transitional model from the present data distribution (based on fees) to a distribution model involving web services
5. to describe organisational fundamentals regarding security/ control of use/ authenticity

It was neither a subject matter of this study to draw up a market study (customers, products, etc.), because the preparatory work relating to this was done before, nor was it a subject matter of this study to give recommendations regarding the pricing policy (prices in Swiss francs).

¹ MC = marginal costs

Definition of web services

From a technical point of view web services are services which are provided via XML on the basis of internet network protocols. The services provided by web services are not directly designed for human users but for software components collecting information. Interaction with these services is normally effected by client programmes, which send enquiries to a web service and get the required information as an answer. The web services are accessible via an unequivocal URI (Uniform Resource Identifier), which allows communication between the services.

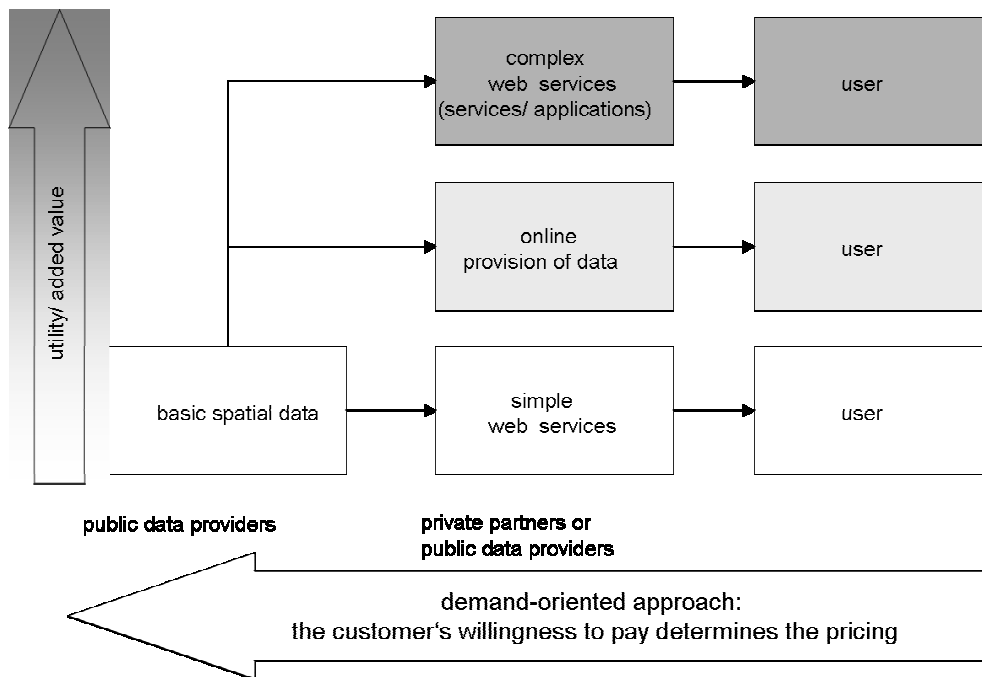
The enquiring client programmes do not implement the utility of a web service but the users implement it. Therefore a customer-oriented approach is necessary, which takes the respective willingness to pay/ the utility into consideration, in order to define appropriate billing models for web services. From the user's or product's point of view a web service is a service providing the required information in the respective necessary form.

Demand-oriented approach

The starting point for further considerations are therefore the customer requirements. Future rating and clearing structures can only be successful if these requirements are taken into consideration. The focus is put on the utility, which the customer can achieve with the respective products, and on the corresponding willingness to pay.

Firstly, the different product categories and their distinction within the framework of geo web services are described from the user's point of view based on the approach mentioned above. Secondly, the fundamental value-added chain, which is necessary for developing these products, is described. On the basis of this it is shown which principles are necessary and recommended to develop future billing models and how adequate price models may be designed. Finally, it is described how these new billing models may be implemented within a spatial data infrastructure in terms of organization.

The demand-oriented approach takes the achievable utility into consideration



2. Product categories

Regarding the development of billing models it is necessary to define clearly between which products one has to distinguish in view of the future online distribution. From a technical point of view one has to distinguish between the following services²:

Product categories from a technical point of view

1. Viewer: reading access to spatial data
2. Web Catalog Service (WCAS or WRS): allows search for data, taking specialist, temporal and spatial criteria into consideration (metadata)
3. Web Map Service (WMS): purchase of maps in the form of a picture or factual information about geographic objects
4. Web Feature Service (WFS): reading and writing access to (vector) spatial data
5. Web Coverage Service (WCS): allows access to raster data (in an unedited form)
6. Web Gazetteer Service (WFS-G): maps indirect geographic references (addresses, place names, administrative units) on direct geographic references (coordinates)
7. Web Coordinate Transformation Service (WCTS): spatial data are sent in the form of GNL, and they are transformed into a given spatial reference system
8. Web Terrain Service: generates "dimensions" on 2,5-D or 3-D data on inquiry
9. Specific applications, e.g. routing or business-specific solutions

² Following the use of the term by the Open Geospatial Consortium (OGC). The service categories used in this context are based on one another, the respective following service in the list covers the preceding services.

Product categories following the ISO prestandard

The ISO prestandard (Text for IS 19119 Geographic information – Services) classifies the different services even in a more detailed way. It distinguishes between six categories of services³:

- human interaction services: services for control and administration of user interfaces, graphics, multimedia, etc.
- model/ information management services: services for managing the development, processing and saving of metadata, plans and data banks
- workflow/ task services: services for supporting users with specific tasks and activities
- processing services: services carrying out extensive computing services (e.g. transformation of coordinates)
- communication services: services for encoding/ decoding and transfer of data in telecommunications networks
- system management services: services for control of system components, applications and networks (e.g. administration of user accounts)

The prestandard distinguishes between numerous services belonging to the six categories and specifies them. The description of the services aims at guaranteeing that the components of a spatial data infrastructure can interact smoothly.

From the customer's point of view the technical definition is however not adequate to develop billing models. It often happens that not the individual service is considered to be a product but that a combination of different services creates new products. From the customer's point of view it is not important to know how many and which services are necessary in technical terms to provide a product. For the customer it is more important to know which utility and which functionalities a certain product has.

In the following passages a demand-oriented approach is pursued, which shows the product categories from the customer's point of view, because a technical description does not allow any inferences to the customers' benefit. In this context it has to be distinguished between the following three product categories:

Product categories from the customer's point of view

1. Information:
It is the result of an enquiry, which does not allow any technical processing in the systems of the customer. The customers have the possibility to see the information provided at their display and to print them out if they wish. The purpose of providing data is normally clearly focussed on specific information for an enquiry. The information are often depicted in an edited form according to the purpose of information.
2. Data:
It essentially concerns a form of project-oriented data purchase, which is normally oriented towards surface coordinates. The customer normally gets the data online (purchase of raster or vector data). If the records are more extensive, the data are at

³ Cf. ISO/TC 211, Geographic information/Geomatics, ISO reference number: 19119, Text for IS 19119 Geographic information - Services as sent to the ISO Central Secretariat for issuing as International Standard

present often provided on a data medium/ CD. The data provided can be integrated into the systems (e.g. GIS) of the customers. The data are then normally used for the customer's own analyses/ company internal planning. In this case raw data and not edited data are usually purchased.

3. Solutions⁴:

These products are spatial data products which are developed according to a specific customer inquiry and which normally consist of several components. It is possible to provide these data in different ways:

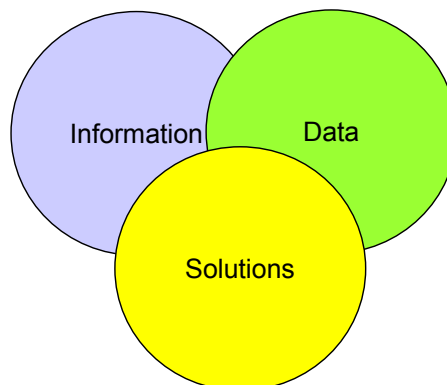
- a) The data provided are integrated into the customer's system.
- b) The provider keeps the software components of the solution.
- c) The software components are also installed in the customer's systems.

