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STRATEGIC WHITE PAPER

Emerging Best Practices for Carrier IP Transformation

As telecom carriers begin the transformation of their networks towards IP, many have learned that transformation inevitably extends far beyond the technology elements to impact all aspects of their business, including operations and organizational structures. This paper identifies emerging best practices for planning, implementation, migration, and operations based on hands-on experience with IP Transformation initiatives across the globe.

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Introduction

Carriers are continuing to invest significant time, effort, and resources into their network transformation initiatives, but few have gone beyond lab and early field trials of the key technology elements, such as IMS (IP Multimedia Subsystem). The absence of commercially available services, delivered via next generation networks should not be construed as a failure of the technology or of the carriers themselves, but a measure of the complexity and scope of what these new services can provide. In some cases, they replace a wireline physical infrastructure that has been operational for the past century. For this reason, new implementation projects may well take years – in some cases decades – instead of months or weeks.

This paper explores the issues and challenges facing the telecom carriers as they plan, implement, migrate to, and operate their next generation networks[1]. It identifies best practices that are beginning to emerge in the areas of planning, implementation, migration, and operations.

The concepts and best practices discussed are based upon four years of interactions with IP transformation program team members – planners, network designers, operations team members, and IT personnel – from Alcatel-Lucent and wireless and wireline carriers located around the world.

What is IP Transformation?

Best practices are emerging from implementations of both IMS and non-IMS IP-based services, products, and technologies, reflecting the nature of the carrier IP transformation programs. In many cases, carriers are deploying complex architectures that use a variety of technologies (such as VoIP, IPTV, and IMS-based services) to accomplish their business objectives and to provide what they hope is the right mix of features, services, and access methods.

One advantage of the expanded scope is the ability to adopt best practices that may have been developed in other technology areas or technical disciplines. For example, the convergence of telecom and IT activities in support of IP transformation programs has spawned a number of discussions regarding operational models based on telecom foundations, such as the Telemanagement Forum's eTOM (enhanced Telecom Operations Map) model, and models based on IT-heritage, such as the ITIL framework published by the UK Office of Government Commerce.

The term "IP transformation" lacks a formal, industry-accepted definition – it can refer to any number of activities related to making the transition to IP-based services within the carrier's wireless or wireline environment.

1 For a related paper published a year ago that describes challenges facing service providers implementing IMS see: (author), "IMS Early Adopters: Lessons Learned", Alcatel-Lucent, 2006.

For the purposes of this paper, IP transformation refers to implementations and activities at any or all of the access network, core network, session control elements, or the application layer. Figure 1 illustrates different aspects of IP transformation projects in both the wireless and wireline environments at each of these layers.

