



# The Swiss Telecommunication Market After Liberalization

Katarina Stanoevska-Slabeva

=mcm institute, University St. Gallen, Müller-Friedbergstr. 8, 9000 St. Gallen, Switzerland, Katarina.Stanoevska@unisg.ch; PH: +41 71 224 2793;  
Fax: +41 71 224 2771

## ABSTRACT

*The Swiss government deregulated the Swiss telecommunication market in January, 1998. This paper presents the results of a broad empirical survey of the Swiss telecommunication market after liberalization. The survey focused on applied tariff models and pricing strategies.*

## INTRODUCTION

January 1, 1998 marked a fundamental change in business practice in the Swiss telecommunication market. The Swiss government deregulated this particular market, allowing free competition between incumbent and new service providers. De-regulation took place in Switzerland more than 15 years after deregulation started in the USA and England. At the start the most important question was: How would the Swiss telecommunication market behave after liberalization? Would it change according to the patterns experienced in the other countries?

This question was the subject of the project "Charging Information Management and its Technical Implication in a Liberalized Broadband Telecommunication Environment (CIM-BT)", which was initiated by Alcatel Switzerland Ltd. and supported by the Swiss National Foundation. The project has a special focus on tariff models and pricing strategies for telecommunication services and pursues the following goals:

- the evaluation of developments in pricing strategies for services in liberalized telecommunication markets,
- development of scenarios for future pricing strategies,
- the assessment of the impact of tariff models and pricing strategies on network elements, especially switching technology.

Before deregulation, tariff models, i.e. calculation schemas and pricing for telecommunication services were influenced by national monopoly supply, social objectives, certain competitive and customers pressures. They were rather less influenced by hardware and software progress and innovation or international consensus regarding cost allocation methodologies (Gupta et al, 1997). As a result, there was one tariff model for specific services, which made telecommunication costs transparent and predictable. This imposed clear requirements on network technology providers as well.

The liberalization of the telecommunication market in many countries, the convergence of infrastructure, the emergency of new services as interactive TV and particularly the explosion of Internet usage has given rise to a broad discussion of possible new tariff models in a liberalized market. The pressure to introduce new tariffs for telecommunication services also results from the inefficient resource allocation in Internet, based on the prevailing flat-rate tariff model (Walker et al, 1997), (Gupta et al, 1997). This trend is further encouraged by the growing possibilities of sophisticated networks based on the ATM technology to support the variation of bandwidth and the measurement of the usage of network resources (Anania et al, 1995). Finally, in the new competitive environment, service providers are constantly under pressure to find new ways of positively differentiating themselves from their competitors. One competitive advantage could be the introduction of new tariff models.

As a result of the above developments, the introduction of new tariff models might be considered as one possible future scenario for the development of the telecommunication market (Williams, 1997). This could affect all players on the market for telecommunication services – the consumers, service providers, network operators and producers of equipment, i.e. hardware and software for network operation and management. In this paper we are examining the impact of new tariff models from Alcatel's point of view, i.e. from the equipment producer's point of view.

Tariff models are closely related to the capabilities of the network elements (Gupta et al, 1997), especially switching technology. Switches have to be able to collect the necessary data and provide appropriate sup-

port for cost calculation (Rupp, 1997). Complex tariff models as online auction, Quality of Service (QoS) based pricing or real-time advice of charge require additional functionality from network technology, which are not available at present.

The aim of the project is to assess the requirements of new tariff models on network technology. In order to achieve this goal first possible future tariff models were identified. Then, after the liberalization in Switzerland, a reality check of the developed scenarios was performed by a broad empirical evaluation of pricing strategies of new entrants on the Swiss market. The results of the survey were used as the base for detailing and narrowing of the scenarios for future development. In this paper the results of the empirical survey will be presented. The content is structured as follows: First in section 2 tariffs are defined and their importance for equipment providers is explained. Section 3 presents the results of the empirical survey and section 4 provides some scenarios for future developments. Section 5 concludes the paper with an outlook for further work.

