business models in telecommunications

Telco’s Next Battleground

Efficient Partner Management – how it will contribute towards success?

IPTV-VNO – a new business model for IPTV
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4. **Telco’s Next Battleground**
   With an increasing number of mobile subscribers moving to third-party provided applications, the carrier’s role as a service provider has weakened. Carriers continue to offer legacy services, while investing in the development of next generation communications applications but they now must compete with agile and innovative software houses and service providers. If carriers fail to keep a significant service market share, their role will be limited to that of bit pipes that only supply the network, while the revenue from the lucrative part of the business will shift away.

8. **Efficient Partner Management**
   How it will contribute towards success?
   Business models in the telecommunications market are changing. The increasing amount of partners that are involved in the operator’s service offerings, bring about the need for an appropriate partner relationship management (PRM) solution. This article discusses the business benefits that PRM will bring to operators.

11. **IPTV-VNO**
   A new business model for IPTV
   IPTV-VNO can become one of the most widely known telecom acronyms. Many large, well-known brands may consider IPTV-VNO initiatives. There are many exciting new IPTV concepts that are perfectly suited to this model. IPTV-VNO’s can truly add value for customers.

13. **Convergence in Network and Service Management**
   The competitive market of telecommunications nowadays encourages operators to look for different sources of revenue and cost optimization. It happens that fixed operators, in order to offer mobile services, establish separate companies with their own organizational structure and independent network. Then, the majority of mobile operators also deliver internet access services through hotspots. In addition, currently the trend is to outsource parts of the network, including backbone, physical or RAN. All of these circumstances and the historical background have a large impact on network management systems.

16. **How to move Service Assurance to the Next Level**
   The Common Service Monitoring Engine as the heart of Next Generation Service Assurance
   Delivering services to the customer is the lifeblood of an operator’s business. How can operators ensure the proper quality of offered services to fulfill customer expectations? This article will review emerging trends in service management and examine the benefits of the Next Generation Service Assurance concept.

22. **Managing MPLS networks**
   Recently operators have been implementing Multi Protocol Label Switching (MPLS) infrastructure that unifies IP VPN and other data services. MPLS has been adopted as it allows the quick and easy creation of secure IP VPN services, which represent a less costly alternative to traditional leased-line circuits. Enterprise demand has made IP VPNs one of the fastest-growing sources of data revenue for service providers, therefore speeding up the development of MPLS networks.

26. **OSS and CRM Integration that pays**
   The telecommunications industry, although still technology-driven to a great extent, is no different from any other in terms of what customers basically ask for. They look for products that fulfill their needs conveniently, for a fair price, and if something goes wrong, they want the problem to be solved reasonably and fast. Unfortunately, in reality, suboptimal processes in the areas of sales, order fulfillment and trouble ticket management too often negatively impact customer satisfaction and, eventually, the bottom line. It has frequently been said that lack of genuine customer focus or constant process improvement largely contribute to poor results, so it won’t be discussed here again. What is truly worth attention, though, is how much can be done for profitability just through tighter integration of CRM and OSS.

29. **Comarch Product Catalog as the key aspect of Service Delivery Platform**
   Having customers with high expectations forces operators to expect more and more from their systems. Service Delivery Platform helps deliver new products faster and more conveniently. An efficient product catalog acts as the heart of the platform providing operators with a flexible interface to define new offers.

32. **On Marrying Ontologies and Software Technologies**
   MOST Project
   Following “Web 2.0” as a term describing the recent evolution of the Web, a new term “Web 3.0” has been introduced to describe a future wave of Internet innovation. It has been associated at this point mostly with concepts of the Semantic Web. Yet technologies that back up the new approach stem from traditional studies on Artificial Intelligence and are flexible enough to be leveraged by other domains. In this article we introduce the Marrying Ontologies and Software Technologies (MOST) project that tries to improve Software Engineering through Semantic Technologies (MOST). As a part of the project the new approach will be evaluated in the case study on the development of solutions based on Comarch OSS Suite.

36. **The Comarch OSS Suite as a Management Platform for Next Generation Optical Networks**
   Mango – Eureka/Celtic Project
   In order to challenge recently emerging issues concerning optical network management Comarch, together with international partners (operators, a research institute, an SME and different universities), conduct the Eureka/Celtic project Management Platform for Next Generation Optical Networks (MANGO). One of the goals of the MANGO project is to perform and evaluate a pilot of an integrated network management platform for next generation optical networks.
Telco’s Next Battleground
A new role for Telecommunications operators

The most important evolution in the outlook of the telecommunications industry is the diminishing role of landline services in favor of wireless technology. Strong competition in the mobile arena, the ever-increasing popularity of 3G technology, and the emergence of 4G, have made broadband data plans affordable for mainstream consumer acceptance. At the same time, handset vendors are pushing new devices with larger screens and user-friendly interfaces, supporting a multitude of mobile platform applications that used to only be available for PCs.

Although some next-generation mobile applications are still being developed indigenously by carriers in their IT laboratories, many successful ones come from independent third-party providers who do not have direct access to mobile customers, but who are often well established in the Web 2.0 world. For application providers, mobile devices are just another way of providing access to websites like Facebook, Eventful or Whrrl. For customers who have already replaced their desk phones with Skype, their emails with Facebook and news sites with Digg, mobile access extends the convenience of taking their networks and personalized information from their desks and laps and into their hands. What else is needed in order to eliminate traditional telephony, messaging and content offered by today’s telecom carriers? If a social network offers a mobile interface with up-to-the-minute status updates, convergent messaging, voice and video, all location-aware and integrated, then what is the value of the tried-and-tired voice service with its static address book and its busy signal as the only information of one’s presence?

With an increasing number of mobile subscribers moving to third-party provided applications, the carrier’s role as a service provider has weakened. Carriers continue to offer legacy services, while investing in the development of next generation communications applications but they now must compete with agile and innovative software houses and service providers. If carriers fail to keep a significant service market share, their role will be limited to bit pipes that only supply the network, and the revenue from the lucrative part of the business will drift away.

Is the customer the only source of revenue?

Mobile and landline carriers, ISPs and Cable TVs extend the value of their offerings by introducing triple and quad-play and providing complete communication packages that include TV, mobile telephony, landline, and internet access. As they become multi-service operators, including all possible applications in their offers, other business models come into play.

The traditional telecommunications business model represents a revenue stream that comes from customers. In the new approach, customers are no longer the only ones who pay the bills. Mobile advertisers and e-commerce merchants have an ever increasing role in the revenue chain.
The emergence of these new merchants and providers in the mobile arena leads to additional revenue, but not necessarily for telecommunications service providers. Mobile service aggregators like Google, Yahoo, Apple or Facebook are already exploring this market and are succeeding in monetizing mobile advertising. End-customers pay only a part of the price of mobile services while the rest of the revenue is collected from advertisers.

Forecasts predict significant growth of the mobile advertising market over the next few years. This will be possible due to increasing adoption of mobile internet as well as implementation of larger screens on mobile devices, leaving more real estate for advertisers.

Transformation of advertising expenditure and new opportunities for advertisers also contribute to changes in the business model for mobile providers. First of all, a mobile device stays with the user all day. We grab our phones when we wake up and keep interacting with them until we go to sleep. There is no other marketing channel that provides similar, continuous contact with the target. Users listen to the radio, watch TV, use computers or read newspaper for only few hours a day. Mobile phones are with customers all the time.

Some may say, having constant access to the customer does not necessarily mean more ads can be delivered. But what if ads can be perfectly targeted and provided precisely when and where they are really needed? What if advertisers know who the customer is, where they are located and what they are looking for? Correctly targeted advertising could be appreciated, if not desired, by customers and result in dramatically improved response rates.

Technologies like mobile RFID, LBS, 2D bar codes and real-time video processing support mobile marketing and enable accurate targeting, making it significantly more attractive to customers than any other form of advertising.

Over the past few years many consumers, especially the younger generations, have realized that social networks take communications to the next level. Instead of sending vacation pictures to our friends and family or calling them with invitations to birthday parties, consumers now use social networks to let the outside world know about their lives. It seems only natural for users to move from the desktop application to the mobile terminal and take their social network on the go. For the mobile industry, this fact represents a significant change, even a revolution. For many users, the mobile version of Web 2.0 could become the most commonly used application on their phones.

All this puts tremendous pressure on traditional voice and data service providers. Analysts predict that by 2012, the number of traditional mobile voice minutes in Europe will drop by more than 40%, and will be replaced by other applications like VoIP, social networks or click-to-call.

