TM Forum Management World 2010—Driving the Costs out of IPTV

Introduction

This white paper reviews the opportunities and challenges associated with the delivery of Internet Protocol Television (IPTV).

IPTV has now achieved the first level of market introduction—technical feasibility and consumer adoption. The next level of market evolution is to scale for profitability. We can meet this challenge by significantly reducing IPTV installation and ongoing IPTV maintenance costs and delivering the best Quality of Experience (QoE) to reduce customer churn.

This white paper describes the TM Forum catalyst project—Driving the Costs out of IPTV which is a joint collaboration between JDSU, Bouygues Telecom, Bull, and Axiros with the support of TM Forum and Broadband Forum and discusses how the Broadband Forum and the TeleManagement Forum (TMF) are providing the necessary standards specifications to ensure the successful transport and delivery of IPTV services.
Audience

The target audience for this white paper is service providers looking to implement IPTV as a value-added service to existing voice and data services. This white paper highlights the application of the TMF and Broadband Forum standards to support IPTV deployments.

The IPTV Experience

What is IPTV?1

IPTV is the delivery of multimedia content to a home entertainment system over an IP-based packet network. The packet network protocol is based upon the same standard used on the Internet. In addition to providing traditional broadcast TV, IPTV can provide two-way interactive services.

Users can select nonlinear video services such as Video on Demand (VoD) content and watch a movie at their convenience and pace rather than at a broadcast scheduled time (linear video). Extensions to the IPTV experience bring a new dimension to television viewing from the traditional “lean back and watch” to enabling newer “lean forward and interact” services that engage users.

Users can watch broadcast (linear TV), VoD, or use a Personal Video Recorder (PVR) to watch later (time shifting) or even in a different room (place shifting). These new features work on the traditional Standard Definition TV (SDTV) and High Definition TV (HDTV) sets but also Personal Computers (PCs) and mobile phones (device shifting).

The IPTV market

Point Topic Ltd (point-topic.com) reports that the total number of worldwide IPTV subscribers has doubled in the last 2 years to over 17 million in June 2008. Synergy Research Group (www.srgresearch.com) estimates the number of IPTV users will be close to 40 million by 2010.

<table>
<thead>
<tr>
<th>Country</th>
<th>2008Q2</th>
<th>2009Q2</th>
<th>2008Q2</th>
<th>2009Q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>75,768,350</td>
<td>93,549,000</td>
<td>74,440,195</td>
<td>86,227,582</td>
</tr>
<tr>
<td>USA</td>
<td>74,440,195</td>
<td>86,227,582</td>
<td>29,584,700</td>
<td>31,085,500</td>
</tr>
<tr>
<td>Japan</td>
<td>21,420,702</td>
<td>24,086,150</td>
<td>16,601,286</td>
<td>18,324,300</td>
</tr>
<tr>
<td>Germany</td>
<td>16,718,400</td>
<td>17,838,200</td>
<td>15,061,659</td>
<td>15,876,192</td>
</tr>
<tr>
<td>France</td>
<td>11,534,230</td>
<td>12,855,463</td>
<td>8,490,400</td>
<td>10,469,755</td>
</tr>
<tr>
<td>South Korea</td>
<td>9,205,187</td>
<td>9,618,187</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Top 10 broadband countries—IPTV subscriptions per territory (in thousands)
**Why is IPTV important?**

IPTV represents significant value to both subscribers and service providers:

**Benefits to Subscribers:**
- More choices regarding content with individualized offerings
- Interactive features such as camera selection and voting
- Greater access to video programs beyond “packaged” offerings
- Integration with home networking enabling TV to display photos and home video collections
- Time shifting, device shifting, place shifting enables viewing convenience

**Benefits to Service Providers:**
- Triple Play (voice, data, video) or Quadruple Play (voice, data, video, mobile) bundled services significantly and positively impact customer retention
- New revenue opportunities to replenish declining voice revenue
- A single network reduces deployment costs (CAPEX)
- A single network reduces operation and management costs (OPEX)

**The IPTV Ecosystem**

Stepping back and looking at the big picture, IPTV service deployment entails a complex ecosystem that can be represented in a delivery chain consisting of four domains: Content, Service, Network, and Consumer.

Many standards bodies and consortia have been actively working in various areas with different focuses and in varied capacities. The Broadband Forum focuses on the broadband transport from the core/distribution network to the home. It is primarily concerned with the Network and Consumer Domains, while providing enabling functionalities to the other domains. Many organizations have referenced the Broadband Forum's work as part of the building blocks for the complete architecture.
Service Provider Challenges

Service providers face many challenges to successfully delivering a quality experience for IPTV subscribers. With the introduction of IPTV services, service providers must address many new variables, such as intelligently admitting video sessions onto the network to reducing the “zap time”, which is the total time from the user requesting a channel until they start seeing it, as well as assuring the quality.