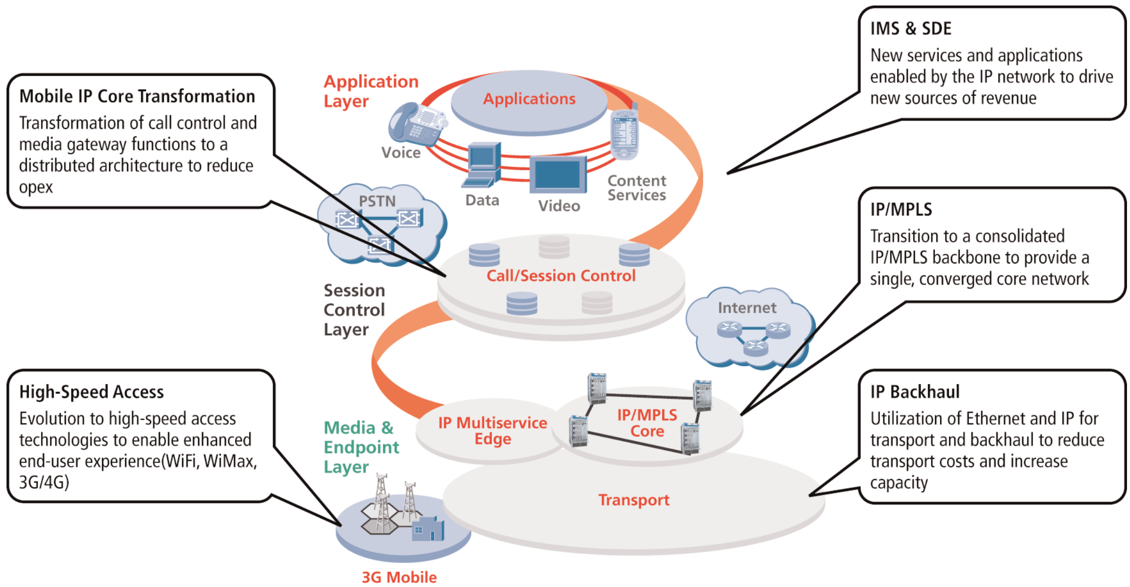

Figure 1a: IP Transformation activities within wireless environments

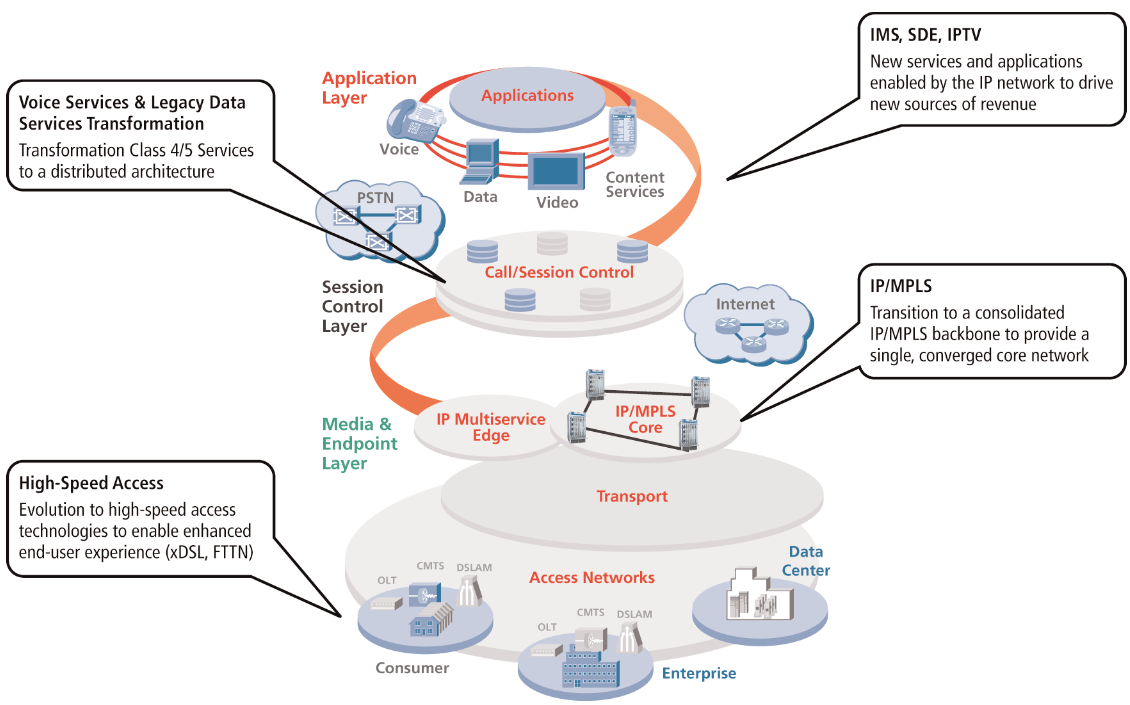

Figure 1b: IP Transformation activities within wireline environments

While IP transformation programs can be described in terms of changes to the technical architecture, the scope of transformation will inevitably extend far beyond the technology elements to impact all aspects of the carrier's business. This is due in large part to a shift from operations of individual services delivered over their own purpose-built networks (such as the PSTN) to operation of multiple services (such as voice, data, and video) over multi-protocol, multi-purpose networks. Carriers will no longer have the ability to infer service quality based on high-level infrastructure performance metrics –such as "number of dropped calls" on a wireless network. Instead, the carriers who migrate to an all-IP-based infrastructure will be forced to re-tool their operations and management capabilities to focus on the performance of multiple service types delivered over multiple access networks.