The use primarily depends on the task on which the customer intends to work with the solution. According to this the uses can differ. The data are normally edited and solution-oriented – this form of editing has added value for the customer compared to raw data.

Intersections of the product categories

An exact delimitation of the categories is not always possible because the possible services are very complex. For this reason there are several intersections.

There are intersections between the three product categories – an exact delimitation is not possible



Survey of the product categories:

1. **Information:** result of an enquiry which does not allow any technical processing
 - provision of data: only depiction at the display (view) or printing function
 - purpose: specific information
 - depiction: often edited depiction
2. **Data:** mainly project- oriented data purchase oriented towards surface coordinates only
 - provision of data: the customer gets the data online (raster or vector data), not on a data medium / CD; the data are integrated into the customer's system
 - purpose: customer's own analyses / planning
 - depiction: edited or raw data

⁴ The term "solution" refers to the fact that the problem is solved for the customer.

3. **Solutions:** spatial data product developed according to a specific customer inquiry which normally consists of several components
 - provision of data:
 - a) the data are integrated into the system
 - b) the provider keeps the software
 - c) the software is installed in the customer's system
 - purpose: depends on the customer's task
 - depiction: normally edited and solution-oriented

On the following pages some examples are given to illustrate the three product categories:

1. **Information:** "BORIS.nrw" (www.boris.nrw.de)

"BORIS.nrw" is a system developed by the ordnance surveying office in North Rhine-Westphalia to present publicly registered land values⁵. The customer has the possibility to make an enquiry regarding a certain address, and he gets information about the land prices there via a viewer with navigational function. The view of the data at the display is free of charge. Registered customers have the possibility to get a printout of the map on publicly registered land values for a fee of 15 € and to purchase additional information about the property market.

An example of information: information about land values

The screenshot shows the BORIS.nrw website interface. The top navigation bar includes links for Mail, Kontakt, Aktuelles, Ihre Meinung, Sitemap, FAQ, and Impressum. The main content area features a search bar with the text "Suche nach Adresse" and a dropdown menu for "Gemeinde: Düsseldorf". The search results show "Straße: Königsallee" and "Hausnummer: 0030". The map display area shows a street map of Düsseldorf with various land values indicated by numbers. A purple circle highlights a specific location on the map with a value of 7700. The interface also includes a sidebar with links for Home, Kurzinformation, and Bodenrichtwerte-Online, and a footer with the text "Die Gutachterausschüsse für Grundstückswerte und das Geodatenzentrum des Landesvermessungsamtes Nordrhein-Westfalen".

Free information: it is possible to see all the updated publicly registered land values of North Rhine-Westphalia at the display

Solution liable to costs: registered customers have the possibility to purchase a printout of a map on publicly registered land values from BORIS.NRW for 15 €

⁵ Publicly registered land values inform about land prices in Germany.

2. **Data:** There are essentially three different cases regarding the online distribution of data:

- (1) **Vector data:** In this case the customer gets objects/ points to integrate them into his own GIS. Typical customers are specialists, who use spatial information in their own systems. Their willingness to pay is often high.
- (2) **Raster data:** The customer gets data without any object reference but with geographic referencing in formats in conformity with GIS. The data are used as a basis for planning or as background information (maps or orthophotos). The willingness to pay for maps in a raster format is comparatively low, but there is a high potential demand.
- (3) **Picture:** The customer gets maps, e.g. in a .pdf, .jpg format or embedded in a Word document. The customers are normally not any specialists, the data are not processed, but they serve as a basis to answer specific questions. The willingness to pay for each enquiry is low in this case, but high demand frequency can be achieved.

Example: spatial data shop of the Geozentrum Hanover (www.geoshop-hannover.de)
The Geozentrum Hanover⁶ provides geoscientific spatial data, which can be purchased online in the Geoshop. Maps in a raster format and as pictures are at present available, an extension to vector data is envisaged.

An example of online data purchase: Geoshop Hanover

The screenshot shows the Geoshop Hannover website in a Microsoft Internet Explorer browser. The page is titled "GEOSHOP HANNOVER" and "GEOZENTRUM HANNOVER". It features a navigation bar with links like "Home", "Kontakt", "AGB", "Impressum", "Sitemap", and "Hilfe". Below the navigation bar, there is a search bar and a list of products. The products are categorized by "Thematische Auswahl" (Thematic Selection) and "Produktarten" (Product Types). The "Thematische Auswahl" includes "Boden" (Soil), "Geologie" (Geology), "Ingenieurgeologie" (Engineering Geology), "Rohstoffe" (Raw Materials), and "Wasser" (Water). The "Produktarten" include "Alle Produktarten" (All Product Types), "Digitale Karten" (Digital Maps), "Digitale Schriften" (Digital Documents), and "Kostenlose Produkte" (Free Products). The "Suche Produkt" (Search Product) and "Suche Region" (Search Region) fields are also present.

Bestellen	Titel	Beschreibung	Räumlicher Bezug	Preis	MwSt.-Anteil
<input type="checkbox"/>	Blatt 2310 Helgoland	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR
<input type="checkbox"/>	Blatt 2318 Neumünster	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR
<input type="checkbox"/>	Blatt 3102 Emden	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR
<input type="checkbox"/>	Blatt 3110 Bremerhaven	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR
<input type="checkbox"/>	Blatt 3118 Hamburg - West	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR
<input type="checkbox"/>	Blatt 3126 Hamburg - Ost	Hydrogeologische Übersichtskarte von Niedersachsen und Bremen 1:200 000; Lage der Grundwasser Oberfläche mehr...	Blattschnitt	50,00 EUR	6,90 EUR

⁶ The Geozentrum consists of the federal geoscientific authority (Bundesanstalt für Geowissenschaften und Rohstoffe - BGR) and the geoscientific authority of the land Lower Saxony (Niedersächsisches Landesamt für Bodenforschung - NfB)

3. Solutions:

The distribution of solutions comprises both data and software components. There are different cases according to what is provided for the customer.

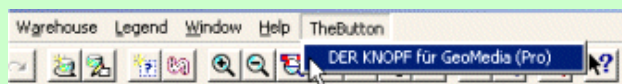
Different variants of software and data purchase

The customer gets:

Software	Data	
	x	The provider keeps the solution. The customer has access to the application via a browser when he makes an enquiry online, and he gets edited data as a result. example of a product: database evaluation online, Web Terrain Service
x	(x)	The customer purchases a solution with which he has access to data online according to his needs. example of a product: "The Button" (Terramapserver) – purchase of spatial information directly from CAD/ GIS or MS-Office (locate addresses, choice of maps, order of spatial data...)
x	x	The customer purchases a solution and data for his own analyses and planning example of a product: navigation system Normally it is not a web service, but online updates are possible.
(x)	x	The customer has a solution which allows him to access to data.

There are two different types of solutions:

- solutions comprising certain functionalities for analysis or planning, e.g. measure distances, navigate in maps, mark objects, add new objects⁷
- solutions supporting the integration of data into business processes
example: the product "The Button" provided by the provider Terramapserver allows to purchase spatial information directly from the company-owned CAD/ GIS or MS-Office:



Example "The Button": integration into CAD/ GIS- or Office software

As a result the customer normally does not get original data but data edited by the solution.

⁷ If "BORIS.nrw" comprised the possibility to integrate the search results into the system as a download and not only to print them out, this product would have to be classed with the category "solution".