Service providers must now manage a diverse ecosystem with many complex parts, such as multicast Internet Group Management Protocol (IGMP), Digital Rights Management (DRM), set top boxes (STB), Routing Gateway (RG), identity management, charging, customer care, and programming content. Moreover, the service demarcation point (termination point for service providers) has now moved from the side of the house to the STB, extending the management sphere for service providers deeper into the home network arena. This change creates a large potential opportunity, but it also introduces many new variables that add complexity and potential costs to IPTV service deployments.

BroadbandSuite™—Addressing IPTV Delivery Challenges

The Broadband Forum through its Technical Reports (TRs) and work in progress (WTs—Working Texts) has defined requirements for establishing an optimized network and management platform for IPTV. The work of the Broadband Forum addresses specific issues in three network realms: BroadbandAccess, BroadbandControl, and BroadbandHome that are necessary for IPTV users to experience a superior quality experience beyond that provided by existing TV delivery methods.

The Broadband Forum's BroadbandSuite (BBS) extends the concept of traditional end-to-end solutions by developing an access and management platform responsive to devices beyond the customer gateway as well as the distribution network.

![BroadbandSuite architecture](image)
This “blueprint” is designed to minimize provisioning and maintenance issues for service and application providers who must support the vast and growing requirements of new applications and hardware. With BroadbandSuite, components work together seamlessly, delivering a high-quality consumer experience vital for driving next-generation voice, video, data, and mobile services.

Through its BroadbandSuite, the Broadband Forum is addressing these important requirements to help the industry expedite the rollout and ensure the quality of experience for IPTV. The BroadbandSuite defines a robust architecture that spans from the home to the access and aggregation network and includes an intelligent control plane to orchestrate the successful delivery of IPTV.

These efforts address the following key areas:

- **BroadbandAccess**: Defines specifications for broadband “agnostic” access network architectures that deliver inherent quality, scalability, resiliency, and inter-working capabilities that enable delivery of services via multiple business models.

- **BroadbandControl**: Creates an intelligent, programmable control layer that unifies all next-generation network assets and empowers service providers to deliver personalized services that enhance the subscriber experience.

- **BroadbandHome**: Unifies the home networking environment by establishing a common set of customer premises equipment (CPE) capabilities as well as automating device activation and configuration in order to simplify the service delivery process.

Collectively the BroadbandSuite domains provide an end-to-end transport architecture that gives service providers a solid foundation on which to deliver next-generation services such as IPTV, while reducing operations costs through automated network operations.

**BroadbandAccess**

BroadbandAccess defines specifications for broadband agnostic access network architectures that deliver inherent quality, scalability, resiliency, and inter-working capabilities. These capabilities enable service providers to successfully deliver video across an infrastructure that offers faster bit rates more affordably, support packet-based quality of service (QoS), support IP multicast group management, and reduces management costs.

- TR-101 “Migration to Ethernet-Based DSL Aggregation” is a cornerstone in BroadbandAccess architecture. While TR-101 was originally defined for digital subscriber loop (DSL) aggregation, a majority of the requirements are access-agnostic.

- Specifications such as WT-156, which addresses GPON in the context of TR-101 architecture, will extend TR-101 to other access technologies such as fiber and even fixed wireless.

**Access Solutions for IPTV**

TR-101 “Migration to Ethernet-Based DSL Aggregation” is the migration from asynchronous transfer mode (ATM)-based access aggregation to Ethernet. One of the driving factors for this change is for IPTV deployment. Ethernet not only reduces the equipment cost, but also provides the higher bandwidth that HDTV demands.

TR-101 describes general architecture aspects regarding application enabling capabilities. TR-101 also requires backward compatibility with existing IP services and existing connectivity models as well as enabling forward compatibility with native Ethernet on the access loop. It also supports both Dynamic Host Configuration Protocol (DHCP)- and Point-to-Point Protocol (PPP)-based access methods for residential customers.
**Bandwidth**

IPTV requires higher bandwidth than is traditionally offered today. The introduction of new protocols and streaming techniques dramatically improves video transmission quality but requires more bandwidth to support the higher-quality broadcasting features. Any scenario that increases bandwidth will also require additional investment in CAPEX.

**Multicast Group Management**

The availability of multicast capability in the access segment and specifically in the access node increases the handling efficiency of IPTV/video services. Broadband Forum TR-101 describes equipment functionality required to facilitate several Multicast (MC) optimization points along the IPTV transmission path. TR-101 includes the capability of using multicast Ethernet virtual local area networks (VLAN) to deliver linear IPTV content to multiple subscribers from the "service edge", because it supports both single and dual edge topologies. Single service edge architectures use a single Broadband Network Gateway (BNG) to provide multiple services such as Internet Access (Unicast) and IPTV (multicast). Dual edge architectures use equipment such as multicast injection routers to provide the IPTV service (for example, to the multicast VLAN).