IP Transformation: Similar Motivations, Varying Implementations

Carriers consistently cite their primary motivation for IP transformation as the need to aggressively reduce operating expenses and respond effectively to competitive threats. However, implementations of the transformation programs do not follow a consistent model. While carriers like BT and KPN have announced ambitious programs to completely replace their existing legacy infrastructure with an IP-based architecture (including access network, core network, session control, and applications), other carriers are considering applying IP-technology using a more phased approach.

Because of these differences in approaches, the cost and complexity of IP transformation projects will vary significantly. For example, the effort associated with the deployment of a broadband access network for a wireline operator will be considerably higher than the cost for a wireless carrier due to the massive effort required to replace and/or augment the physical wired infrastructure required to support broadband IP connectivity. Incorrect assumptions made during the planning for the migration of subscribers from PSTN to an IP-based voice service can be catastrophic when multiplied by the millions, or tens of millions, of subscribers that will be impacted by the program.

Transformation programs are based on a number of factors, including:

- Local competitive environment,
- Regulatory constraints,
- Size/demographics of the subscriber base (existing and new customers),
- Projected uptake for new services,
- Availability of capital,
- Existing operating expense profile.

Each of these factors influence a carrier's architecture and implementation plans, so it is inevitable that carriers will make different choices to meet their varying business needs.

Identifying Common Challenges and Best Practices

Despite the fact that each carrier implements their IP transformation initiative in a slightly different way, early adopters face similar types of challenges due to the fundamentals of the technology and similar operational and business models. These challenges include:

- Planning
- Implementation
- Migration
- Operations

The following sections identify some of the main problems in each of the areas and address the best practices that are beginning to emerge to address these challenges.

Planning

IP transformation planning entails a wide range of activities – from the development of an initial business case and detailed designs, to the planning for operations and maintenance of the new infrastructure and of the hybrid transitional infrastructure that will exist during the transformation program.

Proper planning for a comprehensive transformation in a large carrier environment involves a complex set of activities. Program managers must be experienced in planning and executing programs that contain potentially hundreds of work streams.

RATIONALIZE PRODUCTS AND PORTFOLIO FIRST

While some carriers are moving to an all-IP infrastructure to provide new services, most want to migrate existing subscribers and services to the new architecture to reduce overall network operating expenses. One crucial step that some of the early adopters neglected was to perform an initial rationalization of their portfolio to determine which services to migrate, and which services to either discontinue or retain on the legacy network. A common approach for these planners was to assume that they would transition all existing features, services, and subscribers to the next generation network.

This is a less-than-optimal approach for a number of reasons, including:

- Costs of duplicating some features/capabilities in a next generation network may outweigh the revenue that the service will generate. This is particularly true in the case in environments where carriers developed custom capabilities using IN (intelligent network) features, and also where uptake for certain features has been extremely low.
- Migration for some features and/or services may be disruptive to end users, resulting in dissatisfaction and churn. In other cases, certain features may not be able to be supported transparently in the new network. Carriers must determine if it makes sense to discontinue features like these altogether, or to assume the risk of negative impact on their customers.
- Portfolios for some carriers have grown in an unmanaged fashion – the carriers continued to enable new features without considering when to discontinue low uptake features. In some cases, the end result is the inability of the carrier to have a clear picture of the volume of subscriber usage for individual features.

In the best practice for portfolio rationalization, network planning teams work closely with sales and marketing teams to perform a comprehensive analysis of the existing portfolio. This might start with a list of the absolute minimum feature set to migrate, followed by a list of additional legacy features and functions after determining their cost and associated revenues. This may require several iterations because costs for migrating certain features may initially be unknown and require research.

CONSIDER THE IMPACT OF A DISTRIBUTED ARCHITECTURE

While most carrier environments are already based on a distributed architecture, next generation networks take distribution one step further by dividing elements according to their function within the network.

For example, the evolution from a Class 5 switch to a VoIP softswitch involves the separation of call control functionality from media gateway functions. IMS takes the distributed architecture further by separating subscriber authentication, database functionality, and application services from call control. While this distributed architecture provides carriers with a number of benefits – such as the ability to scale selected functions more easily, and the ability to use products from multiple vendors – it introduces some new challenges in areas such as security, performance, and resiliency.