Carriers are trying to navigate this new world by offering next-generation applications that could respond to the new demands of customers and prevent them from moving to third-party providers. Is this the right direction for carriers? Shouldn’t they accept the fact that the best applications will be developed by those who specialize in these areas? Carriers have a lot to offer as aggregators, combining networks with third-party applications, content and advertising. Platforms equipped with the following attributes provided by carriers would become unique and valuable propositions for independent application providers:

- Their own customer base
- Their own network
- Brand recognition
- Marketing data
- Location data
- Identity and Authentication
- Policy Management
- Established invoicing and payment channel

**Customer-centric vs. telco-centric model**

Depending on how mobile carriers react to the changing market environment, there are two overarching models that can be foreseen as a future configuration of the mobile industry. Carriers will either continue to position themselves as dominant service, content and device providers, or they will adjust to changes by offering attractive delivery platforms for external third party providers.

In the first scenario, carriers would not be able to compete with other providers, and could merely become “bit pipes” losing a significant part of the revenue. In this customer-centric model, carriers lose their dominant role in the value chain. This is very analogous to what happened to internet service providers. ISPs have no control over where and what equipment customers buy as long as it is compatible with their networks, what service customers use for email, IM and VoIP calls, who the content provider is, and ultimately who delivers ads. The ISP is just a part of the value chain.

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**Figure 2  Mobile Advertising Revenue Growth, Worldwide, 2006-2011**

Source: Gartner (January 2008)
and it is up to the customer to decide which providers will deliver the rest of the internet experience to them.

The **second model** is much more promising for telecommunications operators as it places them in the center of the ecosystem with an assumption that they are able to serve as a delivery platform, supporting both customers and other service providers. In this Telco-centric scenario, the customer is not exposed to any individual external provider but is rather offered an aggregated service from the telecom carrier. There is a single bill, integrated payment and identity management provided by the carrier throughout the platform. From the customer's perspective, this model is similar to the traditional approach the industry has had over the past decades. The real difference lies within the operational ecosystem. Telecommunications carriers, instead of trying to develop and add new services to their portfolios, enable external providers by offering the delivery platform for their services. Such a platform simply opens up access to the carrier's customer base, streamlining order management and billing processes for all the operational ecosystem members.

It is probably too early to gauge which model will become the dominant one, but it is clear that the Telco-centric model is beneficial to both external providers as well as carriers. Customers also gain more from this model than they would from the customer-centric one. The customers will still have the advantage of choosing the service and provider but they do not have to struggle with mixed delivery standards and multiple front-ends. It is crucial for carriers to recognize this opportunity and realize that the Telco-centric model can only be implemented if they reorganize, open their networks, develop service delivery platforms and make them attractive for external providers.

**Summary**

Telecommunications carriers need to find a way to incorporate social networks and other Web 2.0 related services into their offerings, even in lieu of losing partial revenue from less attractive on-deck applications. They have to strike a balance between their ambitions to utilize their own service development potential and the need to compete with experienced Web 2.0 players. Carriers should put more focus on enabling their networks and OSS/BSS systems to aggregate, offer and support services provided by third-parties while capturing a significant share of the mobile advertising market.

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**Greg Kwiatkowski**

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Efficient Partner Management

How Will it Contribute Towards Success?

Due to the earlier business models employed many years ago, the problem regarding the exchange of information between partners was not considered to be as important as it is today. This is because the total amount of information exchange between partners was not as high. This ongoing trend, where operators reduce their operational costs when facing reduction of revenue growth from traditional services, has caused operators to pay more attention to business process automation.

In the near future, when legacy networks will be transformed to IP-based networks, the business influence of third parties on the business models is expected to grow, highlighting the importance of an effective partner management system. When operators have multiple partners, interaction can become
complex, especially if multiple forms of information flows exist between the operator and their partner.

Business problem 1: High amount of information
Currently, the typical scenario where the importance of efficient partner management can be seen is in the case when the operator rents an access line to an external partner. The external partner then sells network access services to end subscribers. The reason for the popularity of this kind of business scenario is that the regulative environment demands more open environments to increase competition. The business scenario of line rental also translates into a large amount of information that is exchanged between partners and the operator. This kind of information can include agreement definitions, management of disputes, management and collection of debts, and multiple ways of communication to deliver the information (phone, e-mail, fax...).

Business problem 2: Multiple applications and flows of information
Having multiple applications to handle partner communication and information exchange can lead to a situation where introducing new functionalities to the existing system becomes complex and expensive. The common situation can occur, for example, when the operator wants to introduce new services to the existing environment, but the legacy application the operator is using, may not support this new type of service. The service integration to the existing platform may become expensive.

The business problem of multiple information flows is shown below. Many different systems and many different forms of communication cause complex interaction between partners. This leads to increased operational costs as well as frustration for the partners.

Business problem 3: Complexity of the SLA audit
The SLA audit process can be complicated to perform efficiently without an appropriate PRM system. Typical parameters in the SLA agreements can be such things as time limitations for resolving a problem and quality indicators for specific services. For example, a trouble ticket should be resolved within a specified period of time in order to avoid an SLA violation.

Business problem 4: Dispute management
Cooperation between an operator and partner does not always happen without disputes. One typical situation where a problem can occur is the existence of discrepancies related to reference data (e.g., differences in the settlement reports). Another problematic situation can be when there are technical problems related to the lines that the partner has rented from the operator. When operators and partners interact to resolve the disputes, extra effort is needed from personnel of both companies causing additional operating costs. In addition, the quality of dispute management processes is difficult to keep at a high level, if the critical processes connected to processing disputes are not automated.

Solutions for business problems
Automated business processes can be used during all stages of interaction with partners: during agreement definition, price management, communication channel management (e.g., automatic processing of e-mails) and order management. Bringing a high level of automation to all of these processes (not only limited to those mentioned here) reduces the need to use several different systems and also reduces the effort that is needed to manage the system properly. The advantages of automation are shown below.

Solving a dispute is an issue that is not related to technology – it is related to knowledge. Disputes should be categorized and solved using an appropriate trouble ticketing system that can support the problem resolution process by collecting and showing relevant information about the problem. Usage of trouble ticketing reduces the time and effort to solve these problems and allows the system user to see relevant information during all stages of the problem-solving process. In addition, reconciliation is an efficient tool in the support of dispute resolution, allowing discrepancies in the settlements to be found.

For an operator that has a large amount of agreements with partners (e.g., in the line rental case), efficient business processes for the management of agreements are important. Automation of agreement management processes can be implemented for many situations. During the agreement negotiation process, the usage of agreement templates reduces the time to introduce agreements into the system. It is also important in order to manage the end dates properly – the agreement time period may need to be extended, or a reminder about an existing agreement deadline should be sent to start new negotiations. There may also be other reasons for starting negotiations regarding a new agreement. For example, if the agreed upon amount of the partner’s data transmission quota has expired, the operator may want to negotiate another pricing plan.

The PRM system should have open architecture to enable easy integration with external sys-
tems. Similarly, the addition of new services (that the partners may use) to the existing platform should be simple in order to minimize time-to-market and to enable earning revenue from the new service as soon as possible. Additionally, in order to reduce CAPEX, it should be possible to manage services from one system instead of many individual systems. The usage of automated processes also provides savings in the form of reduced OPEX. The risk of SLA violations becomes lower because of improved SLA management. Also, in the event of SLA violations, penalties are automatically calculated and can be applied in the form of discounts.

From the partner’s point of view, the communication experience with the operator will be improved as the partner receives up-to-date information about order statuses, agreements and prices.

**Insight into future trends**

The telecommunications environment is changing. Operators are migrating their legacy networks to IP-based networks. This brings about more business opportunities for third parties in the form of advertisements, loyalty programs, etc. The changing environment involving more partners in business scenarios also has the effect of blurring the distinction between the roles of a partner and end-subscriber. In the telco 2.0 environment, the end subscriber may actually provide content to the operator, to be used in the offered services. In exchange for the content, the end subscriber may get a commission or discount for his usage of the services. These kinds of scenarios highlight the need for appropriate billing, commissioning and partner management solutions.

**Conclusions**

Appropriate interpartner settlements and revenue assurance scenarios between operators and partners are needed when the amount of service offerings for end subscribers increase. One contributing factor for the increasing role of third parties is also the regulation that intends to increase competition on the market. Changing business models with increasing amounts of partners involved in business scenarios will result in an increase in the amount of money on the wholesale market. Furthermore, partner relationship management will have an essential role in that business.
IPTV-VNO can become one of the most widely known telecom acronyms. Many large, well-known brands may consider IPTV-VNO initiatives. There are many exciting new IPTV concepts that are perfectly suited to this model. IPTV-VNO’s can truly add value for customers.

IPTV Market
The term IPTV (IP television) first appeared in 1995. Originally during this time, there was not enough bandwidth to transmit live TV to homes and thus there was not enough headroom with which to apply added value and enable transmission over IP to be attractive. Recently this has started to change.