**Control Path**

The control path plays an essential role of the MC capability as it controls the distribution process. Ideally it supports multicast optimization by controlling the flood of Ethernet multicast frames using IGMP agents in intermediate (Layer 2 Ethernet) devices. Such agents can locally adjust replication filters on the device so that packets are replicated only on those ports (physical and logical) that have specifically requested a multicast group. Specifically, the data plane uses multicast media access control (MAC) address-based filters that link Layer 2 (L2) multicast groups to egress ports on bridging devices which potentially include aggregation switches and access nodes. The net effect is that a bridge, upon receiving a packet destined for a certain multicast group, will limit the flood of that multicast group to the list of ports attached to the filter.

**VLAN Models**

In order to manage QoS in the access network, various services must be segregated based on traffic types with each type guaranteed the necessary resources to meet its QoS requirements, such as reserving bandwidth, controlling jitter, and reducing delay to meet the limits for that particular traffic type. VLANs provide a method for segregating services by differentiating the various traffic types. VLANs enable guaranteed resource attributes (such as bandwidth, jitter, and delay) on a per application/service basis. Appropriate management of VLANs in the access network allows the IPTV streams to maintain their QoS and thus meet QoE expectations of the viewers.

**Quality of Service**

The Broadband Forum specifications define several methods to deal with QoS and support IPTV/Video applications. QoS ensures that IPTV sessions are guaranteed the correct network parameters for the duration of the session to ensure a quality experience for the subscriber. Dynamic and automated provisioning of network resources based on the defined business and network policies ensures that the most valuable sessions receive adequate resources.
**BroadbandControl**

The successful delivery of IPTV requires the real-time control of network and application resources based on established business and network policies. IPTV and other broadband video services employ a complex ecosystem that spans from the application delivery framework, through the aggregation and access networks right into the home network, making it imperative to employ an intelligent and programmable control layer to help assure the successful delivery of these resource-intensive and quality-sensitive services. Moreover, because user experience is critical to success, it is equally important to measure the QoE at critical junctions within the delivery path.

**Policy and Network Management Solutions for IPTV**

The Broadband Forum recognizes the need and answered the call for policy and network management solutions for IPTV within its BroadbandControl work, including important specifications such as WT-134 “Policy Control Framework” and TR-126 “Quality of Experience for Triple Play Services”.

For IPTV, a policy management framework such as WT-134 can assist with the provisioning of three key capabilities: Admission Control, QoS and QoE, and Dynamic Resource Control.

**Quality of Experience**

Broadband Forum TR-126 "Quality of Experience for Triple Play Services" defines QoE as “the overall performance of a system from the viewpoint of users. QoE is a measure of end-to-end performance at the services level from the perspective of users and an indication of how well the system meets their needs.” QoE is, in a sense, the only figure of merit that truly matters to the customer of any broadband delivery system. "Do I, the user, enjoy this experience? Does it meet my needs?"

QoE is inherently subjective, therefore, objective QoS measurements, such as error seconds, degraded packets, latency times, jitter, and so forth, only have importance relative to the experiences of real viewers of video programming in their own homes.

TR-126 identifies three aspects of service delivery that affect the QoE for an IPTV user:

1. **Session setup**
   - Delay before delivery of the selected program to the user. Because of the analog TV environment, TV viewers have come to expect a channel change to be nearly instantaneous (10s of milliseconds).
   - Easy process for program selection.
   - Number of simultaneous sessions supported per household.
   - Individuation. IPTV promises virtually unlimited program selection with access to video servers decoupled from the limitations of the physical method of delivery (Broadcast TV channels, frequencies in a Hybrid Fiber Coax [HFC] cable TV system, or satellite). IPTV uses the ability of IP to reach any number of video servers, each with an arbitrarily large amount of programming. Unless the IPTV system can achieve this, there is no differentiation from the existing TV delivery methods.
   - Ease of adding new devices in the home.
   - Provider’s capability to accurately bill for services ordered.
2. Session performance

- Picture and sound quality. Viewers are often more sensitive to digital degradations than to analog noises (pixilation vs. snow). HDTV increases viewer expectations regarding image quality.
- Stability of the connection—a program stream cannot fail during viewing. Unlike existing TV delivery schemes, IPTV requires session establishment between the source and the viewer’s system, which must be stable.
- Capable of supporting various devices in the home and evolving to support the consumer electronics, gaming, and home computer industries in providing new and creative home devices.