- **Security** – Standards-based architectures enable carriers to create networks based on products from multiple vendors so they can select the best-of-breed product for each function. The downside is that most carriers will be forced to maintain effective security across multiple products and multiple platforms from a variety of vendors that may not share a consistent approach to secure product design. Carriers will need to allocate sufficient resources to analyze the next generation architecture on an ongoing basis, and to participate in the development process for subsequent releases of the architecture. In addition, it is helpful for the carriers to use a consistent framework for evaluating the security of their distributed architecture, such as ISO 18028-2.
- **Performance** – A distributed architecture creates multiple points within the network that can negatively impact service quality and performance. In the past, carriers were able to manage performance at specific points of the network, typically by monitoring and managing call processing capacity or throughput. Since next generation networks will carry multiple types of traffic, each with its own requirements for quality of service, it is likely that at any given point the quality of one service may be at a desirable level while the performance of more demanding applications may fall below acceptable thresholds. An emerging best practice is a shift towards tools and metrics that focus on service performance quality and management.
- **Resiliency** – A distributed architecture also creates multiple potential points of failure. Carriers require highly reliable services, such as providing 99.999% availability. This level of availability requires careful consideration of issues such as redundancy and uptime. Although the carriers are already employing engineering processes designed to provide high availability, the availability and performance of a next generation service depends on the operation of a much larger set of elements. Therefore, network planners may need to develop new models for analyzing availability.

ASSESS PROJECT TEAM READINESS AND ORGANIZATIONAL READINESS

Transforming an existing carrier network means introducing a number of new products and technologies. Also, effective management of the new infrastructure requires major changes to existing operational processes and metrics. Carriers should assess the transformation readiness of the team that is responsible for implementing the transformation, as well as the readiness of all of the organizations within the carrier such as marketing, customer care, operations, and billing.

TRANSFORMATION TEAM READINESS

Network transformation programs require a diverse mix of skill sets and experience. A transformation team will typically require:

- Senior program managers with experience in managing large-scale, complex programs;
- Experts on all aspects of existing legacy infrastructure and services;
- Experts on new technology elements and infrastructure;
- Resources and facilities for effective testing and trials for the new architecture and for migration activities;

- Experts in Operational Support Systems (OSS) with the ability to plan and integrate legacy and new elements into the carrier OSS environment;
- Sufficient technical resources to execute the transformation and migration activities at a level of volume consistent with the needs of the business.

The magnitude and complexity of a transformation program will demand that carriers develop a plan for training transformation team members to an effective level while also maintaining sufficient resources to focus on the day-to-day demands of the legacy network. It is also critical at this stage for the planning team to identify a standard set of processes and tools to be used by the program management teams.

CROSS-ORGANIZATION READINESS

Transformation teams also must consider how ready the company is to effectively accommodate the introduction of the new infrastructure into its business. This extends beyond the basic network engineering functions to include activities such as customer care and operations. Customer care agents must have the ability to quickly identify and resolve problems across the new network. Operations teams will require a diverse base of skills and capabilities to effectively manage performance and maintenance activities.

Costs associated with preparing existing resources to support the new infrastructure should not be underestimated. For example, carriers transforming from a legacy circuit-switched PSTN architecture to a broadband-access IP infrastructure must contend with retraining a workforce that may have decades of experience in circuit-switching, but virtually no exposure to IP networking. In these cases, carriers will need to either plan for a significant multi-year retraining program, or find ways to augment their existing workforce. These new resources should include people who are already experienced in key areas and can, as part of their job definition, bring other team members up to speed on the new technology.

ENGAGE ALL STAKEHOLDERS AND ORGANIZATIONS EARLY

Because IP transformation will impact so many different parts of the company, it is critical that the transformation team engages with all of the carrier's stakeholder as soon as possible. Issues such as retraining, operational readiness, security management, performance engineering, and portfolio management require active involvement of multiple teams beyond the technology planning group. Technology planners should align with other organizational teams early in the process. This provides the organization teams with the advance notice needed to properly develop and budget their readiness plans.