Connection between the technical point of view and the customer's point of view

The technical components within the framework of web services may be directly classed with the three product categories. The following matrix illustrates this connection:

Example:

Customer's view:	Information	Data	Solution
Technical view			
Viewer	x		
Web Catalog Service (WCAS or WRS)	x		
Web Map Service (WMS)	(x)	x	
Web Feature Service (WFS)		x	
Web Coverage Service (WCS)		x	
Web Gazetteer Service (WFS-G)		(x)	x
Web Coordinate Transformation Service (WCTS)		(x)	x
Web Terrain Service		(x)	x
Specific applications (e.g. routing, business-specific solutions)		(x)	x

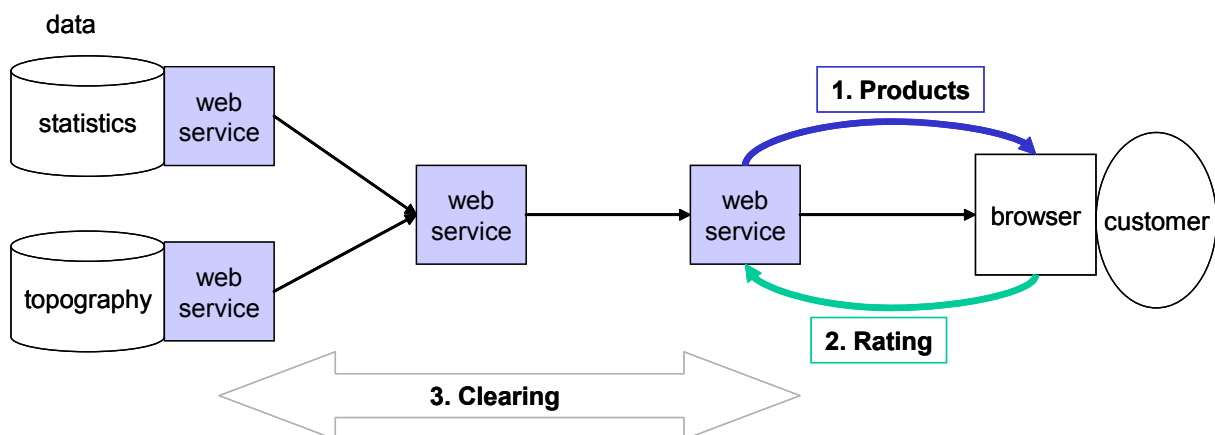
The technical implementation of the supply determines the cost structure. The rating is to be less oriented towards the cost structure, but it is to be oriented towards the customers' willingness to pay. Against this background it is indispensable to consider the customers' benefit for developing adequate billing models.

3. Value-added chain

Multi-level value-added chains

When a spatial data infrastructure is created there will not only be found single-level value chain models, but there will certainly be found multi-level value-added chains. The concatenation of different web services will result in value-added chains involving several parties. In addition to defining possible products and an adequate rating, adequate billing models involving the different parties are therefore necessary in order to be able to offer web services in line with market requirements.

Example of a value-added chain in a spatial data infrastructure



In this context it is important to distinguish clearly between the matter of clearing and the matter of rating/ of the price of the final product. The market price which is achieved for a

certain product must in the end not have any impact on the clearing mechanism along the value-added chain.

Principles for developing billing models

The following principles, which are based on the considerations mentioned above, are to be taken into consideration when future billing models are developed:

1. All the services provided by the web services are always provided and cleared according to the same rules. There is no distinction between different customers or different uses.
2. Internal data purchases are also dealt with according to the provision rules, i.e. it is not important if a customer uses services internally or if he resells them.
3. Although the provision and purchase rules are standardised and applied according to the same principles, the rating policy may however vary in terms of the absolute amount of the fee, i.e. it has to be categorically distinguished between the matter of clearing and the matter of prices/ fees.
4. On the one hand, billing models are to allow a cost distribution in accordance with the causes, but on the other hand, they are not meant to impede the spatial information market by causing prohibitively high prices or clearings.
5. When geo web services are provided to other persons exclusive rights are to be avoided.
6. It has to be possible to implement billing models in a differentiated way so that the matter of clearing does not fleece individual distribution channels.
7. Furthermore, the following general conditions are to be applied to a billing model:
 - simple
 - transparent
 - adequate/ reasonable
 - flexibly applicable
 - in accordance with the causes

4. Billing models based on transfer prices

Transfer prices instead of full-cost-oriented prices

It is advisable to use transfer prices in order to meet the principles mentioned above. The method of billing (full-cost-oriented) fees or prices which has been applied so far often results in prohibitively high prices. This problem increases for networked services and their corresponding value-added products. Information is often provided on the basis of vector data. Their production involves high costs so that vector data are accordingly expensive. A service provider that intends to offer an information service would have to pay for the expensive vector data in this case, and it would have to refinance its own cost of operation. However, normally the willingness to pay for information is relatively low so that the costs for the information provided could hardly be covered. In fact information provided for only a few Swiss francs is often based on raw data which has a ten times higher market price.

In this context the central problem are cost-oriented fee models. These models reflect the production costs of the products, but they do not reflect the benefit which the customer has from the products. The consequence often was that only marginal sales were achieved. This illustrates that utility-oriented market prices are the only type of market prices which are enforceable at the market with long-lasting effects. Therefore clearing based on costs does not lead to the desired results.

Marginal cost as a pricing basis?

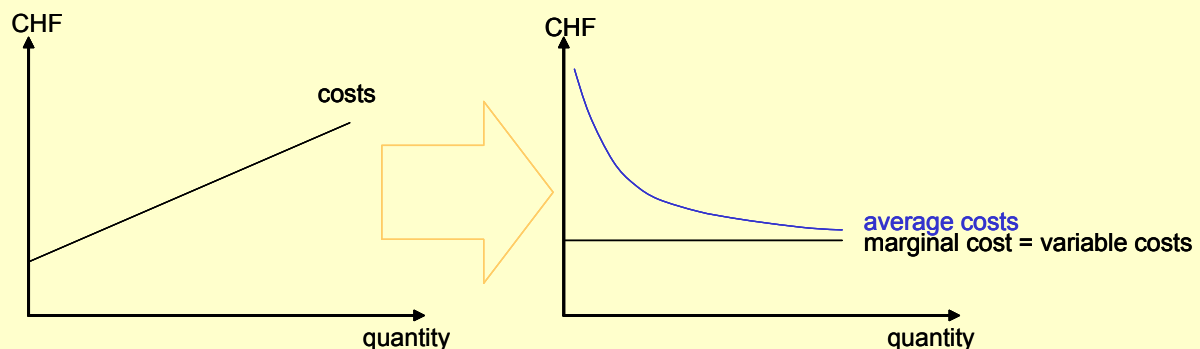
The federal and cantonal administration starts thinking about alternatives because the use of the existing fee models might cause problems regarding the billing models. In this context the marginal cost approach is an approach which is often discussed. This approach is shown in greater detail in the following excursus.

Excursus on the term of marginal cost:

The basic idea of the marginal cost approach regarding clearing is to avoid prohibitively high prices, which may be found in (full)-cost-oriented scales of fees. This shows the intention to implement market-oriented prices in order to promote the development of the market.

Marginal cost are defined as costs arising for each unit which is created additionally. In the case of web services the cost function shows a linear course - this results in fixed marginal cost (to the amount of variable costs).

The course of costs of geo web services (qualitative depiction)



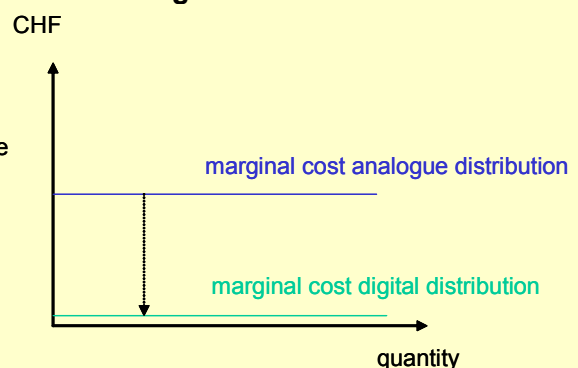
Especially automated online services have low variable costs, which tend to be nearly zero in an extreme case. Variable costs in the narrower sense are only the electricity consumption of the systems per unit sold and the arising internet charges. This would result in drastically falling proceeds with the increasing automation in the course of the creation of a spatial data infrastructure and a pricing based on marginal cost.