3. Session teardown (logging off, shutting down)

- Teardown must be rapid and invisible to users.
- Teardown must never leave the user in a “peculiar state” that delays their access to the next desired program.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Tools</th>
<th>Fault Sectionalization</th>
<th>WT-160 categories</th>
<th>TR-126 GoE Objective TR-135 support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity of service installation</td>
<td>Zero-Touch Configuration</td>
<td></td>
<td>IPTV Portal Information Retrieval Time</td>
<td>Global Operation Average Response Time</td>
</tr>
<tr>
<td>Visibility in the Home network</td>
<td>Ability to diagnose and repair problems idealy without the feared “truck roll”</td>
<td>Head-End / Service Delivery Platform</td>
<td>IPTV Service Access Time</td>
<td>Global Operation Service Access Time</td>
</tr>
<tr>
<td></td>
<td>Availability of tools to automatically monitor the network</td>
<td>Core Network</td>
<td>IPTV Channel Switching Time</td>
<td>Video Response Stats Average Video System Response</td>
</tr>
<tr>
<td>Service Availability</td>
<td>Probes</td>
<td>Aggregation Network</td>
<td>IPTV Video on Demand Access Time Song</td>
<td>Video Response Stats Average Video System Response</td>
</tr>
<tr>
<td>Videoaudio Quality</td>
<td></td>
<td>Loop Network</td>
<td>IPTV Video on Demand Access Success Ratio</td>
<td>Video Response Stats Access Successes, Access Failures</td>
</tr>
<tr>
<td>System Reliability (DSL stability)</td>
<td>DELT / SELT / MELT</td>
<td>Home Network</td>
<td>IPTV Video on Demand Completion Ratio</td>
<td>Video Response Stats Access Successes, Completion Count</td>
</tr>
<tr>
<td></td>
<td>DLM, DSM</td>
<td></td>
<td>IPTV Video on Demand Control Response</td>
<td>Video Response Stats Average VoD Control Response</td>
</tr>
<tr>
<td>Immunity to noise and other impairments (no packet loss)</td>
<td>FEC (CoFPA)</td>
<td></td>
<td>IPTV Media Quality</td>
<td>Metric Data Metric Value</td>
</tr>
<tr>
<td></td>
<td>RTP/RTCP retransmission - RFC 3550, RFC 4959, DLS FEC</td>
<td></td>
<td>IPTV IP Packet Loss</td>
<td>Packets Expected, Packets Received Gmin, Loss Event, Severe Loss</td>
</tr>
<tr>
<td>Available bandwidth</td>
<td>Bandwidth management</td>
<td></td>
<td>IPTV Channel Availability</td>
<td>N/A</td>
</tr>
<tr>
<td>Bandwidth stability</td>
<td></td>
<td></td>
<td>IPTV Video without Disturbance</td>
<td>N/A</td>
</tr>
<tr>
<td>Delay of Transmission and delay variation (jitter)</td>
<td>Availability of tools to automatically monitor the network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability of Connection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery Time from Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5: TR-126 / TR-135 / WT-160 KPI and KQIs
BroadbandHome

BroadbandHome unifies the home networking environment by establishing a globally identifiable set of CPE specifications. It also automates device activation and management to simplify the service delivery and support process. These common specifications can work for STBs and other next-generation quad-play devices to ensure they can adapt to the varying needs of the broadband access networks, allowing customers to choose from a larger body of multimedia services that services providers can readily support.

Remote Management of the Digital Home

With TR-069 CPE Wide Area Network (WAN) Management Protocol (CWMP) an auto-configuration server (ACS) acts as a centralized control point for the CPE devices, such as RG, STB, and network attached storage (NAS) devices. An ACS that implements TR-069 is built for mass support of TR-069-compatible CPE devices.

The TM Forum started a collaboration program in partnership with other industry groups to investigate the feasibility of a common approach to managing user devices such as mobile handsets, STBs, home gateways, and consumer electronics. TM Forum has developed a technical report called “TR150, End User Device Management Technical Report, Release 1.0”.

TR-069 enables provisioning and installation of IPTV STBs and RGs without subscribers having to access the CPE graphical user interface (GUI) and configuring via home computer. The TR-069-enabled ACS is built to remotely manage millions of devices, upgrade firmware, and turn on new services. With its remote CPE troubleshooting capabilities, it can improve customer satisfaction, shorten support calls, and reduce truck rolls.