The transformation team should also develop a plan for engagement with external stakeholders, such as large enterprise customers, wholesale customers, business partners, and governmental/regulatory agencies to ensure that the future architecture will meet all obligations, both contractual and legal. A comprehensive plan for managing external stakeholders should also address transition management to ensure that expectations are set early.

Implementation

Implementation of an IP transformation program includes the activities required to deploy and integrate the new technology elements into the carrier's infrastructure. Some implementation activities (such as lab trials and field trials) may be concurrent with planning efforts. This may be intentional in order to incorporate real-world findings into aspects of the design; or it may be unintentional due to planning activities that took longer than originally anticipated.

While most carriers have managed multiple new technology implementation programs, a major transformation initiative has some distinct requirements. For example, distributed architectures such as IMS allow an unprecedented level of vendor diversity – carriers can literally choose a different vendor for every element in the architecture.

The logical outcome of adopting an open standards-based architectures is that every carrier implementation will be unique – it is unlikely that any two carriers will use the same combination of elements to deliver basic sets of services.

UNDERSTAND THE SCOPE OF NEXT GENERATION INTEROPERABILITY TESTING

While this flexibility is seen by technology planners as a tremendous advantage over legacy architectures, implementation teams and operations personnel must prepare for additional complexity during testing phases and the subsequent operation of the environment.

Carriers have learned that it is not sufficient to ask their vendors if a given product has interoperated with another product. Instead, each product must be tested in the context of the planned solution. Rigorous element-to-element interoperability testing between each element of a planned infrastructure must be accompanied by tests of every combination of features, services, and use cases the carrier plans to support over the entire architecture. This applies not only to the initial launch of the architecture, but to every subsequent major and minor revision.

ESTABLISH DISCIPLINED REVISION CONTROL AND DOCUMENTATION PROGRAMS

While activities such as revision control are more an operational consideration, it is critical that the next generation architecture is implemented in a way to allow for appropriate levels of configuration management.

Implementation teams should plan to establish a set of configuration and provisioning standards that can be handed over to operations at the conclusion of the implementation program. These standards should address all aspects of the physical and logical infrastructure, and should include configuration and engineering guidelines for each element within the architecture and the subscriber service level. It is critical for implementation teams to create a comprehensive platform for effective change management, both to ensure the success of the initial deployment and to support the change control process over the foreseeable lifetime of each element in the architecture and overall solution.

Migration

Migration within the context of an IP transformation program addresses all activities related to the migration of subscribers and services from the legacy architecture to the new next generation infrastructure.

Generally speaking, there are two migration models that carriers have used and will continue to use in IP transformation programs. The first model is subscriber-driven. Subscribers are given the option to switch to a new service and carriers execute a process to deprovision the subscriber from the existing network and provision them on the new network. The second model is carrier-driven – here the carrier dictates the pace and schedule of migrating subscribers, or groups of subscribers, to the new infrastructure.

In either case, the level of disruption that subscribers may experience during the migration process can vary significantly based upon a variety of technology and portfolio-related issues. For example, subscribers migrating from a POTS service to a broadband IP-based voice and data service may have to replace their existing handset with a new residential gateway that may require them to change the wiring layout within their house. On the other end of the spectrum, a carrier may execute an IP transformation program that provides PSTN emulation services to the end subscribers. In these situations, subscribers may have no indication that they have been migrated to the new infrastructure.

ADDRESS "FEATURE PARITY" CONSIDERATIONS CAREFULLY

Subscribers can be impacted during migrations in a number of ways. For example, a process failure during the actual cutover of the subscriber to the new architecture could leave that subscriber without service. Or, a particular feature or service could fail to operate the way a subscriber expects. This leads carriers to place a high value on issues such as "feature transparency" – the ability of a given technology to provide identical functionality to the technology it replaces. It is important to note the distinction between feature "transparency" and terms such as feature "parity" or feature "equivalence." Both parity and equivalence entail some level of duplication of a given feature or service, but they do not necessarily guarantee that the feature will operate identically to the feature on the legacy system.