Changes in marginal cost in the course of digital distribution

- If the distribution is organised analogue, marginal cost arise from the creation of data media, dispatch, etc.
- If the distribution is organised online, the marginal cost tend to be nearly zero. For widely automated services the variable costs per transaction are marginal: electricity price, internet charges.
- If the pricing is based on marginal cost, the receipts therefore tend to be nearly zero.

Possible solution:

1. The spatial data implemented in the product are priced as a preliminary product, and they are considered to be variable costs.
2. The marginal cost pricing therefore becomes PRI-based pricing.



A possible solution might be to price the spatial data implemented in the respective product as preliminary products and to consider them to be variable costs. The marginal cost approach therefore becomes a profit contribution approach.

It has become apparent that it is not possible to develop a billing model without taking transfer prices into consideration. The search for adequate transfer prices in decentralised production structures or profit centre structures is however often complex. The same applies to shared web services:

“There is probably no other problem of controlling for which more management time and energy is needed in decentralised companies than to fix reasonable transfer prices. The energy needed in this field is much higher than the energy needed for fixing prices for products which are sold at the market.”

Source: <http://much-magic.wiwi.uni-frankfurt.de/Professoren/ewert/down/buch/Kapitel10.ppt>

A possible solution is cost accounting with transfer prices, which are necessary in general value-added chains involving autonomous areas. The following principle applies there: transfer prices substitute market prices – they “simulate” the market. At the same time it becomes apparent that an allocation of the fixed costs in accordance with the causes is always arbitrary so that it is in principle not possible to fix the “right” transfer price. The optimum transfer price results from the respective strategy/ the goals strived for.

Principles for fixing transfer prices

The following principles have to be considered regarding possible transfer prices⁸:

1. **Market-oriented transfer prices** are to be given preference: “If a market price exists or can be approximated – use it”!
2. **Marginal-cost-oriented transfer prices** result in a loss for the distributor to the amount of the fixed costs.
3. **Unit-costs-oriented transfer prices**: The distributor is able to cover its costs – the buyer gets the profits total. It is doubtful to what extent such a system would be fair. Another problem this model involves is that one does not know the quantity of sales in advance. One does not know the unit costs in advance either because they fall with an increasing quantity of sales.
4. **Negotiation-oriented transfer prices**: This method simulates individual customer behaviour, and it results in solutions close to the market. The problem of this approach is that a corresponding method involving the parties involved would be time-consuming and intransparent, and it could cause conflicts.
5. **Strategic transfer prices**: In this model a “manager” fixes the prices according to strategic considerations on how to open up new markets. The problem of this model is that the position of such a manager cannot be taken over in a federal administrative structure.

⁸ Cf. <http://much-magic.wiwi.uni-frankfurt.de/Professoren/ewert/down/buch/Kapitel10.ppt>

It becomes apparent that a decision about transfer prices depends on the respective objectives pursued. A possible objective, which might be pursued by public administrations regarding the creation of a spatial data infrastructure and the development of adequate billing models, could nowadays be to provide the economic sector with spatial information and services in an economically optimum way. The demand function of users, i.e. the customers' willingness to pay determines such an "economically optimum provision".

Clearing based on market-oriented prices instead of cost-oriented clearing

This form of clearing therefore represents an essential element of billing models. It is advisable to carry out the clearing on the basis of market-oriented prices and not to base it on the arising costs.

Excursus: Clearing of costs?

It is advisable to create networked services within a spatial data infrastructure according to the most typical free-market conditions possible. That means that each service always bears its own costs and that there is no clearing of the arising costs between the different services.

There will however always be services which are not able to cover their costs on their own, e.g. metadata services or services allowing to access to specific data for which the demand is only low. It may however turn out to be necessary or useful to create such services. It has to be decided on a political level to what extent such services are to be (co-)financed by the state.

Is it possible to break even on the basis of market-oriented transfer prices? This question has to be answered in the affirmative:

- The operator of the front-end service has the possibility to fix the prices at the market, and by doing so he is able to cover the costs.
- The operators of the back-end services have fixed costs. Their sales shares must cover these costs. The lower the level in the value-added chain is, the more varied are the possible sources of income of the different services. The provider of vector data may make profits from selling vector and raster data as well as viewers and solutions.
- The key factor is to re-use the services.

A basic principle is that an exact distinction between the billing model and the matter of pricing policy has to be made. Nevertheless, to guarantee the model's success, price models which are more utility-oriented have to be developed; seeing the principle of demand orientation this is intuitively understandable.

The following passages therefore describe how market-oriented price models may be designed.

5. Price models

Firstly, this chapter develops some rating structures for the different types of services. Secondly, it is described which principle may be applied to organise the future rating policy. In this context it is important to consider that it is not possible to determine the optimum market price under model assumptions because the real market price depends on the users' price sensitivity. In fact, the market determines the optimum price in the long term.

Instead a possible adjustment path is outlined in order to fix gradually reasonable market prices replacing the present cost-oriented fees.

5.1 Rating structure

This chapter develops rating structures for the three fundamental product categories

- information
- data
- solutions

as well as for additional transaction-based services like payment/ billing.

Objective of developing future price models

The objective is to implement simple, transparent and utility-oriented rating structures replacing the present fee models:

- Potential customers are not to be scared off by intransparent rating structures.
- The rating structures are to allow their implementation in the system for online purchase within the framework of a spatial data infrastructure.

There is in principle a large number of factors which can be important for determining prices. The following eight basic price-determining factors are used in practice:

Eight basic price-determining factors come into question

1. **Hit:** inclusive price per transaction (data or information provided), the customer's enquiry is not considered to be a hit
2. **"click":** inclusive price when it is taken into the shopping cart; is partly applied to standardized products (e.g. topographical map sheets/ tiles of a scale line); in principle it corresponds to the "hit"
3. **Amount of data:** the customer pays depending on the amount of data purchased (megabytes)
4. **Area:** the customer pays depending on the area (km²); normally it is distinguished between scale lines in this case
5. **Granularity / resolution:** the price-determining factor for the provision of raster maps, orthophotos, etc. is often the granularity (e.g. in dpi).
6. **Number of pixels:** corresponds to area *granularity
7. **Number of points/ objects:** for vector data it depends on the area and the scale line
8. **CPU time:** computing efforts to provide the enquired information (it is partly used for complex analysis applications), but it has hardly been used for online offers up to now; online offers normally provide data/ solutions which are directly available; the CPU time is negligible in this case

Furthermore, the following eight additional price-determining factors are used:

Additional price-determining factors

1. **Number of licences:** is oriented towards the number of users
2. **Duration of use:** normally distinction between use for 1 year and unlimited use
3. **First time use/ update:** the customers partly have the possibility to purchase regularly updates after their first time use
4. **Use:** it is in principle distinguished between internal use and commercial further use
5. **Format:** the decisive factor is the format in which the data are provided (.dxf, .tiff, .pdf, etc.)
6. **Quantity-dependent depression:** may be done in the form of a quantity discount or according to the following classification:
 - unit price
 - basic charge plus reduced unit price for frequent customers
 - flat rate for big customers
7. **Customer-related price discrimination:** in this case the customers pay different prices according to the different categories of customers; this approach is problematic regarding the price fairness, but it can be successful if there is a corresponding product differentiation
8. **Flat rate:** may be a basic charge or a single registration fee

The number of factors used is to be minimized because the rating model becomes more complex with every additional price-determining factor and therefore it becomes less transparent for the customer. The following passages show how such models might be designed.

5.1.1 Price model for “providing information“

Customers looking for information do not wish to purchase megabytes or mega pixels – they would like to purchase information for a specific enquiry. It is therefore advisable to set a fixed price for each information enquired and not to carry out a rating based on the amount of data used.

In this case the price-determining factor is to be the “click”, that means when the information is taken into the shopping cart or when the results are retrieved.