From a purely functional perspective, TR-069 is intended to support a variety of functionalities for managing a collection of CPE, including the following primary capabilities:
- Auto-configuration and dynamic service provisioning
- Software/firmware image management
- Status and performance monitoring
- Diagnostics reporting
- Identity management for web applications

TR-069 Plays a Critical Role in IPTV Success

Overall, TR-069 CWMP is an important component for ensuring customer QoE in the IPTV application as it empowers the ACS to work seamlessly with the video devices in the home to ensure stable network connections, hands-off device provisioning, ongoing image monitoring and correction, automated software and firmware updates to maintain peak performance of the video device. This specification has become an industry de-facto standard as other organizations such as Alliance for Telecommunications Industry Solutions (ATIS), Digital Video Broadcasting (DVB), Home Gateway initiative (HGI), International Telecommunications Union (ITU-T), and Digital Living Network Alliance (DLNA) reference it in their own specifications.
TR-135
This data model for a TR-069-Enabled STB provides the specifications for remote management of digital television (IPTV or broadcast) functionality on STB devices via CWMP as defined in TR-069 and TR-106.

Figure 6: STB context

TR-135 covers the data model for describing a STB device as well as rules regarding notifications on parameter value change that provides standard data model profiles typically seen while remotely managing such a device. An IPTV service platform manages access to network and PVR content. The ACS may perform some initial configuration of newly installed STBs, but it mainly functions to configure STB parameters for trouble management and collection of statistics for QoS/QoE monitoring.

A STB is regarded as part of a home network in which it can consume content as well as provide or relay content to other devices. It may store content locally inside, within another home network device such as a Media Center, or can come from one or more of the external networks to which the home network is connected. Local and remote access can occur simultaneously.

Based on this scenario, the goals of the TR-135 specification are as follows:
- Enable the ACS to configure those objects and parameters that are not the responsibility of the IPTV Service Platform
- Enable monitoring and checking from an ACS of operational status for the specific parameters of a STB
- Enable performance monitoring of an arbitrary set of STBs, from one to millions, through estimates of QoS and QoE
- Support various types of STBs, including Digital Terrestrial Television (DTT) and IP STBs, with or without PVR and other optional functionality
- Accommodate STB devices that are embedded as part of an Internet Gateway Device
- Accommodate stand-alone STB devices, such as those implemented in separate hardware devices
STB/IPTV Performance Management

The ACS automatically monitors STB performance. Performance reports can include:

- QoS parameters or network parameters such as average bit rate, jitter, and packet loss ratio
- QoE parameters such as visual quality indicators or the average speed of a channel change
- usage statistics such as the number of STBs on at a certain time or the length of time each remained tuned to a certain channel.

Perform monitoring:

- periodically on all STB devices to ensure proper functioning of the network and devices.
- on subsets of STB devices, for instance when periodic test reveal problems; criteria for selecting subsets can be geographical or based on specific STB characteristics such as manufacturer, hardware, and/or software version.
- periodically on specific STB devices to manage SLAs of subscribers of premium services. Use performance management to immediately identify problems followed by trouble management technicians can then attempt to resolve them.

STB QoS and QoE reporting capabilities allow for performing in-service passive measurements at the service level which are of fundamental importance to an operator in a number of cases that will be discussed later. Other cases are possible beyond those listed here:

- Understand and measure the QoE delivered to individual end users via collection and aggregation of STB reports across the user base.
- Troubleshoot the service delivered. STB reporting allows near real-time processing of collected reports and correlation of indicators that let operators determine where faults lie such as in the head end, in the network, in the local loop, in the home network, or in the STB itself.
- Assess and measure the IPTV service as delivered in the mid to long term and define and control whether it is meeting performance objectives.
- Proactively catch increasing hidden behavior that reduces service performance but that end users have not yet noticed.
- Proactively manage certain end users who are receiving poor levels of service but who have not yet called customer care.
- Configure and define operations management service quality thresholds on aggregated reports that can be tuned in order to take action before end users notice or report problems.
- Understand loop and end-to-end behavior in order to design and assess error correction strategies for the IPTV service.
- Manage service maintenance and understand the impact of changes in the network, device upgrades, or new device insertion on IPTV service.
TM Forum Frameworx and Best Practices

TM Forum’s Frameworx Integrated Business Architecture provides an industry-agreed, service-oriented approach for rationalizing operational IT, processes, and systems that enable service providers to significantly reduce their operational costs and improve business agility.

Service-oriented approaches encourage business agility through re-use, essential in today’s market where service providers must deliver new services rapidly and increase revenues in the face of changing value chains and technologies.

Frameworx uses standard, reusable, generic blocks—Platforms and Business Services—that benefit from standardization yet allow uniquely customized assembly where necessary.

Frameworx defines the mechanism by which the Forum’s existing NGOSS standard Framework components are integrated into a comprehensive enterprise IT and process architecture that also embraces major IT industry standards such as Information Technology Infrastructure Library (ITIL) and The Open Group Architecture Forum (TOGAF). Its components are:

- Business Process Framework (eTOM) is the industry’s common process architecture for both business and functional processes.
- Information Framework (SID) provides a common reference model for Enterprise information that service providers, software providers, and integrators use to describe management information.
- Application Framework (TAM) provides a common language between service providers and their suppliers to describe systems and their functions, as well as a common way of grouping them.
- Integration Framework provides a service-oriented integration approach with standardized interfaces and support tools.