## TARIFF MODELS AND BILLING OF TELECOMMUNICATION SERVICES

In every day life we usually understand under the word tariff, the price for telecommunication services. This word is used interchangeably with the words rate or price. In this paper we distinguish between tariff model and price. Thus, in order to prevent misunderstanding first the basic terms will be defined and the motivation for the survey will be presented.

### Definition and Classification of Tariff Models

We define a tariff as a scheme of rates and regulations governing the charging of telecommunication services. A specific tariff model consists of two components:

- a monetary component called price and
- a related tariff model, i.e. a calculation schema, which clearly delimits the unit for which the given price is valid and provides a charging function which governs the calculation of costs. For example prices for telephone calls are defined per time unit of active usage of the network.

In theory numerous tariff models have been proposed for telecommunication services. Basically they can be divided in two groups:

- tariff models used to calculate the cost of each transmission
- discounts, which are defined over occurred costs within a period of time.

Following both categories will be described in more detail in accordance with (Mitchell/Vogelsang, 1991).

### Tariff Models

Tariff models are basically classified in two groups:

- Linear Tariff Models, which are based on an equal price per defined unit of usage
- Non-Linear Tariff Models, which result in different prices per used unit.
- **Linear Tariffs**

The group of linear tariffs comprises usage based pricing and Ramsey pricing. In usage based pricing the revenue depends on the quantity, i.e. number of units sold. Total cost of a call or transmission is calculated by a multiplication of the unit price with the number of units used. Ramsey pricing or differentiation pricing is a special linear tariff, where different prices are charged for essentially the same service, i.e. for a defined unit of

usage. The prices can be differentiated according to customer type (for example private and business customer), time of the day, distance of the call, etc. (Varian, 1996).

#### • Non-Linear Tariffs

The best known and simplest non-linear tariff is known as flat rate (McKnight et al, 1997). With this model, the customer pays a fixed price for a certain period of time, regardless of how much he uses the service. From the customer's point of view, the ability to budget for that service may be an advantage. The service provider also saves costs, as no measurement related to charging is required.

#### • Complex Tariff Models

Further tariff models can be defined by combining linear and non-linear tariff models. One such example is the Two-Part Tariff which consists of a fixed entrance fee for a certain period of time and Ramsey Pricing for used units.

#### • Static and Dynamic Tariff Models

The above mentioned tariff models can further more be combined with a fixed or changeable price per defined unit. In the first case we have static tariff models and in the second case we have dynamic tariff models (Morris and Verus, 1999). Static tariff models are all linear tariff models. Examples of dynamic tariff models are the block dynamic tariff and the discrete dynamic tariff, where the price per unit is increased or decreased during the transmission after a certain amount of used units is reached.

### Discounts

Discounts are a special type of tariff models. While the above described tariff models are applied in order to calculate the cost of each transmission, discounts are applied to decline the total cost for the customer. They are defined as percentage of total costs, which is deducted at the end of the billing period. They can be defined over total costs occurred for a special type of transaction or on total costs occurred for a certain period of time.

### New Tariff Models

The liberalization of telecommunication markets in many countries, the convergence of infrastructures and the emergency of new type of services initiated a broad scientific discussion about possible new kind of tariff models as bandwidth allocation by way of auctions (see for example Semet et. al., 1999), bandwidth oriented pricing (see for example Varian, 1999), QoS based pricing (see for example Fishburn and Odlyzko, 1998), usage based pricing for transmitted volume instead of time used (see for example Carter and Gurthrie, 1995)) or content-based pricing (see for example MacKie-Mason et. al., 1996). Except of volume based tariff models, which are in use in New Zealand for pricing Internet traffic, the rest of the new tariff models have up till now experimental character.

### Charging and Billing of Telecommunication Services

Tariffs are used in order to calculate the total cost for a telecommunication service, which was used by the customer. Thus, they provide the base for charging and billing of telecommunication services. Charging is the process of determining the total cost for telecommunication services for a certain period of time. Billing is the process of notifying the customer about the charges and the legal require for payment.