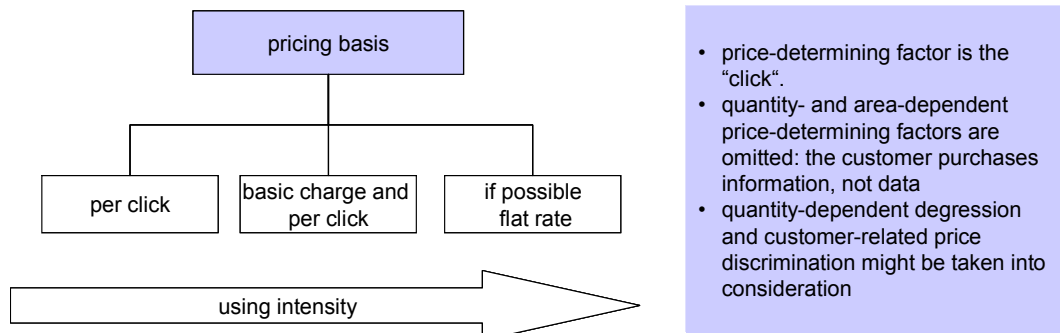
In this case it can be distinguished between the demand frequency/ intensity of the users⁹:

- infrequent users pay a price “per click”
- regular users pay a basic charge and a reduced price “per click”
- big customers (“power users“) get a flat rate

Other price-determining factors are omitted. Customer-related price discrimination (different prices “per click”) might be taken into consideration. For reasons of acceptance this consideration is however only advisable if a corresponding business-specific product differentiation is made.

⁹ The price model is comparable to rating models used by internet providers.

The price model for providing information



Proposal:

- basic price depending on "per click"
- for regular users: basic charge plus reduced price per click
- if possible flat rate
- customer-related price discrimination: only if business-specific product differentiation is made

The basic idea of providing information is to generate the greatest demand possible by fixing moderate prices – in this case the turnover is not achieved with few customers who are willing to pay but by means of a huge number of single queries. This underlines the fact that simple price models are necessary. A customer will not be willing to read several pages of explanations regarding the respective rating before starting a specific single enquiry.

5.1.2 Price model for data

The price model for data distinguishes between the distribution of raster data and vector data.

a) Raster data:

An essential factor for distributing raster data successfully is that the customer has freedom of choice regarding certain sections so that he does not need to purchase given map sheets, but he has the possibility to choose for himself the section of the area he needs by drawing a polygon.

The decisive factor regarding the informational content of raster data is the number of pixels. The finer the granularity and the better the quality of the data is the higher is the number of pixels per area. When freedom of choice regarding the sections is given the number of pixels within a data bank acts proportionally to the chosen area.

Against this background it is advisable to use the following rating model for raster data¹⁰:

¹⁰ In this context raster data are data without any object reference – if a data format allowing object reference is chosen, the price model for vector data is to be applied.

The price-determining factor is to be the number of pixels, and in this context a price gradation according to the granularity¹¹ as well as to freedom of choice regarding the sections is to be applied. The area is therefore not a price-determining factor.

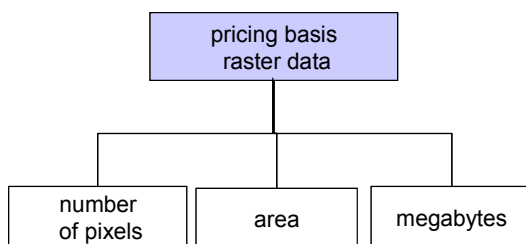
Different granularities particularly serve to take different customer requirements into account.

As an alternative the number of megabytes may serve as a basis and price-determining factor because the number of pixels acts proportionally to the amount of data (megabytes).

Additional price-determining factors are not necessary, and they are to be avoided if possible in order to create a simple rating model. In this context it is in particular not advisable to limit the duration of use because it is hardly possible to check whether this guideline is kept.

In principle it is possible to consider rebates, but it is however advisable to take into consideration that the model as a whole does not only offer advantages for big customers but that it is also an interesting model for smaller customers.

The price model for distributing raster data



- price-determining factors are to be quantity-dependent
- possible factors are the number of pixels or megabytes
- the number of pixels depends on the granularity
- the granularity serves to take different customer requirements into account

Proposal:

- number of pixels as a price-determining factor when the gradation of prices is made according to the granularity and freedom of choice regarding sections
- no limitation of the duration of use (not checkable!)
- when giving discounts consider that the model is also interesting for small customers
- limit the number of additional price-determining factors to a minimum

¹¹ Such a gradation of prices according to the granularity is for example applied by the provider Terramaps server in distributing orthophotos.

b) Vector data:

The fact that the customer has freedom of choice regarding certain sections is also an essential factor for success in distributing vector data. The customer gets a certain number of objects or points according to the scale line and area.

There are essentially the following three price-determining factors which come into question:

- number of points/ objects
- area
- megabytes

The area is a price-determining factor which does not take into account that the information density is different in different regions.

The data volume (megabytes) depends on the format and the compression. Therefore it is not transparent from the customer's point of view. It is therefore advisable to choose the number of points as a price-determining factor – this factor also takes different information densities into consideration according to the chosen section of the area.

With regard to transparent pricing it is necessary that the customer has the possibility to see directly how much he has to pay for a chosen area when he orders the data. It is necessary to calculate the number of points or objects by making a database query in order to serve this purpose.

If it is not possible to put it into practice within the framework of online distribution within a short period of time, corresponding second best solutions may be used:

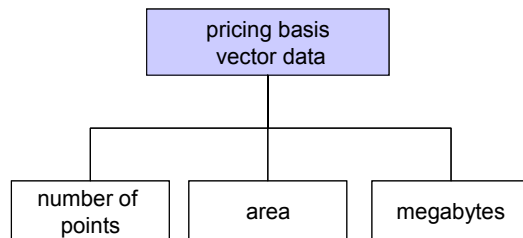
- | | |
|------------|---|
| Variant A: | non-binding price preview in the form of a price corridor ("ranging from 500 to 550 CHF") |
| Variant B: | non-binding preview comprising a calculation of the area and a distinction between point densities (category A: high density of points or objects, category B: medium density of points or objects, category C: low density of points or objects) |

In both cases it would be necessary to supply the exact price calculation later. This method is accepted in so far as a preview may be sufficient for customers who do not have any concrete demand. Customers who want to purchase high-quality vector data are willing to accept a certain delay as a result of price calculations better than to use offline ordering methods, which have been applied so far.

If necessary it is possible to define different price ranges for the prices per point or object depending on quality/ accuracy or topicality.

With regard to additional price-determining factors the same conditions apply as for the distribution of raster data.

The price model for distributing vector data



- price-determining factors are to be quantity-dependent
- possible factors are the number of points or megabytes
- the data volume (megabytes) depends on the format and compression; it is therefore not very transparent from the customer's point of view
- the number of points considers different information densities according to the chosen section of the area

Proposal:

- number of points as a price-determining factor when the gradation of prices is made according to freedom of choice regarding sections
- prices vary according to the point accuracy
- no limitation of the duration of use
- when giving discounts consider that the model is also interesting for small customers
- limit the number of other additional price-determining factors to a minimum

5.1.3 Price model for solutions

It is not possible to define a general pricing strategy for the huge number of possible solutions. The optimum pricing strategy depends on many different factors like the customers' benefit, the valuable part of spatial information for the final product or the complexity of the software components. It is not possible to make any general statements in this connection because these factors may vary strongly according to the different products. It is only possible to develop an adequate pricing strategy after the respective product has been developed.

It is however possible to outline some principles regarding the pricing of solutions:

- The two components "data" and "software" have to be considered in principle when prices are fixed.
- The price models for data purchased via solutions are in principle to correspond to the price models for raster and vector data.
- Additional price-determining factors are also to be omitted in this case if possible. The objective is that the customer uses the solution regularly.
- The price models have to be developed individually in detail according to the respective solution.