Current strategies for deploying IPTV solutions for most network operators include a combination of delivering LIVE TV channels over a broadband connection, adding basic interactivity and finally access to a Video-on-Demand service. The growing functionality of set-top boxes (IP-STB) allows network operators to build new business models and new sources of revenue. Within the next few years,
Comarch Next-Generation TV

The Comarch NGTV solution allows broadband and mobile operators to provide interactive TV services across various devices including TV sets, mobile phones and PCs.

For customers, our solution provides a next-generation experience with many sophisticated features such as an Electronic Program Guide (EPG), Video-on-Demand (VOD), Music-on-Demand (MOD), visual radio, online shopping, online access to Google's Picasa™ photo galleries, personal TV profiles, favorites and much more.

For operators, the Comarch NGTV suite provides a complete IPTV middleware that is easy to integrate and is customizable, reliable and cost-effective. It can be used for delivering various third-party premium interactive TV services. It also supports open standards and integration with products of leading head-end, VOD, CAS/DRM and set-top box vendors.

Comarch NGTV is a basis for innovative business models such as NGTV Ecosystem and IPTV-VNO, acting as a bridge between Internet and television services.

the main emphasis will be on interactivity, personalization, social services and advertising.

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The nature of IP-based services means that you can deliver content and services everywhere independent of the end-user terminal supporting IP. Televisions offer an opportunity for an exceptional user experience of multimedia services due to content quality and simplicity of use. The second important accelerator of IPTV market growth will be Fiber-to-the-home (FTTH) networks.

New business models

An innovative technology often generates innovative business models. In the case of IPTV, one of the most promising opportunities is delivering services through the networks of existing FTTH/DSL operators by external retail companies. We call this IPTV Virtual Network Operator or IPTV-VNO. This model is quite similar to the Mobile Virtual Network Operator (MVNO). An IPTV-VNO is a company that provides an IPTV service, but does not own its own network infrastructure. Instead, it uses the FTTH/DSL infrastructure of an existing network operator and has the required IPTV infrastructure deployed on that network. At a minimum, an IPTV infrastructure is usually comprised of IPTV Middleware, a CAS/DRM system and VOD servers. Additional components include what is commonly referred to as a head-end, which is a set of systems responsible for sourcing and encoding live TV content. A head-end is crucial and expensive however it is optional in various cases given that live channel feeds may be received directly from another IPTV operator, who has already deployed a head-end.

IPTV revenue sources

There are several new business opportunities for an IPTV-VNO. Core services that can be offered include premium TV channels, EPG and VOD. What we refer to as interactive services go beyond this and include things such as quizzes, dating services, access to Internet services (PicasaWeb™ etc.), internet radio access and so forth. The third promising area is online shopping and interactive advertising. An advertisement can be displayed before and/or after viewing a movie and the user can access more information regarding the product displayed. The order can also be submitted online and payment may be added to the IPTV monthly bill. For example, when a user starts to watch a movie, they can be asked if they want to order a pizza. If the user agrees, then they can browse through a pizza menu and subsequently place an order. Personalized advertising known from the Internet can be one of the key factors pushing IPTV forward.

The key to IPTV-VNO success

IPTV-VNO can become one of the most widely known telecom acronyms. Many large, well-known brands may consider IPTV-VNO initiatives. There are many exciting new IPTV concepts that are perfectly suited to this model. IPTV-VNO’s can truly add value for customers.

We can denote three key areas where business plans usually require more work distribution, loyalty programs and content. Acquiring new users takes more than a compelling product. It requires a set of distribution channels and efficient audience targeting. The IPTV-VNO need to build their own retail network or develop a multi-channel distribution strategy. Strategic alliances with existing retail or Internet businesses can also be a good choice. In a competitive business environment, churn is an important threat for operators. While IPTV-VNOs focus on launching and building their business, they should remember that quality and the means of how they incorporate loyalty programs can determine their success.

The top priority for a good IPTV service is interesting and high quality content. Currently, due to the high initial costs pertaining to the distribution of content from major movie distributors and their rigid distribution licensing models, this is probably the largest barrier for small players. The solution is in cooperation with content aggregators who offer content from multiple sources.

Conclusions

In summary, the main IPTV-VNO revenue sources are:

- IPTV service subscription fees
- Live pay-per-view TV transmissions
- “Content on Demand” distribution fees - Movies, Music, Internet Radio, Events and Audiobooks
- Delivery of 3rd-party premium TV services
- Interactive advertising
- Online shopping
- Retail stores
- Internet portals
- MVNOs
- DTH platforms (in hybrid mode)

IPTV is expected to be the next big thing. It seems apparent that this is an exceptionally promising technology with a high business potential. There are many business opportunities that lay behind it, and IPTV-VNO is one of the most promising ones.
Convergence in Network and Service Management

Service providers’ challenges
The competitive market of telecommunications nowadays encourages operators to look for different sources of revenue and cost optimization. It happens that fixed operators, in order to offer mobile services, establish separate companies with their own organizational structure and independent network. Then, the majority of mobile operators also deliver internet access services through hotspots. In addition, currently the trend is to outsource parts of the network, including backbone, physical or RAN. All of these circumstances and the historical background have a large impact on network management systems.

Synergies in fixed and mobile network management
Currently it is quite a common situation that telecommunications operators, delivering both fixed and mobile services, use different systems to manage mobile and fixed parts of the network. It constantly happens that backbone connections delivered by a fixed network for mobile traffic are visualized as leased lines in the mobile network inventory. The only difference is that those leased lines are provided by the company from the same business group. In such a situation the same network resource is managed twice in different Network Management Systems.

When one investigates mobile and fixed networks many similarities can be found:
- Similar technologies and hardware delivered by the same vendors used in the backbone network
- The same processes for backbone upgrade and maintenance
- The same problems in service-to-resource mapping and service delivery
- Similar services offered over different access networks

One of the possible solutions to these problems is to allocate a separate unit responsible for managing the whole backbone network. In order to
remove duplication of the network management systems an OSS solution must allow for easy assignment of responsibilities to appropriate user groups and roles. A single Network Inventory application managing the whole mobile and fixed network delivers the following benefits:

- A single repository for all the network-related information, allowing for a comprehensive end-to-end view of network connections – one source of information for Fault Management and planning tools.
- Up-to-date information about the whole network thanks to Network Reconciliation
- De-duplication of systems and tools for backbone network planning and maintenance
- Reduced CAPEX and OPEX on different network management applications

Figure 2 presents the idea of one convergent backbone and one application managing it. Convergent network management creates a framework for additional enhancements in the operations area:

- Orchestration of network growth
- Service management and delivery
- Outsourcing of the network and/or its operations

**Orchestration of network growth**

Once the network management systems are integrated, one of their main roles is to support network growth. In such an architecture network changes may be triggered by radio network upgrade or reorganization, by fixed access network needs, or just as an output of internal backbone optimization processes. The change may have different impacts, starting from a small reconfiguration of some logical connection, to building new sites and physical infrastructure. In order to automate and orchestrate these processes a tight integration of network inventory and process management is needed. The Change Management process is triggered in the context of network resources, and the above-mentioned tight integration allows for automatic calculation of the impact on affected resources. Since changes may have different scopes, some parts of the change project may be orchestrated by different systems, including financial management tools responsible for signing contracts for new sites. Such systems have to be triggered by change processes via open interfaces in SOA compliant architecture.

**Service management**

In order to fully utilize the network potential flexible service modeling should be introduced. Service models should contain definitions of required or used resources grouped in manageable internal services. One source of network information feeding service models can lead to the creation of new services, which will utilize different access networks, backbone transport and content servers in order to deliver one convergent service, regardless of the used access method. For example, mobile TV over IP may be delivered via a radio access network, but when the user with a mobile handset is at home within the coverage area of their wireless router, the service may be sent over a fixed access network.
Service Inventory also supports different domains in network management. In each domain Resource Facing Services may be defined independently by users responsible for the management of a given network domain. These services may be offered to users responsible for defining and offering Customer Facing Services. Figure 3 illustrates this idea.

Outsourcing
Currently, the outsourcing of a network and its operations is a common trend. Service providers want to focus on service delivery and, on the other hand, introduce additional cost savings. But even when the network operations or the network itself are outsourced, there is still a need to have a general picture of the network resources, both outsourced and locally managed. Outsourced parts may still be offered as Resource Facing Services in a given network domain. Operations require orchestration and automation inside the domains and between them. That is why inventory systems must allow for such network management organization and must comply with much higher security requirements for inventory data.

Outsourcing may also introduce other Network Inventory applications (even from the same vendor), and then the central Network Inventory works as the so-called manager of managers. In this case data is divided into domains which are managed by different systems, and one central inventory gathers only the data which is required to deliver an end-to-end view on network connections and network services. In the central repository Customer Facing Services are also modelled and master processes for network upgrade are triggered.