Charging can take place in two ways 1) on a regular basis for an agreed upon period of time (for example monthly or quarterly) or 2) during the call. In the second case we are talking about advice of charge (AOC). Advice of charge is a special network function, which allows notification of charges before, during and immediately after a call. AOC is therefore the prerequisite for online and real-time charging and is for example applied in case of calls from public phone cabins or prepaid cards.

### Motivation for the project - The Interrelationship between Tariff Models, Charging, Billing and Switching Technology

Tariff models have a close relation to switching technology. This will be illustrated on the example of charging and billing of telephone calls.

A customer makes a telephone call. The connection is set-up by network switches. As soon as the connection is set up, the switch creates a data record. This so-called charging record contains all relevant data for the calculation of cost of the call, e.g. to identify the customer (via the telephone number). This data is stored right at the beginning of the call. Additional parameters are measured and added to the charging record dur-

ing the call. Thereby the stored information has to provide input for calculation of total costs based on the chosen tariff model.

Charging records are usually transferred upon request to a specialized center, the billing and customer administration (BCA), for further processing. At the end of the month, all charging records are processed by the BCA to a bill.

The telephony example demonstrates the interrelationship between used tariff models and applied technology. Switching technology has to collect the appropriate information necessary for the selected tariff models, to store it and to transmit it to the BCA and/or to the customer directly. For the design of switches important aspects related to tariff models and charging are:

- the parameters, that should be measured,
- the volume of charging information, which has to be stored at the switch and transmitted to the BCA or to the customer,
- real-time feedback to the customer about occurred costs for transmissions.

Prevailing technology was developed to support two part tariff models, which measure usage in time units, and might not include all necessary functions for the support of other tariff models.

In order to determine the applied tariff models and pricing strategies after liberalization a broad empirical survey of the Swiss telecommunication market was conducted. The results are presented in the next section.

## EMPIRICAL SURVEY OF TARIFF MODELS AND PRICING STRATEGIES AFTER THE LIBERALIZATION OF THE SWISS TELECOMMUNICATION MARKET

### The Applied Survey Approach

The survey concentrated on the end consumer market, i.e. on services, which are of importance for end customers: telephony, mobile voice communication and Internet.

The following aspects were investigated:

- services offered
- pricing strategies for the different services

The collection of information was performed in three phases: In the first phase, which lasted from March to October 1998, an initial collection of information about offered services and prices was conducted through analysis of web-pages and marketing material of providers for telecommunication services. In a second step interviews were performed in order to get missing information.

### Major Survey Results

#### *The Structure of the Liberalised Swiss Telecommunication Market*

After liberalization the structure of the Swiss telecommunication market changed remarkably. According to the valid telecommunications law issued 30.04.97 by the Swiss Federal Office for Communications, any organization, which has the necessary capacity and can furnish convincing proof, that it can provide telecommunication services with a defined quality can get a license (OFCOM, 97). The right to provide telecommunication services is not bound to possessing an own network. This opens a wide range of options for provision of telecommunication services. As a result different kinds of providers entered the market:

1. Network operators, who own a network and offer a large assortment of services. In this category fall the former monopolist Swisscom ([www.swisscom.ch](http://www.swisscom.ch)) and its major competitors Sunrise ([www.sunrise.com](http://www.sunrise.com)) and DiaX ([www.diax.com](http://www.diax.com)).
2. Service providers, i.e. brokers who do not own a network, but offer services via the networks of other operators.
3. Network operators, who own a network and resell a part of their capacities ("reseller").
4. As a fourth category we can mention providers, which do not belong only to one of the categories mentioned under point 1-3, but offer a combination of services.