The following table gives a survey of possible price models:

Price models for solutions

The customer gets		The customer pays:
Soft-ware	Data	
	x	1. price per click (cf. viewer) or for the amount of data and if necessary the computing efforts (e.g. CPU time)
x	(x)	2. the customer pays a fixed price for the solution and separately for data per query (depending on the quantity and the computing efforts if required)
X	x	3. the customer pays a fixed price provided that he does not have any own solution, and he pays for regular data updates
(x)	x	4. the customer has his own solution and pays for data purchase

Normally private companies, which are not bound to guidelines under public law regarding the pricing, offer the majority of solutions. It is therefore advisable to make as few stipulations as possible in order not to impede the development of free-market-oriented price models.

5.1.4 Price model for additional services

It is in principle possible to offer all the services provided by the services, which have been described so far, as products at the market. In addition, there are also services which would on their own not be marketable, e.g. catalogue services, metadata services, components for payment and billing. It is perhaps not possible to determine market prices for such additional services. There only partly exist service providers in private enterprises which have specialised in additional services. Their prices may be used as a comparative size in this context¹².

It is therefore important to answer the question which criteria are necessary for such additional services in order to be able to develop adequate price models.

The marginal cost per transaction including the arising internet charges, electricity costs, etc., which are similar to those of other services, are marginal and do not constitute a pricing basis.

Instead, in this case it is possible to use the cost of operation, for example, particularly including the material and personnel costs, which are necessary to run and maintain the service. A service certainly aims at covering this amount via a corresponding participation in sales in other services.

¹² The service provider "Firstgate", for example, offers billing and payment services for "click&buy" offers provided by other providers.

Clearing for additional services

There are three different ways of carrying out the clearing between a transaction-based service and a service which sells products at the market and accesses to the transaction-based service:

1. Cost of operation approach:

Example: If the cost of operation of the transaction-based service amount to 50 and if those of the accessing service amount to 150, the sum of the cost of operation is 200. The commission of the transaction-based service would then amount to 25% ($=50/200$).

However, this approach has the drawback that not each of the networked services involved in a spatial data infrastructure is willing to make its cost of operation available for public scrutiny. Furthermore, the commission of the transaction-based service falls if this service reduces its cost of operation – this has a rather counterproductive effect.

2. Overhead calculation

The transaction-based service invoices a fixed percentage of the total value of the transaction¹³. It is possible to determine the percentage by drawing up a forecast of the estimated number of transactions and then determining to what amount the percentage per transaction has to amount in order to achieve altogether the desired degree of cost recovery. The service therefore takes the business risk to what extent it is able to cover its cost of operation.

3. Transaction-based fixed price

In this case a fixed price per transaction is determined instead of a percentage. The procedure of determining the fixed price is carried out in the same way as the overhead calculation.

The cost of operation approach does not seem to be very practicable in a spatial data infrastructure involving several parties. It is advisable to choose instead the overhead calculation or transaction-based fixed prices.

5.2 Rating policy/ Adjustment path

It is not possible to make any statements regarding optimum prices (in CHF) as the examples regarding the billing model have illustrated; in fact the prices have to develop at the market.

General conditions of rating policy

The following passages show how the necessary conditions for developing right prices for the market may be created. In this context the following general conditions are to be taken into consideration:

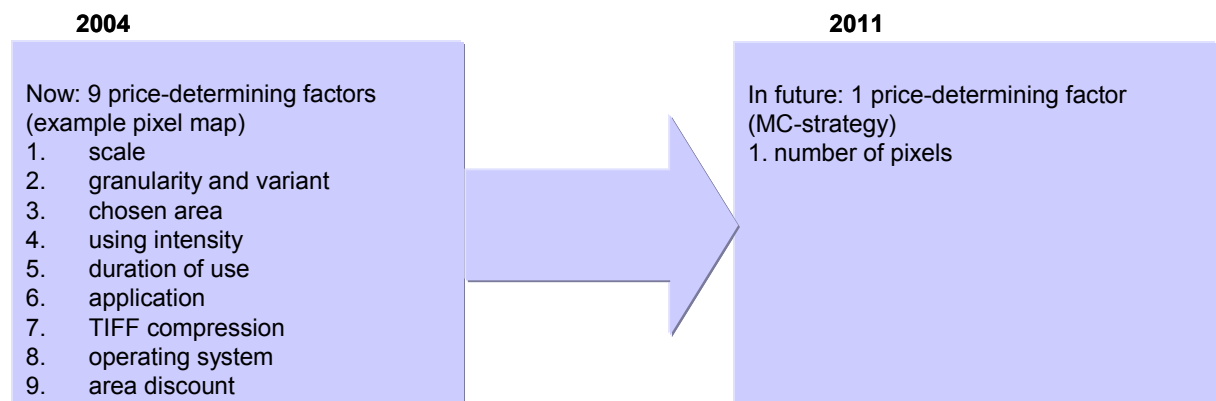
¹³ Compare transactions by credit card: in this case an amount of 3% of the total value of the transaction, for example, is often invoiced.

- The existing fee-oriented rating structure will not be fully abandoned before 2011.
- It is however possible that the prices have gradually been adjusted by 2011.
- Quantitative sales increases are necessary because possible price cuts are to be budget neutral.
- It is also possible to cause a positive effect on demand by simplifying the terms of sale/ fee models.

Therefore the objective is to improve gradually the customer service and the transparency by gradually reducing the number of price-determining factors.

The example of the online services offered by swisstopo may illustrate this method. For purchasing a pixel map¹⁴, for example, there are 9 price-determining factors, which are important at present – for the future price model 1 price-determining factor will however be sufficient.

The adjustment path of the price model shown on the example of a pixel map



Source: www.swisstopo.ch/geodatashop/default_d.htm

Every reduction in the number of price-determining factors and with it every simplification of the price model will increase the users' acceptance and may therefore result in positive effects on demand.

It is possible that price cuts flank these changes in the rating structure. A higher quantity of sales is therefore able to compensate drops in takings when the prices are cut. This does not only have positive effects on the end customer, but it is also more worthwhile for service providers which provide value-added services to invest in the development of innovative offers if the necessary preliminary products (in terms of public spatial information) are available for the right prices for the market.

This may offer the chance to build up an extensive network of sales partners including retailers or service providers which provide value-added services.

Additional distribution channels create new sources of income, and they may also contribute to adjusting the rating structure and policy in a budget neutral way. It is therefore advisable to make changes in the rating structure and policy and at the same time to set up

¹⁴ Corresponds to the definition of raster data on which the study is based.

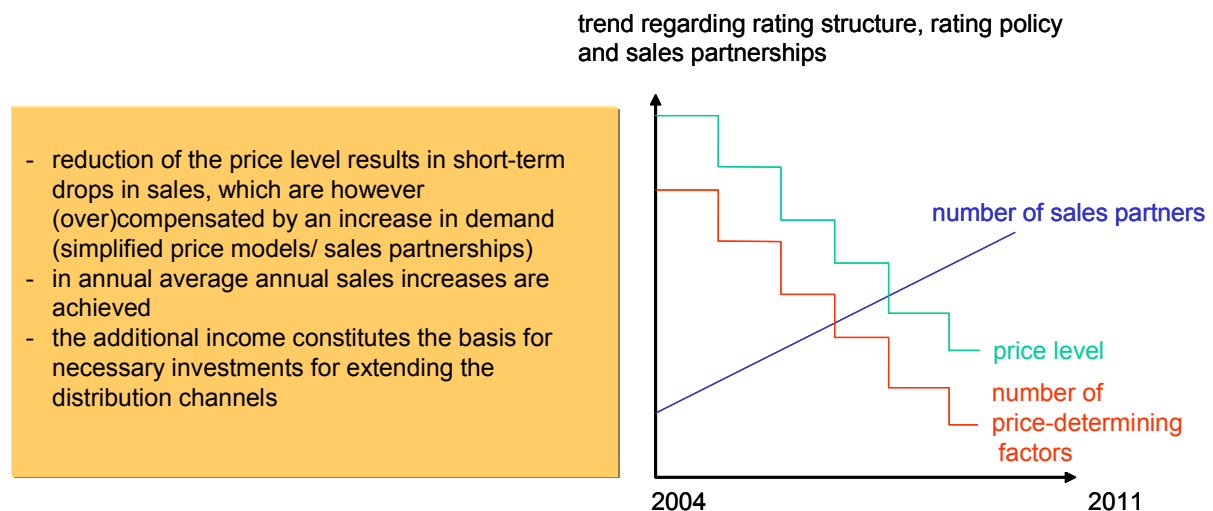
a network of sales partners and value-added services in the course of the creation of a spatial data infrastructure.