Comarch Process-Driven Network & Service Inventory
The Comarch OSS Suite includes the Network Inventory Management solution, which allows for dividing the network into domains with different user groups and roles assigned. It is possible to restrict access in such a way that certain user groups have access only to the part of the network which is under their management. It is possible to divide the domains further in order to allow the outsourcing of certain parts of the network.

Furthermore, Comarch OSS Process Management offers automation and orchestration capabilities in defining and running Change Management processes, even in large OSS environments, where responsibilities are shared among different applications.

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How to move Service Assurance to the Next Level

The Common Service Monitoring Engine as the heart of Next Generation Service Assurance
Delivering services to customers is the lifeblood of an operator's business. When the services offered are maintained with a high degree of quality and fulfill SLA agreements, when they are constantly modified according to market requirements, and when new ones can be activated quickly - the business succeeds. However, when the service management is poor, with frequent service outages due to network failures and, furthermore, when the resolution process is slow, customer experience is not in line with expectations. The evolution of telecommunication networks brings about a constant emergence of new services, with their number and complexity growing rapidly, while at the same time service lifecycles are getting shorter.

How can operators ensure the delivery of proper levels of quality for so many complex services? Fortunately, operational support systems are evolving together with operators' businesses. The growing number of services means that OSS systems have never been as important as they are nowadays. Today, operators can not even think about delivering modern services with a high level of quality without significant help from the supporting systems. This also means that Service Assurance is becoming the most critical area of modern OSS solutions.

The challenges of Next Generation Networks

The changes that have occurred in the telecommunications market in the last decade, and the transition to NGN networks that is currently happening have increased competitiveness in the telecommunications market and forced all the operators to optimize their costs and make their services much more attractive to end customers. However, this optimization can not be achieved using the previous generation of OSS systems. The move from traditional architecture to a next-generation telecommunications network poses additional problems for network management and operation. The introduction of multi-layer network architecture simplifies the development and introduction of advanced services, e.g. providing connectivity as a network layer service as in IMS, but hides the complex relationship between the services provided and the network resources used. In other words, Next Generation Networks require Next Generation Service Assurance to fully protect the services delivered to the customer and conserve operator revenues.

In the traditional architecture, the services provided were embedded in the networking equipment. Analysis of the service state was easy and straightforward. In modern networks, however, services are no longer associated with a single device in the network. Instead, each service is composed from resources provided by many devices operating within the network, or even based on many other simpler services offered by third party companies. With more advanced services offered, the structure of these services can become more and more complicated.

In the case of any failure in such a complex mesh of connected resources, the contents, suppliers, quantity and importance of the affected services usually determines the severity of the network failure. Therefore, in a next generation network, exact information about the service state is essential for network management and operation.

Let's see this problem in an example. Imagine the telephone switch in an old-fashioned network encountered a failure. In an old-fashioned network manual identification of affected customers and services was quite feasible: simply, all customers directly connected to the affected ports were cut off from the voice service. In a next generation network, the relationship between the equipment and provided services is much less straightforward. In the case of an edge router failure, it is not a simple task to determine which services are affected by this failure. Services offered over an IP network can vary, from basic residential Internet access to highly critical IP VPN for enterprise customers. Since these services are not provided directly by the edge router itself, it is usually difficult to quickly determine the set of affected services. As these are the services that are sold directly to the subscriber, the quantity and importance of the affected services usually determines the severity of the network failure. Therefore, in a next generation network, exact information about the service state is essential for network management and operation. With more advanced services offered, the structure of services can become even more complicated.

Nowadays, gathering information about the failure is also not simple. The event can be an alarm collected directly from a network element or a network management system, an end-to-end probe or a third party SLA monitoring engine, but also a Trouble Ticket generated by a call center or information from a customer self-care system. What is more, these different sources can all report together about the same outage, every one in its own way! This means that we need advanced logic
to find and present clear information for network and services maintenance staff, as well as a set of standardized interfaces to inter-connect all parts of the Service Assurance system.

However, delivering precise information about the customers and services affected by a failure is only one part of modern Service Assurance. The other is to improve the process of finding the event's root cause for an operator's staff. Supporting the engineers in the fast location of the fault's source is crucial for the operator's business. The later the reason for a failure is identified, the bigger the losses it causes. Here we come to another challenge - Next Generation Service Assurance should not only provide visibility of service states, even with failure root cause analysis, but a comprehensive solution should also proactively support the process of incident resolution to speed-up service recovery – minimizing losses. When it comes to fixing even hundreds of outages (planned and unplanned) per day with complex services based on a mesh of resources, with divided staff skills and responsibilities, often partially outsourced, doing it in an organized, optimal way with proper prioritization of performed actions, without any help from OSS system, seems to be a very hard or even impossible task.

We can point out the most crucial challenges for NGSA solution:
- providing actual information about the huge number of services with complex structure and resource dependencies
- offering a clear and coherent presentation and analysis of events gathered from multiple classes of sources
- organization and automatization of the incident resolution process.

To summarize, the huge number of services with complex structure and intricate mapping on the resources, which are essential for an operator's business growth, imposes a duty on the OSS system to provide clear visibility of the service, easy service control and governance and, last but not least, optimal and automated business process management.

**How to design the ultimate solution**

To overcome the challenges of Next Generation Networks an operator needs a comprehensive Operational Support System providing a permanent opportunity to model and monitor complex services based on the underlying network resources. A Progressive Fault Management module with advanced event processing and enrichment should be the main event source. Standard and common interfaces to external systems (e.g. Trouble Ticketing, Customer Care, SLA Management, E2E probes) should provide the ability to collect events and information for alarm enrichment from non-network sources. By taking a closer look at the telecommunications market we can see that the best strategy is choosing interfaces founded on the OSS/J initiative, which seems to be becoming the ‘de facto’ OSS interfacing standard. Such an expanded system needs an
efficient correlation engine to support the presentation of the most relevant information regarding upcoming events in an automated way, as well as to implement advanced logic to support the network engineers in root cause analysis. Automatic business impact analysis on the basis of information about possible SLA violations, affected customer importance, failures in rush-hours etc. should also be performed during the event enrichment process and incident creation. To deal with emerging incidents, a process management system controlling and organizing complex workflow is also crucial. To structure the business process it is very convenient to use workflows based on the best practices described in ITIL and eTOM recommendations. The knowledge gained during hundreds of failure-fixing related tasks should be stored in a Know-How Database in order to improve and speed-up solution finding for subsequent, similar cases. In modern business models many maintenance tasks are outsourced, so there is a strong need to include a highly configurable Web Interface for presenting dashboards or simple task panels for external partner companies. Service Assurance should also have control of Service Level Agreement fulfillment and direct communication with the customer, such as through Trouble Ticketing.

**Benefits**

Using the solution described above we are able to provide instant and comprehensive assurance of offered services. The wide range of gathered events and the advanced logic to process them automatically shortens the time of failure root cause analysis and, combined with the workflow system, speeds-up the incident resolution process. That simplifies the network staff’s every-day activities, makes their effort more effective and, from the customer’s point of view, provides more reliable services offered with higher QoS. Automatic business impact analysis giving task prioritization prevents most important SLA violations and protects VIP customers etc. reducing potential losses. The open interface strategy also makes the solution more flexible in the perspective of further growth and development. Analysis of the processes related to the assurance of typical services shows that the majority of human tasks result from data fragments...
Figure 3 Event propagation

A scheme of event processing, from ‘rare’ event, coming from network elements or systems, through correlation and enrichment stages, up to service monitoring and incident handling layers.
tation and redundancy between all the systems involved in the end-to-end process.

The integration of the process management engine with the OSS Solution, and the foundation of a predefined processes on well-documented and preconfigured workflows based on the ITIL recommendation, organized in the skeleton of the eTOM framework, optimizes human and network resource usage, thereby reducing redundancies and ineffectiveness. Having a library of executable workflows mapped on the eTOM process framework, and a ready to deploy SID based data model, it is possible to quickly address a chosen eTOM area by building a mesh of coupled workflows operating on event data. The added value can be a redefinition of business processes in the company, on the basis of ITIL knowledge and best practises, to make them more effective and reduce unnecessary costs.

Using the available automations in incident or problem process handling, it is possible to reduce human interaction by 60% on average. Considering that each human task involves a long and unpredictable pending period, execution of the process can be greatly improved, from several hours or days to either minutes or seconds.

This optimization, together with a Know-How Database repository, allows the network staff to operate efficiently and quickly and keeps the business away from unnecessary losses.