Another major step forward with Frameworx is the introduction of product certification, certified training, a certified TM Forum partner program, and extensive implementation support that will help service providers implement practical solutions based on Frameworx. Frameworx, scheduled for full release in June 2010, is the result of a multi-year TM Forum effort and extensive collaboration among its 700-strong corporate membership through TM Forum’s collaborative research and development (R&D) programs.
eTOM—The Business Process Framework

TM Forum’s Business Process Framework (eTOM) is a key element of the TM Forum Framework Integrated Business Architecture. It is the industry’s common process architecture for both business and functional processes and has been implemented by hundreds of service providers around the world. Business Process Framework drives down operational costs by analyzing all facets of an organization’s processes, thereby eliminating duplication, identifying missing process steps, expediting new development, and simplifying procurement.

The Business Process Framework (commonly known as eTOM) is the ongoing TM Forum initiative to deliver a business process model or framework that service providers and others within the telecommunications industry use.4
**TAM—TM Forum’s Application Framework**

TM Forum's Application Framework (Telecom Application Map [TAM]) is a key element of the TM Forum Frameworx Integrated Business Architecture shown in Figure 9.

Figure 9: The Telecom Application Map

TAM provides a common language between service providers and their suppliers to describe systems and their functions as well as a common way of grouping them.

As the next generation of digital services pushes enterprises to collaborate with more partners and greater numbers of systems, the ability to identify functional gaps becomes critical for purchasing and integration decisions. The Applications Framework provides organizations a standardized model for grouping functions and data into recognizable applications or services.

The Applications Framework provides the bridge between Frameworx components, such as the Business Process and Information Frameworks, and real applications by grouping process functions and information data into recognized OSS and BSS applications or services.

By providing a structure to define support systems’ application functionality, the Framework helps Service Providers navigate the entire procurement process—from initial request for information, through systems comparison, to actual implementation. It also helps Suppliers position which systems they supply themselves and which ones they supply through partnerships with other companies.

The TAM is intended as a working guide to help operators and their suppliers use a common reference map and language to navigate a complex systems landscape that is typically found in fixed, mobile, and cable operators.

Where the enhanced Telecom Operations Map* (eTOM) provides a frame of reference for telecom processes and the NGOSS Shared Information Data model (SID) provides a frame of reference for standardized information language, the TAM provides a frame of reference for telecom applications."
**TM Forum Interfaces**

In today’s environment where services change rapidly, customers modify profiles often, networks evolve quickly, new charging schemes are defined regularly, and new partners join the value chain as never before, systems must be dynamic—and demand well-understood application integration points.

Open, flexible interfaces are critical to connecting the multitude of support systems, multi-technology networks, and data that exist in this IT/management environment.

Utilizing standardized interfaces to address these integration challenges is repeatedly saving 50–75 percent of costs compared to development based on non-standard interfaces.

All stages of development see gains in productivity, from requirements definition, to design, code, and test. Risk is substantially reduced across the board as development artifacts become reusable and processes become repeatable.

The most powerful interfaces for connecting all of these inter- and intra-service provider pieces are available under the TM Forum’s Interface standards suites:

- **MTOSI**—interfaces for network and service management for transport networks
- **MTNM**—interfaces that model the management of multi-technology networks
- **OSS/J**—multi-technology APIs that deliver on Solution Frameworks (NGOSS) design guidelines for component-based management systems
- **IPDR**—interfaces used for usage data management and accounting
- **Identity Management**—unified identity management across operational systems

TM Forum Interfaces shares common administration for specifications, reference implementations, and other artifacts—all in accordance TM Forum’s Solution Frameworks (NGOSS) principles.

**MTOSI—Multi-Technology Operations System Interface**

Service providers must deliver new services and products more effectively—faster and cheaper—than ever before in an environment that requires inter-working between many different vendors, technologies, and systems.

MTOSI, the Multi-Technology Operations System Interface, is a single standard that provides the “glue” to connect these components together. MTOSI has been part of the TM Forum Interface Program (TIP) since April 2008.

The MTOSI Product Delivery Team with the TM Forum Interface Program presents Release 2.0 of the Multi-Technology Operation Systems Interface (MTOSI) Solution Suite.