The above four categories represent providers, which are involved in provision of telecommunication services. In addition to that, a new type of information brokers emerged, who provide comparing information about prices offered by the different providers (see for example [www.comparis.ch](http://www.comparis.ch) or [www.allo.ch](http://www.allo.ch)) (Wewerka et. al., 1999). This are usually Internet companies, i.e. cybermediaries, which also provide click-through to the provid-

ers.

Despite the liberalization and deregulation of the market in global, Swisscom, the former monopolist, still retained a special position on the market. The company was transformed into a joint-stock company, but the state remained the main stakeholder and influenced the liberalization procedure (Jansen-Lecroix, 99). As a consequence a very important segment of the market, the so called "last mile" was not deregulated and unbundled from Swisscom services and operations. New entrants on the market, which possessed their own network still have to lease the last mile from Swisscom.

Swisscom takes advantage of this situation and even though interconnection prices were reduced, they still remained over the average European level. This had remarkable influence on competition. For new entrants it is not possible to offer competitive prices for local calls. As a result at the beginning competition focused on long distance calls. But soon it became clear, that in order to be competitive and attractive especially for business customers, service providers must offer the full range of services. Thus, few months after liberalization most of the new entrants started to offer local calls, but have to subsidize them by long distance calls.

Until the end of 1998 the distribution of market shares among the incumbent and new entrants was as given in table 1.

Table 1: Estimation of Turnover and market shares of Swisscom and new entrants per December 1998 (Pelda, 98).

|                     | Swisscom                   |                        | New Entrants               |                 |
|---------------------|----------------------------|------------------------|----------------------------|-----------------|
|                     | Turnover<br>(in mill. Sfr) | Market<br>share (in %) | Turnover<br>(in mill. Sfr) | Market<br>share |
| National Calls      | 2300                       | 96                     | c.a. 100                   | 4               |
| International Calls | 1300                       | 87                     | c.a. 200                   | 13              |
| Number of Calls     | 1000                       | 95                     | c.a. 50                    | 5               |

#### Tariff Models and Pricing Strategies for Telephony

Before liberalization telephony, i.e. voice communication over the fixed network, was charged based on a two part tariff model consisting of:

- A fixed monthly access fee and
- Ramsey pricing for defined time units of network usage. Prices were differentiated according to type of customer, distance of the call, time of the day and day in the year (holidays and working days).

New providers of telecommunication services applied the following pricing strategies:

- *Application of Ramsey Pricing for time units of network usage*

New entrants basically took over the Ramsey pricing part of the former monopolist's two-part tariff model. They do not charge entrance fee, as the last mile is still controlled by Swisscom.

- *Aggressive price policy*

The new entrants tried to differentiate themselves and to attract customers by remarkably lower prices compared to the prices of the incumbent. Most entrants even used the percentage of reduction against the price of the incumbent as a major marketing slogan. As a result, since the beginning of liberalization prices for voice communication have dropped for more than 50 %.

- *New differentiation strategies as part of Ramsey pricing*

Even though new entrants adopted Ramsey pricing, they tried to differentiate by changing some of the parameters of these calculation scheme. In particular each entrant tried to define:

- different time units, for which prices were defined,

- different time intervals as peak and off-peak intervals with different prices. For example, Sunrise has a night tariff from 11 p.m. to 8 a.m. the next day. Compared to that, the night tariff starts at Swisscom and DiaX at 10 p.m. until 6 a.m. the next morning (see picture 1).

#### • Introduction of discounts as part of the aggressive price politics

As a further differentiation strategy of new providers, the numerous discount models have to be mentioned. Discount are offered on:

- costs for calls to one or several predefined domestic and/or international telephone numbers,
- costs for calls to telephone numbers with the highest monthly turnover,
- on total costs occurred during a given period of time (for example month).

Discounts are furthermore combined to complex discount systems defined over several services as voice communication, mobile communication and Internet.

The discount rates and the strategies for which kind of calls discounts are offered differ from provider to provider. Private and business customers are treated differently as well.