**What to look for in a Service Assurance Solution**

When looking for a next generation service assurance solution, you should be sure to consider the following elements:

- A comprehensive service modelling and monitoring engine, providing the mapping between resources and services even for complex cases. This should be the heart of Next Generation Service Assurance.
- A progressive fault management system, including advanced event enrichment (with the use of information from external systems) and a strong correlation engine to assure clear data presentation and root cause analysis.
- Automatic business impact analysis giving task prioritization related to business (e.g. SLA) information.
- Standard OSS/J based interfaces to external systems, giving you the ability to collect events and information from non-network sources as well as protecting system growth possibilities.
- A process management system controlling and organizing the complex workflow in the areas of Incident and Problem Management, equipped with predefined ITIL and eTOM founded process templates and enabling task automation.
- Web GUI dashboards and panels with highly configurable content restrictions for external partners’ use.
- A Know-How Database to gather and store knowledge, tips, solutions and all necessary wisdom about the devices, services and procedures related to service assurance in your business case.
- The solution provider’s ability to adapt and customize the off-the-shelf solution according to your company’s particular needs, because not everything that is convenient for other companies is suitable for you.
- Choose a stable, well-experienced solution provider with at least 10 years’ experience in the OSS market, and which is a member of international organizations and forums like TMF, ETSI etc. This assures you that the supplier knows and tracks the changes in the IT world and follows new concepts and ideas.

**Comarch’s offer and vision**

Our proposal is Comarch Next Generation Service Assurance, based on the Comarch OSS Suite 4 modules: Service Management, Fault Management and OSS Process Management. It provides the ability, through a very efficient event correlation system, to monitor complex services, find a problem’s root causes in an automated way, enrich events with advanced information, e.g. incident business impact calculated with the use of external system information and, most importantly, resolve incidents through structured processes modelled in the OSS Process Management module which is specifically designed for managing a Telco operator’s processes. It provides several mechanisms and tools which enable process automation at different levels. Each typical, common task can be defined at the highest level as an automatic process. Finally, Process Management provides a scripting mechanism to define actions even at the atomic level and use them in high level processes as automatic tasks. OSS Process Management comes with a large number of preconfigured workflows based on ITIL best practices. It also contains automation patterns operating on a predefined data model based on SID. A Know-How Database integrated with the Process Management system provides additional added value, and Web GUI enables the possibility of configuring dashboards or panels for use by external partners. Seamless integration of all the components of the Comarch solution with 3rd party software, through OSS/J interfaces, delivers an OSS system which enables Service Assurance to be controlled from one convergent application.

In conclusion, every day we have to deal with new emerging services with steadily increasing service complexity. This situation introduces new requirements for Operations Support Systems. Only tools that are service and process oriented with highly automated incident and problem management are able to help an operator manage this live environment of resources, services, customers and partners.
Managing MPLS networks
Recently, operators have been implementing Multi Protocol Label Switching (MPLS) infrastructure that unifies IP VPN and other data services. MPLS has been adopted as it allows the quick and easy creation of secure IP VPN services, which represent a less costly alternative to traditional leased-line circuits. Enterprise demand has made IP VPNs one of the fastest-growing sources of data revenue for service providers, therefore speeding up the development of MPLS networks. In order to use all the benefits of MPLS operators or service providers must have OSS environments that:

- Provide up-to-date information about configuration of the network and elements composing it
- Properly monitor the network and provide information about the alarms and the network’s utilization
- Monitor and ensure QoS offered to the operator's customers
- Ensure proper progress of MPLS operational processes within the operator’s environment

MPLS Overview

MPLS puts together connectionless IP with connection-oriented networks. It is also called Layer 2½ technology as it combines Layer 2 advantages – speed & efficiency, and Layer 3 advantages – scalability. MPLS networks consist of Label Switching Routers (LSR) that transmit packets according to traffic labels introduced by entry LSR and removed by exit LSR. Another important entity in MPLS networks is the Label Switching Path (LSP) which is a path through an MPLS network, set up by a signaling protocol. The path begins at a Label Edge Router (LER) that sets an MPLS prefix to a packet. It then forwards the packet to the next router in the path, which swaps the packet’s outer label for another label, and forwards it to the next router. The last router in the path removes the label from the packet and forwards the packet, based on the header of its next layer, for example IPv4.

Each LSR holds a Label Information Base (LIB). LIBs are tables that contain information about label switching and related activities. Each LSR examines the label and inbound interface for the packet and determines the outgoing interface and outgoing label. Additionally, each LSR can perform an operation on the label. If necessary it can substitute it and forward the packet with a new label. Labeling and building LSPs also allows traffic class differentiation. Specific types of packets may need to be forwarded to the same hop or along the same LSP. All the packets to which a specific label is assigned form a Forwarding Equivalency Class (FEC). An FEC can be variously defined by a provider, depending on its size or set of services. An FEC may be constituted by all the packets bound for the same LSR entry, all the packets with a defined class of service, bound to a certain region or matching the route statistics for a large service provider.

VPN tunnels

The main idea behind the MPLS VPN is that the provider’s core routers do not even know about the VPN networks and just switch the labels inside the MPLS network. Provider Edge routers (PE) take the responsibility of routing the client’s packets correctly into and out of the MPLS network.

Every PE router keeps multiple routing tables containing definitions of routes to the remote sites. The PE router keeps track of just those routes which need to be forwarded to the same hop or along the same LSP. All the packets to which a specific label is assigned form a Forwarding Equivalency Class (FEC). An FEC can be variously defined by a provider, depending on its size or set of services. An FEC may be constituted by all the packets bound for the same LSR entry, all the packets with a defined class of service, bound to a certain region or matching the route statistics for a large service provider.

Managing MPLS Networks with the Comarch OSS Suite

The Comarch OSS Suite includes a Service and Resource Inventory, Service Provisioning, Network Discovery and Reconciliation, and Performance and Fault Monitoring, as well as Service and SLA Management. The OSS Framework, which provides core functionality and supervises the operations of Comarch OSS modules, includes functionalities which are shared by all modules: Visualiza-
tion Engine, Reporting and Notification Service, Administration Tools and Reasoning Engine. Seamless integration of the Suite with third-party software in an existing environment is ensured by the Comarch OSS Mediation module.

Inventory of MPLS network
The Comarch Network and Service Inventory allows the managing of information related with MPLS networks. The Network and Service Inventory becomes a central point where all data is gathered and made available for consultation by the user or other modules or systems.

The Comarch Network and Service Inventory provides:
- MPLS backbone network modeling. This application allows the managing of MPLS technology items related to handling traffic inside the provider’s core MPLS network. The set of inventory objects includes, among other things: Label Switching Routers (PE, CE), MPLS tunnels and clouds Label Switching Paths (LSPs), Label Switching Tables in (LSRs), Virtual Routing Forwarding Tables (VRF), Route Targets, etc.
- Business layer modeling. This area covers all items related to services offered to customers by MPLS backbone network providers like MPLS VPNs, or Virtual Wire Private Services (VWPs), providing point-to-point connectivity between customer sites, while the provider emulates a set of wires between sites over the underlying MPLS tunnel.

Autodiscovery/ Reconciliation
Thanks to the Autodiscovery/Reconciliation module the system user can rest assured that the information stored within the system is synchronized with the network and is always up-to-date. The system integrates with MPLS Network Elements mainly using the SNMP protocol, but other protocols are also possible.

The Auto-discovery tool covers the following inventory reconciliation functionalities:
- Adding/ Removing the Network Element to/from the Inventory database
- Updating the Inventory database due to: adding/ changing/ removing cards, ports, etc. to/ in/ from the Network Element
- changing status of the interfaces in the Network Element
- Adding/ Updating/Removing NE configuration (the VPN information)

User friendly data presentation
All data stored in the Inventory can be easily presented to the user with several visualization methods (e.g. Inventory View, Hierarchical View, Logical View, Table View etc.).

In addition to the many visualization possibilities the user can easily filter appropriate information and navigate among different views using a context menu. Such an approach ensures that the system user can quickly find adequate information within the Comarch Inventory.

MPLS Network Monitoring
Fault and Performance Management
The Comarch Fault Management solution for MPLS is preconfigured to properly treat MPLS specific alarms. The correlation engine allows the correlation of MPLS alarms with other alarms across the protocol hierarchy, and therefore helps the user to solve the alarm quickly by providing Root Cause alarms.

Comarch Network Performance Management allows the gathering of MPLS performance specific data in order to track the traffic that is traversing the network with its parameters. The system allows real-time control of gathered performance data against predefined threshold levels. The system is able to report Threshold Crossing Alarms in the case of performance policy violation.