Adjustment strategy

This results altogether in an adjustment strategy including the following three main points:

1. gradual reduction of the price level
2. gradual reduction of the number of price-determining factors
3. continuous development of a network of sales partners

The strategy regarding the budget neutral adjustment of the rating policy and structure



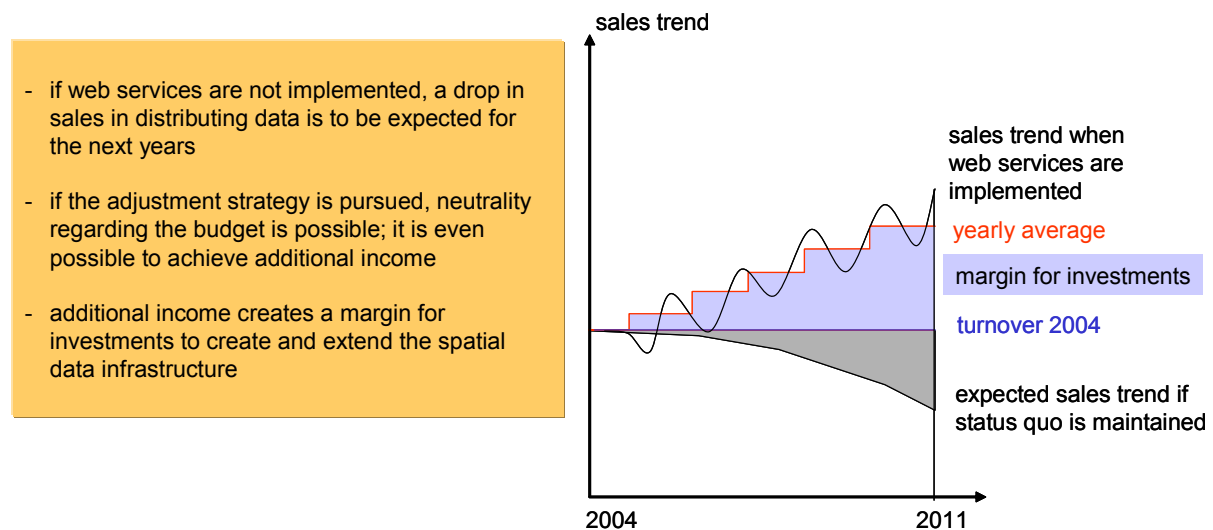
What significance does this strategy have? Experience from other European countries, especially from Germany, shows the following fact: if the fixed fee systems are not changed in any way and if public spatial data are not made available online, the spatial information market will in future develop without any public providers. The consequence will be that sales achieved by public providers will fall off, and offers provided by private companies will replace public data at the market if the status quo is maintained¹⁵.

Positive sales trend as a result of the adjustment strategy

The adjustment strategy may however not only guarantee neutrality regarding the budget; by generating additional income it might also create a margin for investments into the creation and expansion of the spatial data infrastructure.

¹⁵ The maps provided by providers of navigation services, for example, have already replaced topographical maps serving as basis data in great parts of the spatial information market.

The development of receipts using the adjustment strategy until 2011



It is necessary to create adequate conditions for implementing the adjustment strategy, as it has to comply with budgetary restrictions. A possible approach is for example to apply so-called “experimental clauses” in the budget, which allow departures from existing scales of fees within a certain time limit¹⁶. An adjustment of the scales of fees will however be necessary in the medium term. In this context it is advisable to supplement the existing body of rules and regulations instead of cutting the prices in the scales of fees. Prices for the online distribution will then supplement regulations regarding the analogue distribution of data.

It is advisable to plan such projects early because it is normally necessary to consult the appropriate department.

6 Organisational concept for clearing

The previous chapters have shown which principles are to be applied to organise the clearing. On the basis of this the following chapter will outline how this may be implemented in terms of organization.

6.1 Delimitation: billing and clearing

The matter of clearing of networked services has to be seen in another context than the billing with the customer.

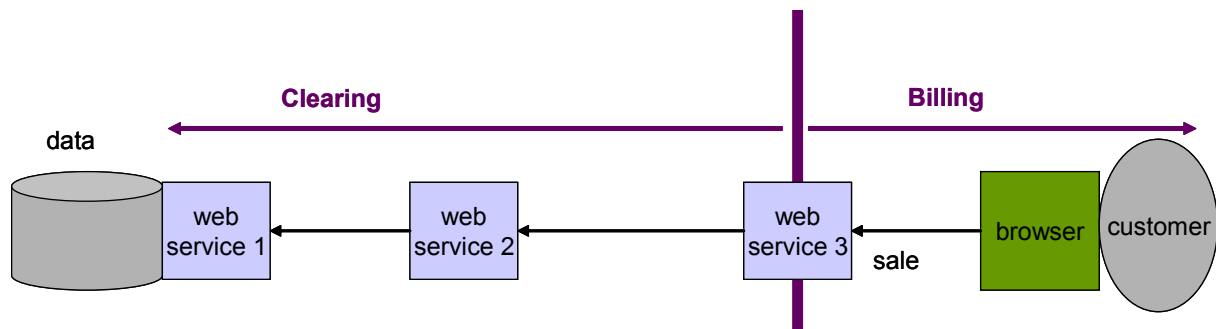
The respective billing system only influences the time of clearing. It is in principle possible to carry out the billing towards the customer in advance, during the transaction or afterwards.

When clearings between the different services are carried out only the respective sales which have so far come in are to be taken into consideration. For example, if quarterly billing has been agreed with the customer, the clearing of individual sales is carried out within the corresponding delay of 3 months at most if required. The following principle is to

¹⁶ This method has proved to be more pragmatic than to make changes in existing scales of fees, which normally involve a considerable amount of administrative costs.

be generally applied: only proceeds which have really been achieved are taken into consideration for the clearing.

The delimitation of clearing and billing



It is advisable to carry out clearings between all the linked service operators at regular intervals (e.g. every month) and not to clear all receipts separately in order to minimize the number of transactions and with it the administrative costs for clearing.

6.2 Billing control

When billing models involving several linked service operators are used it is advisable to develop adequate mechanisms to control the billing. It is necessary to control networked services in two respects:

Need for control when clearing

- The use has to be kept: For example, if a web service accesses to vector data in order to generate raster data, it has to be guaranteed that it really sells raster data only and that it does not sell any vector data. It is possible to take adequate technical precautions within a spatial data infrastructure in this connection.
- Correct sales billing: It has to be guaranteed that all the parties involved clear their sales correctly with the other parties involved. It is possible to meet this demand because it is not an open system involving a vast number of parties involved. In the end, only trustworthy service operators are to be linked to the system, and the respective commission as well as the business model are to be settled by contract.

Technical components of billing control

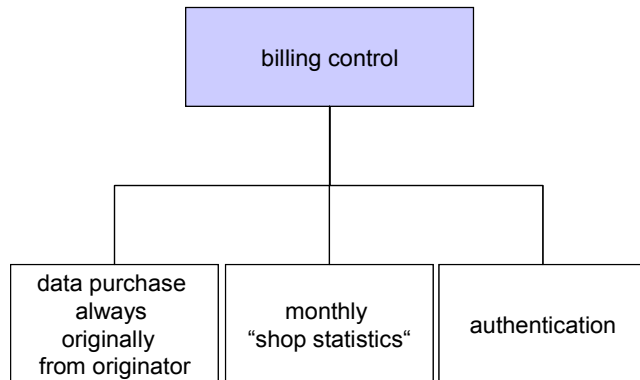
There are three technical components of billing control which are important:

- *The data are always originally purchased from the person who has generated them by accessing to shared databases.*
The data are not reflected from other service operators but there is online access to them. This procedure corresponds to the basic idea of a spatial data infrastructure. The advantage of this procedure is that the person who has generated the data can always directly control the accesses and see which person has used which data. Every service which has been accessed to can therefore determine its components for profit contribution.
- *Shop statistics:*

Shop statistics are automatically compiled during sale; they serve as a basis for billing towards the customers. The shop statistics however provide also information about the sales, which have to be cleared between the service operators.