#### Development in Mobile Communication

The market for mobile communication showed less dynamics and competition compared to the market for voice communication based on the fixed network. This was due to the late approval of licenses for providing mobile communication services. Licenses for mobile communication were approved by ComCom for three provider Swisscom, Diax and Orange in April 1998. DiaX was the first one of the new entrants on the market who started operation of his mobile network in December 1998.

Currently there are no concrete plans for approval of additional licenses. This is also due to the great resistance of Swiss inhabitants against the building of antennas because of the smog. Possible health consequences provoked a broad public discussion against mobile base stations.

The small number of competitors in mobile communication resulted in less competition and even though prices declined, this was far less than the decline of prices for voice communication.

With respect to applied tariff models, the same observations can be made as with telephony. Before liberalization mobile communication was priced with a two part tariff, consisting of a fixed monthly access fee and Ramsey pricing per time unit of usage. The same tariff model is also used after liberalization by the two new competitors, but again with a redefinition of basic parameters. Diax for example offers a certain amount of free minutes per months as part of the fixed monthly access fee. Each minute exceeding the free amount is charged according to Ramsey pricing. DiaX also defined normal and low-tariff time of the day different than Swisscom.

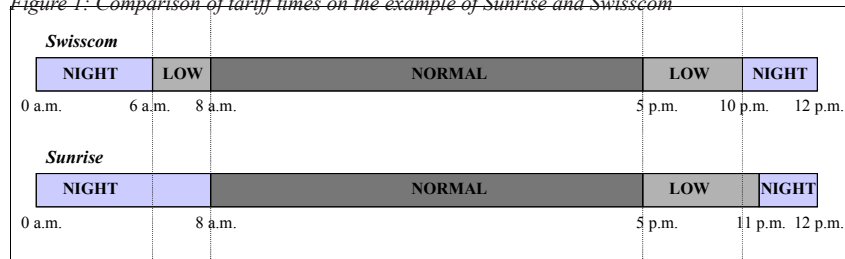
Another important change is the growing importance of advice of charge and prepaid cards for mobile communications. Prepaid cards apply Ramsey pricing, i.e. a linear tariff for usage and advice of charge as the cost of each call is deducted from the amount on the card. Even though the price per unit is higher as it includes a portion of the fixed fee, prepaid cards are popular as they enable an easy control of total costs for communication. Prepaid cards are especially interesting for young people with limited budget for communication.

#### Development of the Internet Market

Before liberalization Internet access via telephone for private customers was charged according to a two part tariff model: a fixed monthly charge for a certain amount of hours of usage and a linear tariff for any additional hour exceeding the hours included in the fixed access fee. In addition, the telephone connection during the Internet sessions is charged according to the lowest local tariff offered.

Due to the strong competition providers were constantly increasing the number of hours included in the fixed monthly charge, which was a clear trend towards a flat rate. A major breakthrough on the Internet segment of the market was reached in February 1999, when one of the new entrants - Econophone - introduced free Internet access for his customers, i.e. subscribers to voice communication. Only telephone costs are charged during Internet access. The initiative of Econophone was soon followed by other competitors.

Figure 1: Comparison of tariff times on the example of Sunrise and Swisscom





### Summary Discussions of Changes after Liberalisation

Based on the findings described in the sections above the following conclusions can be made:

- The example of Switzerland shows, that the deregulation approach can have considerable effects on development of competition.
- Liberalization of the Swiss telecommunications market did not lead to application of new tariff models, yet.
- The basic differentiation strategy of new entrants was aggressive price politics.
- An other differentiation strategy of entrants was the redefinition of the parameters in Ramsey pricing and the introduction of numerous discount models, which resulted in great intransparency of the market.
- Radical changes took place in the Internet market, as pricing strategies changed from a two part tariff to flat rate and free access.
- Obvious is also the growing importance of advice of charge and various prepaid cards which are based on advice of charge.