Finally, the systems can produce various statistics and performance reports. The following list provides just a few examples of the stats reports that the user may choose from:
- Throughput of LSP head and tail routers
- LSP throughput and volume overview
- MPLS tunnel statistics (like tunnel availability)

Comarch Service Level Management
Once the information on how the services are built within the network (Network and Service Inventory), and information about the condition of network components is present in the system (Fault and Performance information), one can deduct the state and
condition of the services offered to a Customer. To facilitate this, Comarch offers the Comarch Service Level Management module, which is able to evaluate service health and performance using already collected network fault and performance data. In addition, the system can offer SLA monitoring which integrates network management information with the business objectives of the operator.

Each SLA is specified using the performance and health parameters accessible in the service monitoring system. In the SLA contract, the operator can specify service reliability metrics, as well as threshold values for the service performance metrics.

The SLM can be used for monitoring MPLS layer services (e.g., VPNs), as the module can be offered with a set of predefined service templates for MPLS. However, the full functionality of the Comarch SLM can be shown when monitoring cross technology, cross layer services. In such a case the MPLS services can be part of a complex service offered to the Customer.

**MPLS Network Processes**

The aforementioned functionalities of the Comarch OSS Suite are helpful in day-to-day operations of the service provider’s business. However, such operations follow well described processes or procedures implemented within the operator’s business. Comarch OSS Process Management can ensure that tasks and operations, in particular those involving several participants (people, departments, etc.), are automated and follow a previously specified process. Furthermore, it supports task automation in order to reduce operation time and costs through an increase in overall OSS solution efficiency.

Comarch OSS Process Management utilizes powerful process modeling functionality to design a robust framework of highly customizable generic processes based on industry best practices. The processes within Comarch OSS can be quickly adapted in order to suit the operator’s needs. OSS Process Management provides a combined ITIL and eTOM process environment based on the TMF GB921V standard. The following ITIL Processes included: Incident Management, Problem Management, Change Management, Approval (as part of Change Management), Configuration Management, Service Level Management, eTOM processes: Service/Resource Operations Support & Readiness, Service Fulfillment, Service Assurance.

The exemplary processes specific for MPLS are as follows:

- Service Desk processes ensuring proper maintenance of service related requests (automated support system with workflow management)
- Service Provisioning orchestration allowing automation of MPLS service creation within MPLS
- Maintenance processes, e.g., Change Management processes ensuring that changes within the network are performed properly.

**Integration with MPLS devices**

The Comarch OSS Suite retrieves configuration and performance data from an MPLS network in order to monitor performance and perform health monitoring of MPLS devices & tunnels by finding MPLS VPNs tunnels and their LSPs inside an MPLS network. This is done with the help of the Comarch Mediation layer, which is responsible for communication with Network Elements and/or other management systems. The integration may be done in several ways:

- Directly from NE mainly using SNMP and following MIBs: MPLS-LSR-MIB, MPLS-LDP-MIB, MPLS-TE-MIB, MPLS-VPN-MIB and RFC 1213 MIB
- With the use of another external system (via e.g. XML files)

The system may gather MPLS network information from external systems e.g., EMSes/NEMSESs in order to keep all information in a central database together with information about other network technologies. Such interfacing may be made with the help of both well standardized interfaces, e.g., MTNM, mTOP, OSS/J, CORBA, CMIP, and also via proprietary interfaces.

**Conclusions**

The Comarch OSS Suite provides several tools and mechanisms facilitating MPLS network management at different levels, starting from simple alarms gathered from the MPLS network, by complex monitoring of MPLS Services offered to the Providers’ Customers, up to operational process control. With the ability to integrate with NEs and other external systems, the Comarch OSS Suite can play a key role within the operator’s environment and significantly reduce the time and effort required for operations and therefore reduce costs with overall solution efficiency. The Comarch solution can be offered as a complete solution (all modules described previously) or just a particular module with specific functionality requested by the operator.

Comarch OSS allows operators to control and fulfill the potential of the network while being able to quickly react to the changing business environment. The solutions bring business value by optimizing network usage and human operations, and therefore directly decreasing operational costs.

**Figure 3 Hierarchical list of VRFs and related Route Targets and Logical View of MPLS Network (VPNs) and its components**

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The telecommunications industry, although still technology-driven to a great extent, is no different from any other in terms of what customers basically ask for. They look for products that fulfill their needs conveniently, for a fair price, and if something goes wrong, they want the problem to be solved reasonably and fast. Unfortunately, in reality, suboptimal processes in the areas of sales, order fulfillment and trouble ticket management too often negatively impact customer satisfaction and, eventually, the bottom line. It has frequently been said that lack of genuine customer focus or constant process improvement largely contribute to poor results, so it won’t be discussed here again. What is truly worth attention, though, is how much can be done for profitability just through tighter integration of CRM and OSS.

There have always been two camps on the operator’s systems map: BSS - customer-facing business support systems (normally covering billing and CRM) and OSS - network-facing operations support systems (for instance: network inventory, fault management, provisioning). This has also been reflected in the organizational schemes – there is traditionally the network operations department taking care of the cost-oriented OSS, and the IT department taking care of the revenue-oriented BSS. The different perspectives have resulted in limited systems integration, as well as multiple disconnected data repositories and processes. These issues, while technical at first glance, have a real business impact and have led to different initiatives, such as attempts at achieving a 360 degree view of customer data, where carriers could view those pieces of physical and logical network inventory that are related to a given customer service. However, the real benefit of bridging the gap between CRM (the part of BSS we focus on in this article) and OSS lies elsewhere.
When customer orientation meets thinking in circuits

Most processes have their “moments of truth”, when only combined CRM and OSS effort is necessary. Imagine an ongoing sales process aimed at winning a new business customer. What we generally know about business customers is that although they tend to have higher expectations and more complex problems taking a good deal of organizational effort to handle, they also tend to be more profitable. At some point, our prospective customer will ask a simple question, like “How much will this T1 link cost me per month?” When a price is quoted to the customer (whose data is stored in the customer-centric CRM) and the costs of the service (based on data from the network-centric OSS) cannot be well defined on a per-customer basis at this early stage, profitability is at risk. Carriers selling services that are provided to them by external providers know this situation well, especially in markets where local-loop unbundling regulation has been implemented and local loop costs vary depending on concrete physical location.

When a contract is signed and an order is placed, order fulfillment and provisioning actions take place, and they are often poorly coordinated and time consuming. The customer may ask for the current status of his order. Once it has passed from the customer-focused CRM to the network-oriented OSS, many providers can only give a laconic “in progress” answer, because they are not able to relate an order back to a customer. Sometimes problems with provisioning may occur on the side of the external provider, which may not necessarily be reflected in order status. The same information gap exists for fault management and trouble ticketing. Let’s imagine that the customer is happily making use of the newly configured T1 link, and suddenly a circuit goes down. OSS systems produce tons of valuable information about the status of the network. When such a fault occurs, the location, possible causes and correlated events may quickly be identified, yet associating this data with the customers who may be affected tends to be more challenging, making customer notification and pro-active assistance even more difficult to achieve.

How many product catalogs does it take?

The true value lies in sales, order fulfillment and trouble ticketing processes effectively spanned across CRM and OSS modules, supported by a shared product catalog and workflow engine. As in our example, knowing costs prior to quoting the price is crucial in achieving desired profitability, but to know the costs and later to be able to acti-vate the product, it has to be clear what exactly this particular “T1 link” looks like from the logical and physical network point of view. In other words, there has to be logic translating the “business product”, with all its parameters collected as part of the sales and ordering, into to the underlying “network product”, with all the necessary provisioning actions. It is usually harder when there are multiple local, disconnected product catalogs disseminated among different layers of breed and home-grown OSS and BSS systems.

A unified product catalog acting as a master and central database for products and offers to be found in the service provider’s systems not only eliminates the error prone processes of manual reconfiguration and synchronization of catalogs, but also reduces the time to market of new products and the customization of products for business customers (e.g. the setup of a dedicated T1 link with a variable billing cycle, or an advanced VoIP configuration). All sales and marketing activity could be driven by the centralized product repository, with corresponding target segments, geographies, bundles, tariff plans, and variants. Of course, not all difficulties can be eliminated – adding new products will remain difficult per se – adding a product to the catalog must be accompanied by setting up all the necessary quoting, ordering and post-sales processes, as well as anything else that is affected by products.

Similarly, with a common workflow engine being the central point for all ordering and ticketing processes, it would be possible to design and execute processes transparently across CRM and OSS layers with a single tool. Not having to configure duplicate procedures and integration logic in both systems enforced by consistent versioning would definitely increase the ease of adapting the business process management environment to changing business needs. Other advantages worth mentioning include common access to order attachments, better handling of provisioning errors, full visibility from CRM into OSS order history (and vice versa) and more possibilities in managing orders in jeopardy.