Migration teams must address the feature parity issue in several ways. First, they should work with the planning teams to understand the decisions that were made during the portfolio rationalization process. In many cases, these decisions will dictate the requirements for feature transparency or feature equivalence. Migration teams should also plan to work closely with marketing, so that the carrier's sales initiatives provide an accurate view of the migration impacts on prospective customers. Finally, migration teams must work with customer care teams to develop appropriate support documentation and processes to assist customers in learning to use those features that will either not be supported in the new infrastructure, or will operate in a substantially different manner.

EVALUATE THE IMPACT OF DATA QUALITY

The ability of a carrier to successfully migrate subscribers from PSTN to IP-based voice services is directly tied to the quality of the data within the carriers various databases, such as subscriber provisioning systems, billing systems, Class 5 switch databases, and circuit inventory databases. An incorrect field in any of these systems could result in a failed migration and an unhappy subscriber.

Prior to migration, carriers need to evaluate the impact of a failed subscriber, both in terms of cost to bring the subscriber back into service, and the increased likelihood that the subscriber may discontinue service altogether and switch to another carrier.

To illustrate the cost impact, consider a scenario where a carrier needs to migrate 10 million subscribers over a four year period. If only 2% of the migrated subscribers are impacted by failures due to data problems, that would translate to more than 200 errors each day.

Carriers should also include a phase in their migration planning in which they perform a spot check of data quality across all systems that will become data sources for the migration program. The results of the initial data quality audit, combined with the anticipated costs of subscriber outage, should give the carrier a preliminary view of the potential cost associated with that level of data quality.

Using this information, carriers can then decide whether it is more cost-effective to use the data as is and incur the potential outages, or to perform a series of logical and physical data audits to resolve quality issues in the affected databases. In most cases, it is cost prohibitive to audit 100% of the data. More likely, carriers will decide on a selective audit model that will increase the overall confidence in the data quality, but cost less than a full physical audit. To accomplish this it is critical to use modeling tools that determine the most likely sources and locations of data inaccuracies, and can create cost effective scenarios to reduce or eliminate these errors, or minimize their impact.

PLAN FOR UNPRECEDENTED LEVELS OF LOGISTIC COMPLEXITY

For many carriers, the business case for transformation will require an efficient migration program that rapidly transitions users off the legacy architecture and on to the new architecture as quickly as possible. By moving quickly, carriers can decommission the legacy network and eliminate its operating expenses.

Performing such a migration, however, requires migrating potentially millions of subscribers per year over the course of the program. This effort represents a level of logistic complexity that most operators are not currently staffed to manage or support. In some cases, this need for additional resources will have a negative impact on the overall business case – particularly for business cases that assume significant reductions in existing staff.

PSTN subscriber migrations require the careful coordination of physical changes (installation of new elements, changes at the cross-connect or serving wire center) and logical changes (changes to provisioning systems, customer care systems, subscriber databases, network element databases, porting/routing changes, etc.). Failure to execute on any of these changes will require a rollback to the legacy systems. Excessive rollbacks increase costs significantly and are detrimental to the overall success of the migration program.

In order to accommodate the volume of subscribers, and the volume of changes and activities associated with migrating those subscribers, carriers must either develop sufficient expertise in workflow management and overall program management or bring in additional resources to plan and manage the migration process. Carriers will also need to develop, test, and manage a comprehensive set of processes, procedures, and rollback methods to deal with all the scenarios that the migration team will encounter in the field.

Operations

Once the deployment team has implemented the new architecture, responsibility for the operation of the network is transferred to the operations team. Operations spans a wide range of activities – including fulfillment activities such as subscriber provisioning and feature activation, assurance activities such as fault and performance monitoring, and various billing activities. Successful transition of the new architecture to the operations team is dependent on:

- Quality of the new operational processes,
- Skills and experience of the operations personnel,
- Suitability of the tools that the operations team will use to manage the infrastructure.

UNDERSTAND THE IMPACT OF THE TRANSITION PERIOD

During any network transformation program, there will be a period of time where the carrier will be forced to operate both the legacy network and the new network simultaneously. The length of this transition period will vary from carrier to carrier, based upon their strategy for migration, their overall business case, and desired benefits.