This means that the developments on the Swiss telecommunication market basically followed the patterns observed at other liberalized markets. The neglectance of other possible tariff models can be explained with the following reasons:

- The new entrants faced at the beginning difficulties to provide the promised services and to establish efficient customer service. In addition, they were from the beginning in an unfavorable position, as their services could be used only through special dial-in numbers. Thus, they did not want to complicate more than it was necessary.
- Due to the monopoly, the profit margin included in the prices of the incumbent was high enough to provide a great opportunity for a price war. An aggressive price politics is also a great marketing instrument and much more adequate for attacking of new customers
- Discounts are also very efficient marketing instruments and enable individualized pricing.
- In the first two years of competition the offered services remained the same. New services as interactive TV, video on demand or broad usage of video conferencing, which might require high Quality of Service and bandwidth are still not in use.
- The introduction of free access and flat rate for popular services as Internet is expected to increase demand for voice communication.

### POSSIBLE SCENARIOS AND FUTURE ACTIONS

But can this trend of price decrease continue? What could be the future pricing strategies? The survey results were used to develop future scenarios, which are explained shortly.

- The intransparency of the market requires real time feedback for the customer, i.e. advice of charge. AOC is currently available during the call and after the call, but AOC before the call can increase the transparency of the market and is getting high attention.
- An other possible development is the combination of different tariff models for the same service. For example in other countries first attempts can be observed with free voice communication, which is financed by advertisements. An other example is the combination of a two part tariff during the week with a flat rate during the weekend.
- Application of combined tariff models for several services. For example free Internet bounded to subscription to the provider.
- Application of different tariff models depending on the content transmitted.
- Tariff models based on QoS.
- Volume based tariff models.

### CONCLUSION AND FURTHER WORK

In the paper first the results of the empirical survey were presented.

Based on the findings some future scenarios were suggested. Currently, the requirements of the future scenarios on switching technology are assessed. Thereby, possible effects are visualized with a specially implemented simulator.

### ACKNOWLEDGEMENTS

The author thanks the Swiss National Science Foundation and Alcatel Switzerland Ltd. for their financial support to the project. Many thanks also to the student Juliane Kaestner, who collected the empirical data and the other project partners for the fruitful discussions and comments.