An integrated CRM-OSS solution

There are generally two notable ways to close the CRM/OSS gap. The first is to use an open architecture based on standards. Use TMF eTom and ITIL as guidelines for (re)defining business processes, use the Shared Information/Data (SID) model for having common terms and relations between business objects in different layers, and OSS/IT for interfaces. In theory, an operator could pick best-of-breed products for every functional area of OSS and BSS (for instance defined by the NGOSS Telecom Applications Map, another TMF standard) and integrate them, trying to adhere to the mentioned standards, but in practice these standards are still evolving, and not all vendors provide current implementations.

The second approach for a service provider would be to diligently pick an end-to-end suite encompassing CRM, BSS and OSS modules, with a shared product catalog, workflow, and integration layer in order to strategically focus the architec-
Adding a limited number of systems from other vendors to the mix. This approach may be more cost effective, faster and easier to maintain than the other – there is no overhead in managing multiple suppliers, a smaller functionality overlap between modules (not all best-of-breed modules are carved precisely along TAM guidelines), and most interfaces are set up between the suite's internal modules (vs. interfaces between systems from different vendors, sometimes implemented by different System Integrators). Unfortunately, there is also a considerable drawback. Many companies find it risky, if not plain dangerous, to become too dependent on one given vendor, proprietary interfaces and technology. No risk, no gain – here the gain is lower TCO of the solution.

Regardless of which approach fits a service provider better under given circumstances, both are just different methods for achieving the same effect. In the end, what really matters is to be focused on the assumed business outcomes of the initiative, while remaining compliant with corporate policy and architecture standards.

**Summary**

Previously, putting up with the gap between CRM and OSS worlds has been a viable - though not optimal - strategy for most operators. But now that the telecommunications industry is undergoing the "communications and content over IP" transformation, service providers are starting to redesign their business models and to rethink the infrastructure. It looks like a great opportunity for bringing CRM and OSS systems, processes and data closer together. Conducting the architectural change with a pragmatic, modular approach is crucial to deeper OSS and CRM integration paying with increased profitability.
The challenge
Fast changing market demands from telecommunication service providers to respond on changes almost immediately. These changes can be growing customer requirements as well as competitor’s innovations. Most often change does not mean that an operator needs to use the newest technology, instead just deliver new value to the customer using existing infrastructure and services. In this case it may be a combination of existing services or new pricing model.

It’s all about money
Increase revenue while reducing the cost and risk of creating new services it’s not only a challenge, but a permanent sticker on the wall. While income depends on market and marketing actions, costs are more dependent on procedures, tools and execution of services. Launching new a product on the market takes from 1 to 18 months. This time can be significantly reduced with a flexible and efficient service delivery platform.

Service delivery platform
The term Service Delivery Platform corresponds to the architecture style used in an operator’s infrastructure. It is intended to enable rapid development and deployment of new converged multimedia services, from very basic to very complex. SDP focuses on both consumer and business applications.

There are two approaches for a SDP. First, is a fully integrated platform that includes all key elements required to: develop, create, launch and
Product Catalog

One of the applications from a service creation environment is the product catalog. This application is used for creation (definition) and maintenance of products and their offers. In practice, this means that it should support the whole lifecycle of product and offer definition. Product catalog should allow operators to configure new products fast and easily. Short time of new product creation and less money spent - this is where costs can be reduced. Especially for large operators which have a wide portfolio or where the portfolio is changing all the time, the functionalities provided by product catalog are crucial. These operators use product catalog all the time creating, modifying or adjusting their offers. Products inheritance, copy of product specification and inheritance of characteristics form product category and so on... these are simple basic features that should be implemented in the product catalogue to speed up products creation. Versioning of products and offers is a next feature which can be useful during maintenance and products evolution. To support product description, it may be useful to attach some documents (graphics, texts, emails). Product catalog should store complete information about particular products and its offers; this also includes what services are used to realize such products. This information can be used for provisioning application to activate required service when product will be contracted.

Most challenging functionality in a product catalog can be pricing of products and exchange information about rating mechanism with billing systems.

It is a good approach to have one central point for product definition in the whole infrastructure. Instead of having a module of product catalogs in CRM, billing, provisioning or any other application, it would be great to have this module pulled before the bracket. First obvious benefit is that we can define a product only once in one system not in many systems. This is an area where we can save time off product development. Data coherence is the next issue. While having many modules where we have to define products we have many opportunities to make mistakes entering data (human error) – that leads to data inconsistency which can generate incorrect bills and potential loss of income.
Comarch Product Catalog is a central product and offer repository. It’s the master database of products and offers for all other systems. More system’s integrated with a product catalog result in better utilization of implemented functionalities. CPC supports product definition and maintenance through the full lifecycle of a product. It is a key element of the service delivery platform. Being crucial in process of delivery values to end customers. By using one central point of creation and modification it is possible to decrease not only the cost of product development but also costs of infrastructure. Operator pays only once for product catalog which is used by other applications and does not have to spend money on many product catalogs in other systems. This may seam a bit naive because we have to remember about integration costs, but using open standards of data model (e.g. SID) and integration (like OSS) these costs may be reduced to a minimum. Important benefit of using the Comarch Product Catalog is also significant reduction of development time. Average time reduction for product development is 40%. This result depends on types of products. For similar products and for simple ones this time reduction is much higher.

The conclusion
It is not difficult to notice that in a challenging market where changes are made very fast it’s important to have a head on competitors or at least follow closely. In such struggles it’s a huge advantage to have infrastructure ready for fast changes. One of the applications most important and most often used in such cases is the product catalog. There are hard requirements against such an application to be able to manage a product development lifecycle and speed up products creation. Also, there are problems with such applications especially in multi-country context where operator wants to use many currencies, languages, and other regional settings.

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On Marrying Ontologies & Software Technologies

MOST Project

FOLLOWING "Web 2.0" as a term describing the recent evolution of the Web, a new term "Web 3.0" has been introduced to describe a future wave of Internet innovation. It has been associated at this point mostly with concepts of the Semantic Web. Yet technologies that back up the new approach stem from traditional studies on Artificial Intelligence and are flexible enough to be leveraged by other domains. In this article we introduce the Marrying Ontologies and Software Technologies (MOST) project that tries to improve Software Engineering through Semantic Technologies [MOST]. As a part of the project the new approach will be evaluated in the case study on the development of solutions based on Comarch OSS Suite.

Semantic Technologies
The opportunities and expectations associated with Semantic Technologies were expressed by Tim Berners-Lee, the inventor of the World Wide Web: "I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web – the content, links, and transactions between people and computers. A 'Semantic Web', which
useful information using cognitive decision-making ability, emulating human beings.

The currently used standard for publishing web information, HTML, is still incapable of defining relationships among data. Rather, it provides merely for the presentation of information. Therefore in order for web documents to be able to be processed by a machine, a layer of semantic information needs to be added over the existing web content. Web Ontology Language (OWL) is a language to classify web content using a standard hierarchical categorization scheme. Resource Description Framework (RDF) is a data modeling framework that can be considered as a knowledge representation format. SPARQL Protocol and RDF Query Language (SPARQL) is an RDF query language that facilitates extracting information from the web where content is represented using RDF. Together, these technologies provide the means to annotate web content with meta-data and then help extract the required information by identifying the nature of the content.

Model Driven Software Development

Model-driven software development (MDSD, often referred to as Model-Driven Architecture – MDA) is an emerging technology that promises to introduce significant efficiencies and rigor to the theory and practice of software development. In large software development organizations, increased complexity of products, shortened development cycles, and heightened expectations of quality has created major challenges at all stages of the software lifecycle. To respond to these requirements, various software-engineering methodologies have been used to capture information concerning requirements, architecture, design, implementation and testing. The majority of such methodologies promote the usage of models to capture and maintain that information. A prominent example is the conceptualization of business entities that exist in the system domain in class diagrams available in Unified Modeling Language (UML).

Although creating models improved the understanding of the software systems, it imposes extra overhead to maintain the models created at different stages of the software lifecycle since their content needs to be eventually transformed manually into code. The models are only blueprints that can guide developers during the implementation phase, thus they may not reflect precisely the systems running. Moreover, as the system evolves, the changes made in code are usually not transformed to the models thus leading to unsynchronized artifacts which significantly reduces the value of the models in the maintenance phase of the software lifecycle.

MDSD provides the means for separating the business and implementation aspects of software
at different levels of abstraction and is therefore a key for the efficient development of large and complex software systems for a heterogeneous customer community. In this approach, models are the artifacts that directly lead to the running system. To achieve this, MDSD promotes frequent usage of automatic transformations that may generate platform specific models and code from platform or computation independent models.