Release 2.0 of the MTOSI product is a major release, which means that it contains new features in addition to corrections and extensions to the previous MTOSI 1.x releases. The many modifications introduced in this release are summarized below:

- service activation management
- resource provisioning and activation
- management of connectionless networks
- performance management and maintenance commands
- inventory updates, multi-event inventory notifications and enhanced inventory retrieval (attribute value matching)
- enhanced model for resource states
- multi-action and request transactions
- division of deliverables into DDPs
In order to allow for more efficient release delivery, the previous monolithic BA, IA, and SS documents have been partitioned into smaller self-contained (though not independent) units called Document Delivery Packages (DDPs). The basic idea is that the interface, specified by the entire document set (of a release), is partitioned into DDPs with each specifying “a certain aspect” of the interface that must be very clearly scoped.

There are three kinds of DDPs:

- **The FrameWork DDP (FMW)**—contains the generic artifacts applicable to all the other DDPs.
- **Data Model DDP (DM-DDP)**—concerns a data model (entities, data structures, attributes, state, but no operations).
- **Operation Model DDP (OM-DDP)**—concerns a computational model (operations, notifications, and transactions) for a given functional area (such as resource inventory management).

The unified deliverables structure for each DDP is as follows:

- **Business Agreements (BAs):** a business view specification
- **Information Agreements (IAs):** a system view specification
- **Interface Implementation Specifications (IISs):** implementation and deployment view specification for XML (such as WSDL, XSD, and bindings)
- **Supporting Documentation:** normative and informative supporting documents

**OSS/J—Standard-based Solutions Framework (NGOSS)**

OSS/J delivers standards-based Solutions Framework (NGOSS) interfaces implementations (OSS/J APIs) and design guidelines for the development of component-based OSS systems. OSS/J technologies provide the foundation for unifying legacy systems and new applications quickly and inexpensively. The OSS/J APIs are multi-technology based and include Java, XML, and Web Services integration profiles. Each integration profile consists of specifications, a reference implementation, and a conformance test suite (TCK). All OSS/J APIs are publicly available at no charge. OSS/J became part of the TM Forum Interface Program (TIP) in April 2008.

**TR-150, End-User Device Management**

This document describes the overall strategy for the TM Forum End-User Device Management collaboration program and helps set the direction for the TM Forum New Markets Initiative for Device Markets. End-user devices have increasing multimedia capabilities and convergence of functionality. The increased sophistication of end-user devices has created a need for a common approach to manage these devices. The TM Forum started a collaboration program in partnership with other industry groups to investigate the feasibility of a common approach to the management of user devices such as mobile handsets, STBs, home gateways, and consumer electronics. The group addressed requirements to manage remote end-user devices for relevant stakeholders—major device players, service providers, content providers, and large corporate enterprises.
Driving Out the Costs of IPTV—Catalyst Project

IPTV has now achieved the first level of market introduction—technical feasibility and consumer adoption. The next level of market evolution is to scale and in a profitable way. This challenge can be met by significantly reducing IPTV installation and ongoing IPTV maintenance costs and delivering the best QoE.

Figure 10 shows the architecture of the TM Forum “Driving Out the Costs of IPTV Catalyst Project” that was demonstrated during TM Forum Management World in Nice, France, on May 18-20, 2010.

This TM Forum “Driving out the Costs of IPTV Catalyst Project” bridges the TM Forum and Broadband Forum initiatives.

“Driving Out the Costs of IPTV Catalyst Project” was developed by the following consortium:

Executive sponsors
- Bouygues Telecom provided business challenges and support to define the test cases.
- Broadband Forum supplied their full support, experience and marketing, and technical documentation to help ensure this project is standards-based.

Team members
- Bull will provide the OSS layer application with SmartOSS and SmartMaps to display in real-time the IPTV customer experience (QoE).
- JDSU will supply the NetComplete® Home PM platform that proactively collects, aggregates, and correlates statistics to provide accurate customer QoE with root-cause analysis (fault and dispatch statements).
- Axiros will provide the ACCESS ACS and CPE monitoring mediation layer called AXTRACT. Both applications are based on broadband Forum standards.
The demonstration will show how to automatically identify customers who are experiencing degraded service.

- This enables the accurate dispatch of technicians for trouble resolution.
- This is achieved by continuously monitoring the performance of home networking equipment in a synchronized fashion at ultra high speed.
- This is performed using a vendor agnostic standards-based approach that does not interfere with any exiting provisioning systems.
- The result—reduced churn, time to repair, and field dispatches improves the overall customer experience.

Figure 11 maps the team member application in the TM Forum Application framework.

![Figure 11: Driving out the costs of IPTV Catalyst project—TAM mapping](image)

![Figure 12: Service problem management—TAM mapping](image)
The following subsections detail how the components of this Catalyst project work and interact.

**Bull SmartOSS™**

SmartOSS provides end-to-end network views and controls heterogeneous networks from one centralized management system. It supports the key service assurance functionalities: Incident Management, Fault and Performance Management, Event Correlation, Network Configuration, and more.