- **Authentication:**

Every linked service operator authenticates itself when it accesses to another operator and gets an access authorisation by doing so.



Data purchase always originally from originator:

- access to shared databases in this context
- the data are not reflected from the sales partner
- the originator can therefore directly control the accesses

Shop statistics:

- access statistics are compiled automatically in this context, which serve as billing basis

Authentication:

- the system automatically carries out the authentication during access

Concept of the clearing office

It becomes apparent that the model requires a certain amount of basic trust between the service operators involved. None of the service operators is certainly willing to grant access to its data banks to an entirely unknown service provider without scrutinizing it carefully. Although the service providers involved may trust one another sufficiently, it may however be advisable to create a clearing office for billing control, e.g. in order to minimize the clearing costs on the part of the services involved. This is especially important during the development phase. The following passages show how such a clearing office might be designed.

6.3 Setting up a clearing office

Functions of the clearing office

The basic idea of a clearing office is to bundle up the clearing of the achieved sales at one point so that it is possible to minimize the costs for administration and coordination. Another function of the clearing office is to act as a mediator between the service operators involved should a conflict occur. The clearing office represents an autonomous function which has its own personnel.

The clearing office needs comprehensive information regarding all realised transactions in order to be able to assume its function in clearing:

- sales achieved with the different products
- value-added chain of the different products (the "history of accesses" for the products has to be understandable in order to know which services were involved)
- transfer prices of the transaction-based services

The clearing office has to be directly informed of changes in market prices or transfer prices in order to make a correct clearing possible.

Clearing of sales

The starting point are the incoming sales because only sales which have already been realised are to be cleared as has been mentioned above. In this context there are essentially two different variants:

1. The sales come in at the different service operators in a decentralised way – the service operators transfer the commission to the service operators involved according to the guidelines defined by the clearing office.
2. The sales initially come in centrally at the clearing office; the clearing office credits them to the account of the service operators involved.

The first variant involves a high potential for conflicts and seems to be hardly practicable nowadays. Therefore it is advisable to use the second variant. Each of the linked service operators gets its part of the turnover from the clearing office. The clearing office takes on the whole clearing and therefore reduces the administrative costs which the different service operators would otherwise have. By doing this the clearing office generates added-value for the service operators involved.

The central idea is that the clearing office runs a bank account on which all the payments made by the customers come in¹⁷ – it is therefore hardly possible to make a distinction between the function assumed by the clearing office and the function of billing/ payment. The sales are then proportionally transferred from the account of the clearing office to the other service operators.

It is advisable in this case to clear the sales at fixed intervals (e.g. every month) and not to clear them separately for each transaction. The following principle is to be applied in this context: only sales which have really come in at the respective time are to be cleared.

Furthermore, the clearing office has to make the proof of clearing regarding certain transactions available on inquiry if there is any doubt. In this way every party involved can make use of the transparency to see that the clearing has been carried out as agreed.

Financing of the clearing office

The clearing office needs its own technical and human resources, which have to be correspondingly financed.

It is possible to finance the clearing office either by overhead calculation or by transaction-based fixed prices like other transaction-based services. In this case the clearing office is part of the value-added chain, and it therefore deducts a corresponding proportion of the turnover. This approach makes sense on free-market lines.

As an alternative it is possible to set up a clearing office serving as a state authority, which has its own budget.

Localization of the clearing office in the value-added chain

Where is the clearing office to be localised in the value-added chain? The following two variants come into question:

¹⁷ The functions assumed by the collection agency and clearing office may be assumed separately if required.

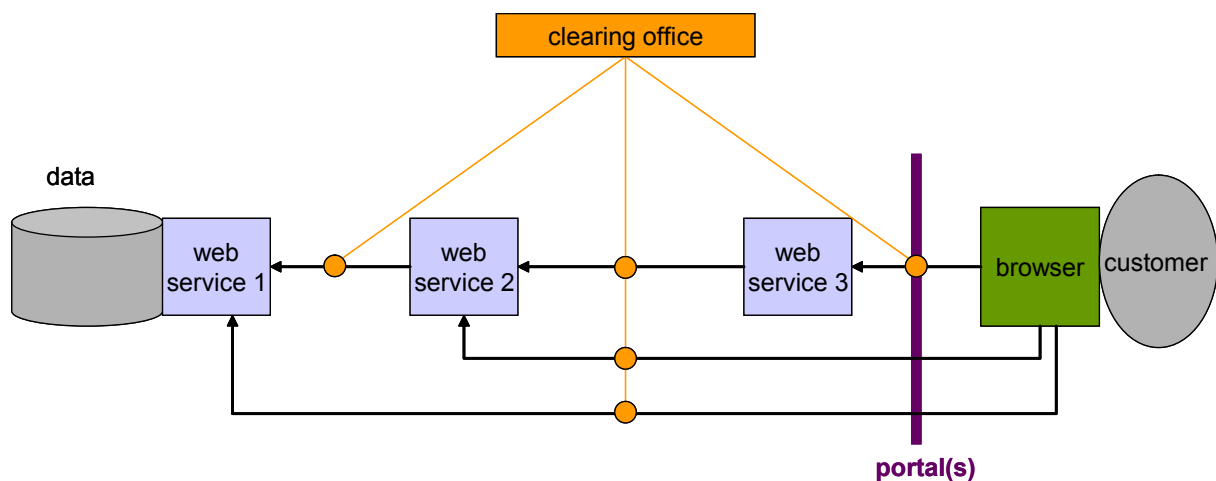
- a) to localise it with a function which runs one of the web services in the value-added chain
- b) to localise it with the function which is responsible for running the portal

It is rather difficult to implement variant a) because one service is only able to control a certain part of the realised transactions. It is therefore advisable to set up a clearing office to serve as a neutral point. It is possible to localise the clearing office at the interface with the customer, that means with the operator of the portal (variant b)). All the transactions that are carried out within the spatial data infrastructure converge at this point.

It is possible to charge an external third party to run the portal – this third party would not be equated with the clearing office, but it would be a function which is responsible for the provision of the portal¹⁸.

The situation becomes more complex if there are different portals. In this case it might be advisable to run the clearing office as an autonomous office which does not depend on individual services or portal functions.

The clearing office interacts with web services on all levels of the value-added chain



7. Outlook

The principles for clearing applied to geo web services, which have been developed in the study, represent an essential contribution to the economic concept of spatial data infrastructures. On the basis of these considerations concrete billing models and mechanisms have been designed. It is aimed at verifying their suitability and practical use within the framework of the pilot project “Business Model WebGIS” – there are corresponding considerations on the part of swisstopo/ COGIS. After the piloting has been carried out the billing models will be published, and it will be explained to what extent they have been able to stand practical tests. The objective is to create adequate organisational and economic conditions in addition to the technical implementation at an early stage in order to create a spatial data infrastructure and to work on it in line with market requirements.

¹⁸ Nowadays it might be obvious to entrust COGIS, for example, with this task.

In this context the following aspects have to be considered:

- to guarantee the data purchase
- to develop services
- to set up a portal
- to set up a clearing office

It is mainly the task of the federal authorities and cantons to provide a data basis, and these institutions are to play a decisive role in promoting the creation of specific services. A bundling function is to carry out the central task of setting up a portal and of creating a clearing office.

Billing models as a condition for economic success

If it proves to be successful to test adequate billing models for networked web services at an early stage, this will be the fundamental condition for the technical as well as for the economic success of future spatial data infrastructures. Under these conditions the positive economic stimulus for the spatial data market, which has been hoped for by creating a spatial data infrastructure, will then appear.

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