In the context of Operation Support Systems, MDSD has already been noted as a promising approach in line with the efforts of such bodies as TMForum. Both TMF/NGOSS and OMG/MDA are aimed at providing benefits to the business leaders and development communities through technology neutral architecture, i.e. architecture that is sustainable through technology changes [TMF].

Marrying ontologies and MDSD

However, as MDSD constitutes a huge leap forward in software development, the fragmentation of the involved models on different abstraction levels, difficult configuration and customization, and the corresponding loss of oversight and understanding still imply a tremendous effort for the software developer. Key questions, such as the validity of the models, the relationship between the models and code, and the properties of model transformations cannot be answered by today's technology.

Yet we face the opportunity to leverage MDSD with ontology technology. Ontology technology allows for managing, integrating and validating information found in different software models and code. Ontologies enable the developer to ask crucial questions and check the validity across model fragments and process steps. In addition, the expressiveness of ontologies allows for recording complex business related concepts at a high level of abstraction.

Thus the main objective of the MOST project is to develop a seamless integration technology for ontologies into MDSD, resulting in ontology-driven software development (ODSD). This integration technology concerns all artifacts involved (ontology and modeling languages, models, tools), as well as development processes in order to guide the developers in their activities.

Comarch involvement in the project

The main role for Comarch, the coordinator of the MOST project, is to provide a case study for MOST technology. This involves both evaluating the research results and providing industrial use cases that reflect the real life challenges of large scale software development.
The case study will cover the area of large scale Operation Support System development. Comarch has already formulated well established development methodology for systems in the Comarch OSS Suite product line, including the usage of model driven methods. The intent of the case study will be to use these existing sources as a starting point and to adopt MOST technological advancement to increase productivity, time to market, and software quality.

**Conclusion**
MOST is a proposal for early innovation in the field leading to more efficient and higher-quality software development with a better integrated understanding of the resulting software product. The MOST project can deliver fundamental results that can be leveraged by European software vendors to improve the quality of software products, productivity of the developer teams as well as the time to market for customized solutions.

**References:**
[TMF] TMF White Paper on NGOSS and MDA
[MOST] www.most-project.eu

**Project:**
MOST – Marrying Ontology and Software Technology

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ICT – Information and Communication Technologies

**Further information:**
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MANGO – Eureka/Celtic project

The Comarch OSS Suite as a Management Platform for Next Generation Optical Networks
Optical networks

Optical communications technologies have emerged as a key enabler of broadband networking solutions for residential and enterprise customers. The amount of raw bandwidth available on an optical fibre, the support of a wide array of signal formats and data rates, and the ability to choose from among a number of topologies (ring, mesh, point-to-point, tree, etc) make optical technologies a strategic component in the evolution of core and access networks. Furthermore, the introduction of flexibility in the optical layer has the potential to provide significant cost reductions, in particular when using all-optical switching techniques. Advances in optical technology enable the evolution of optical networks towards all-optical networks that are capable of providing lightpaths as optical circuits for e.g. virtual private networks or other services.

However, the benefits of optical networking do not come without several associated challenges. WDM networks are able to transport hundreds of wavelength channels (lightpaths) through a single optical fiber with, say, 10 Gbps at each lightpath. Advanced cabling technologies group several hundred optical fibers in a single cable. As a result, a cable cut may cause the interruption of a huge number of digital connections and a tremendous loss of data. Therefore, fast fault recovery mechanisms and proper fault management in the optical networks are crucial. The recovery mechanisms can be implemented in several network layers. However, in order to ensure short recovery times and to avoid conflicts caused by simultaneous actions at more than one network layer, the interactions between the layers need to be well associated, and appropriate recovery processes and actions need to be defined.

Monitoring of the performance parameters in optical networks differs from monitoring in “traditional” telecommunications networks. Services given by the optical layer (optical circuits, Virtual Private Networks (VPNs), etc.) in all-optical transparent networks require a revised approach of Quality of Service (QoS) management and monitoring, as the set of parameters that need to be taken into account includes optical signal quality indicators (e.g. power level, noise, polarization mode dispersion (PMD), etc.). The main advantage of all-optical networks is their transparency to bit rate and traffic format, which reduces the need for costly transmitters and receivers. However, the absence of electronic regenerators in transparent all-optical mesh networks imposes a need to take into account the physical (optical) impairment constraint in Routing and Wavelength Assignment (RWA). Due to the lack of electrical regeneration, and due to the evolution towards the scenario where optical signals are routed, added/dropped, multiplexed, and de-multiplexed in the optical layer, optical signal impairments may accumulate along a lightpath. Thus, it is required to offer rapid connection provisioning tools that take into account physical impairments when performing Routing and Wavelength Assignment (RWA).

The majority of the aforementioned challenges can be solved by management software allowing management of the heterogeneous optical networks. Currently available platforms are developed mainly by companies producing optical network equipment. They are designed to manage only their specific optical network’s elements. A number of different management platforms are required in cases where the network is composed of heterogeneous components. Our approach considers network management from a service management perspective that is not limited to a particular manufacturer.

MANGO Project

In order to challenge the abovementioned issue concerning optical network management Comarch, together with international partners (operators, a research institute, an SME and universities – listed below), conduct the Eureka/Celtic project Management Platform for Next Generation Optical Networks (MANGO). One of the goals of the MANGO project is to perform and evaluate a pilot of an integrated network management platform for next generation optical networks. The pilot is based on the already available Comarch OSS integrated management platform, which combines several functionalities of the management system (Fault Management, Performance Management, Service Management, Circuit Management, Configuration Management and others) that will be expanded to be used for that purpose.

Particular emphasis in work related with the pilot is put on automated fault and performance management, management of optical connections, and complex Quality of Service (QoS) management. Management of optical connections includes path engineering that takes into consideration the physical aspects and characteristics of optical links in transparent domains such as optical signal impairments. Fault and Performance management includes monitoring of the parameters in optical networks, from the pure physical level...
Project outcome
To address the above-mentioned needs, MANGO will produce a number of innovations:
- Fault and performance management software for next generation optical networks, featuring all optical switching technologies and integrated data switching capabilities.
- Algorithms for cost-efficient allocation of lightpath connections in optical networks, taking into account the signal quality constraints.
- Specification of efficient rules for alarm fault correlation and propagation across layers.
- Integration of the management software, algorithms and fault correlation rules into a fully equipped testbed.

Project Consortium
The MANGO Project Consortium consists of the following partners:
- **TeliaSonera (Sweden)** – Telco operator contributing experience in operating optical networks and network test environments.
- **Proximion (Sweden)** – SME contributing experience and knowledge in optical performance monitoring, and with an already existing Optical Performance Management (OPM) system, WISTOM.
- **Acreo (Sweden)** – Research Institute and Telco operator contributing experience and knowledge in optical transmission that will host parts of the evaluation of the proposed management platform.
- **Warsaw University of Technology, WUT, (Poland)** – University contributing research expertise in network modeling, optimization and performance evaluation.
- **Royal Institute of Technology, KTH, (Sweden)** – University contributing expertise in fault management and reliability issues in optical networks.
- **Comarch (Poland)** – Industrial partner – Project coordinator – contributing both experience of network management and the Comarch OSS Suite management platform.

Business relevance
Successful deployment of manageable and cost-efficient optical networks is of utmost importance for accelerating the adoption of broadband technologies. Investments in this area should not be directed only towards the physical network infrastructure building blocks, but also towards the software environment required for the smooth operation of such networks, so that service providers can transfer all the benefits brought by optical technologies to their customers.

About Celtic
Celtic is a European research and development program, established as a Eureka cluster, to strengthen Europe’s competitiveness in telecommunications through short and medium term collaborative R&D projects. Celtic is currently the only European R&D program fully dedicated to end-to-end telecommunications solutions. Launched in November 2003, Celtic (Cooperation for sustained European Leadership in Telecommunications) was founded and has been supported by major European telecommunications players, both vendors and operators. Celtic fills the gap between public R&D programs not specifically focused on telecoms, and short-term R&D efforts by the telecoms industry.

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The growing number of services and their importance for operators’ businesses means that OSS systems have never been as important as they are nowadays. Today, operators can not even think about providing services without help from the supporting systems. It is crucial to take advantage of a comprehensive Operational Support System based on the underlying fault management system that can monitor services, automatically gather events from all possible sources and has a powerful engine to present the most relevant information.

Our proposal is the Comarch Next Generation Service Assurance solution, based on three modules of the Comarch OSS Suite: Service Management, Fault Management and OSS Process Management. Thanks to a highly efficient event correlation engine, the solution provides the ability to monitor complex services, track problems’ root causes in an automated way, and most importantly, resolve incidents through structured processes. Moreover, seamless integration of all Comarch solution components with 3rd party software is realized through OSS/J interfaces. As a result, we get an OSS system offering us all the advantages of service assurance in a single convergent application.

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