### REFERENCES:

- Anania, L., Solomon, R.J. "Flat: The Minimalist B-ISDN Rate", Internet economics edited by McKnight L.W. and Bailey J.P., Presented at MIT Workshop on Internet Economics, March 1995, Also: <http://www.press.umich.edu/jep/works/AnaniaFlat.html>
- Carter, M.; Guthrie, G.: "Pricing Internet: The New Zealand Experience". Discussion Paper of the Canterbury University, New Zealand, 1995, <http://www.econ.canterbury.ac.nz/dp1995.htm>.
- Fishburn, P.C.; Odlyzko, A.M.: "Dynamic Behavior of Differential Pricing and Quality of Service Options for The Internet". In: Proceedings of the First International Conference on Information and Computation Economics (ICE-98), ACM Press, 1998, pp. 128-139.
- Gupta, I., Jukic, B., Parameswaran, M., Stahl, D.O., Whinston, A.B. "Streamlining the Digital Economy: How to Avert a Tragedy of the Commons", IEEE Internet Computing, November-December 1997, 38-46.
- Jansen-Lacroix, A. "Gefährdeter Liberalisierungsprozess im Telekom-Sektor", Neue Zürcher Zeitung, 20.10.99, [http://www.nzz.ch/online/02\\_dossiers/telekommunikation/nzz991020jansen.htm](http://www.nzz.ch/online/02_dossiers/telekommunikation/nzz991020jansen.htm).
- MacKie-Mason, J.; Shenker, S.; Varian, H.R.: "Service Architecture and Content Provision: The Network Provider as Editor". In: Telecommunications Policy, 1996.
- McKnight, L.W., Bailey, J.P. "Internet Economics: When Constituencies Collide in Cyberspace", IEEE Internet Computing, November-December 1997, 30-37.
- Mitchell, B. and Vogelsang, i.: "Telecommunications Pricing", Cambridge University Press, 1991.
- Morris, D. and Verus P. "Charging for ATM Services". In: IEEE Communications Magazine, May 1999, pp.133-139.
- OFCOM. "Swiss Telecommunications Law", Issued 30.04.1997, Swiss Federal Office for Communications, <http://www.bakom.ch/eng/subsubpage/document/130/381/>.
- Pelda K. "Eine Zwischenbilanz nach elf Monaten Liberalisierung", Neue Zürcher Zeitung, 08.12.98, [http://www.nzz.ch/online/02\\_dossiers/telekommunikation/tlkm981208kp.htm](http://www.nzz.ch/online/02_dossiers/telekommunikation/tlkm981208kp.htm).
- Rupp, B. "Preistrategien für ein integriertes Universal-Internet", Tagungsband Wirtschaftsinformatik '97, 1997, 49-69.
- Semet, N.; Liao R.R.-F.; Campbell, A.T.; Lazar A.A.: "Market Pricing of Differentiated Internet Services". In: Proceedings of the 7th Workshop on Quality of Service, London, UK, June, 1999.
- Varian, H.: "Differential Pricing and Efficiency". In: First Monday, Vo. 1 No. 2, 1996, <http://firstmonday.org/issues/issue2/different/index.html>
- Varian, H.: "Estimating the Demand for Bandwidth", Internal Report University of California Berkeley, 1999, <http://www.INDEX.Berkeley.EDU/public/index.phtml>.
- Walker, D., Kelly, F., Solomon, J. "Tariffing in the new IP/ATM environment" Telecommunication Policy (21:4), 1997, 283-295.
- Wewerka G.; Picard, A.; Walder, U.: "Tarifvergleiche im Internet". In Neue Zürcher Zeitung, 18. May, 1999.
- Williams, J. "Internet Billing: Out With the Old". Telecommunications, November 1997, 113-116.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/proceeding-paper/swiss-telecommunication-market-after-liberalization/31556](http://www.igi-global.com/proceeding-paper/swiss-telecommunication-market-after-liberalization/31556)

## Related Content

---

### Research in Information Systems

(2012). *Design-Type Research in Information Systems: Findings and Practices* (pp. 51-75).

[www.irma-international.org/chapter/research-information-systems/63105](http://www.irma-international.org/chapter/research-information-systems/63105)

### Probability Based Most Informative Gene Selection From Microarray Data

Sunanda Das and Asit Kumar Das (2018). *International Journal of Rough Sets and Data Analysis* (pp. 1-12).

[www.irma-international.org/article/probability-based-most-informative-gene-selection-from-microarray-data/190887](http://www.irma-international.org/article/probability-based-most-informative-gene-selection-from-microarray-data/190887)

### Information Visualization Based on Visual Transmission and Multimedia Data Fusion

Lei Jiang (2023). *International Journal of Information Technologies and Systems Approach* (pp. 1-14).

[www.irma-international.org/article/information-visualization-based-on-visual-transmission-and-multimedia-data-fusion/320229](http://www.irma-international.org/article/information-visualization-based-on-visual-transmission-and-multimedia-data-fusion/320229)

### An Efficient Image Retrieval Based on Fusion of Fast Features and Query Image Classification

Vibhav Prakash Singh, Subodh Srivastava and Rajeev Srivastava (2017). *International Journal of Rough Sets and Data Analysis* (pp. 19-37).

[www.irma-international.org/article/an-efficient-image-retrieval-based-on-fusion-of-fast-features-and-query-image-classification/169172](http://www.irma-international.org/article/an-efficient-image-retrieval-based-on-fusion-of-fast-features-and-query-image-classification/169172)

### The Systems Approach View from Professor Andrew P. Sage: An Interview

Mirosljub Kljajic and Manuel Mora (2008). *International Journal of Information Technologies and Systems Approach* (pp. 86-90).

[www.irma-international.org/article/systems-approach-view-professor-andrew/2540](http://www.irma-international.org/article/systems-approach-view-professor-andrew/2540)