Operations planners must identify the additional requirements that the transition period will place on the operations teams. In situations where subscribers will be migrated between the old and new systems, operations staff will need the appropriate tools for provisioning, troubleshooting, and billing across the systems. Customer care teams will require the abilities and tools to quickly identify the migration state of any given subscriber in order to properly address outages or other subscriber concerns. They should be able to determine the root cause for problems that span the existing and next generation networks – for example, a call between an emulated PSTN subscriber and a legacy PSTN subscriber.

During this transition period, the carrier will probably have to grow its operations teams in order to have sufficient resources to operate both the old and the new networks. This is an unavoidable consequence of introducing new elements and technologies into an operational environment that has already been cost optimized. The biggest challenge for the operations leadership team is to define a model that provides the appropriate levels of service for retaining customer satisfaction, while looking for opportunities to quickly complete the transition in order to reduce the total operational costs.

ADJUST CUSTOMER CARE MODELS AND SKILLS PROFILES ACCORDINGLY

The introduction of IP-based technology into all aspects of the carrier network requires operations teams with a more diverse skill set for everyday management and fault isolation and resolution activities. The skill set of the operations team must be even more diverse for carriers that intend to offer multiple service types (voice, data, video) over multiple access network types (DSL, fiber, WiFi, mobile, etc). Long term, the goal of offering any service over any network will drive operations teams to evolve from teams of specialists to larger teams with a mix of skills that provides the multi-disciplinary base required to solve complex problems.

The implications of the IP-based network must be addressed at all levels of the operations organization – from providing the right procedures for performing customer care, through all tiers of the support group.

ADOPT A SERVICE-BASED MANAGEMENT MODEL

In most legacy carrier environments, operations teams can infer the quality of a given service based upon the operating levels of the associated infrastructure. For example, a carrier may look at metrics such as blocked call attempts or dropped calls as indicators of service quality levels.

In an IP-based network it is not sufficient for a carrier to look solely at the performance of the IP network as an indicator of service quality because the IP network may be carrying multiple types of services, each with its own unique performance requirements.

For example, while the use of the IP network may be operating at an ideal level, a subscriber could be experiencing poor quality due to the failure of an application server to respond in a timely fashion. In this situation, the quality of the customer’s experience drops significantly without a corresponding drop in performance at the network level. Therefore, carriers are forced to adopt an operational model that is focused more on service rather than exclusively on the network. The service-based management model represents a major change for virtually all carriers. It requires them to change how they measure – for example, what tools they will need to ensure proper service quality levels –and what they measure, such as what metrics and KPIs to focus on.

Conclusion

While the benefits of a network transformation program seem apparent to many carriers, concerns about the complexity of the transformation program itself have caused some to rethink their program strategies and time lines. The advantages of being a pioneer are only relevant in those markets where significant competitive threats are already eroding the traditional carrier's customer base.

Regardless of where carrier is with its transformation program, it can benefit from the experience accumulated by early adopters and from the best practices that are beginning to emerge.

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As a Principal Consultant for Alcatel-Lucent Services, Morgan Stern advises service providers worldwide as they plan for and implement their network transformation initiatives. In his role, Stern draws upon more than 15 years of experience in the telecommunications and IT industries to assist clients with their IMS architecture design, migration to VoIP, access network transformations, IT integration, and network convergence strategies.

Prior to joining Lucent, Stern worked as a consultant to a number of Fortune 500 corporations. There, he specialized in data/telecommunications network design, identity management strategy development, and network security design.

Stern's ability to translate technical issues into effective network design and business development strategies has made him a popular speaker at conferences worldwide. Past presentations have included discussions of the challenges complicating service delivery over an IMS platform and the use of IMS as an enabling technology for Fixed Mobile Convergence (FMC). During his career, Stern has also written three books as well as a variety of articles and white papers on IP network, network security, and directory services. Recent papers have focused on IMS Security and IMS peering. He was a contributor to the USTA IMS Implementation Guide, published in October 2006 and to the IEC publication "Business Models and Drivers for Next-Generation IMS Services", published in August 2007.

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