SmartOSS brings a unique and unified GUI to the operators that simplify the operations of the network operations center (NOC). It enables monitoring and control of the network. It also allows for a flexible and modular approach for integrating new networks and services based on time to market and minimal, tailored, costs. With SmartOSS, operators can quickly deploy a working solution while maintaining focus on their business challenges.

SmartOSS fits well into an ITIL-based approach and also works well with the TMF standards (eTOM, TAM, and TIP interfaces).

Open source components:

- Diminish risk through extensive adoption of standard technologies
- Enable flexible customization to specific customer requirements enabling operational excellence
- Reduce CAPEX/OPEX

In addition, the operator remains free to either outsource potential solution changes or to internalize them because of this open approach.

- SmartMaps and SmartOSS, are based on pre-integrated open source components
- Enables Delivery of Tools to move up in the QoE Maturity Model
- End-to-end network and service status overview (core, access, home) with root problem location
- Click to Home Network view
- SmartOSS QoS Northbound Interface (NBI): based on TMF standards
- SmartOSS Southbound Interface (SBI): SNMP, OSS/J, and WS to collect performance data (JDSU and other Fault and Performance managers)
SmartOSS Key Features
- “Ready to use” global solution for Operations Support Service
- Supports key domains of operations support: Service Desk, Incident and Problem at Service and Resource levels, Change, Configuration, Backup and Restore, and Report Management
- Pre-integrated components: selected open source products can be easily combined to match customer needs
- Selected products can be easily integrated into existing environment
- Key functions: Fault, Performance, Inventory, Configuration, Trouble Ticketing, Knowledge base
- OSS/J QoS-compliant NBI
- SBI supports SNMP and web services for communication with NMS, EMS, and NE
- Reduces operational costs
- Supports key standards
- Scalable and robust

SmartMaps Key Features
- Flexible Network Topology display
- Flexible Service Status display

Figure 14: Bull SmartOSS architecture
JDSU NetComplete Home PM

The JDSU NetComplete Home PM Service Assurance Solution delivers a positive impact on dispatch reduction, customer service reactivity, operational expense savings, and improved efficiencies by:

- Managing the end-to-end service performance from ingress sources through the least reliable parts of the access network, such as various fiber infrastructures and fiber-to-the-home (FTTx and FTTH).
- Ensuring services are always available with the best possible QoS and QoE.
- Providing thorough end-to-end (content to customer) testing and monitoring with the right mix of probes, software, and OSS applications to truly inspire comprehensive, effective, and economical operations and processes ensuring superior customer service even during high subscriber growth phases.
- Providing a service assurance architecture that easily extends to address the future, such as requirements for FMC/IMS.

Key features of NetComplete Home PM:

- Provides a comprehensive solution for multi-vendor CPE management: monitoring, diagnosis, and troubleshooting, which compliments existing zero-touch provisioning, configuration update, and software upgrade solutions.
- Provides the means to measure service availability and customer experience in real-time and over longer periods of time to quickly pinpoint which service or part of the network might be contributing to service downtime/issues.
- Provides the added value of pre-packaged rules for root-cause analysis based on access technology and multi-play services. These packaged rules:
  - provide accurate and clear fault and dispatch statements.
  - reduce the number of events requiring attention and cut first-level diagnosis lead times increasing NOC and customer support team efficiency and pruning operational expenses.
The major benefits of the NetComplete Home PM Service Assurance Solution are:

- Provides a proactive monitoring solution
- Provides Virtual, Study, Exchange Fault Detection, New Customer modes
- Offers geographical maps with drill down capabilities
- Provides a Service dashboard (WAN, LAN, IPTV, VoIP, and Internet)
- Offers Broadband Home Remote Management Testing support
- Provides customer historical data
- Provides configurable correlation between domains and KPIs
- Offers aggregation and neighborhood analysis
- Provides fault, dispatch, and actions statements
- Provides the means to understand which KPIs are driving the poor QoE
- Provides early life failure (ELF) and churn management
- Detects faulty exchange/DSLAM

Figure 16: JDSU Home PM IPTV customer QoE
**Axiros AXESS ACS and AXTRACT Monitoring Appliance**

The Axiros AXESS ACS provides the full range of TR-069 of CPE management functions throughout the life cycle as described previously.

Beyond the essential TR-069 functions such as CPE software upgrade, configuration, and diagnostics, the AXESS ACS provides:

- support of complex workflows in CPE provisioning
- flexible northbound integration with such components as customer care and billing
- guaranteed southbound interoperability on TR-069
- integration of non-TR-069 devices on the southbound side to support a base of legacy devices.

A typical ACS installation requires only a small number of TR-069 interactions per managed CPE per day. This allows a setup that handles hundreds of interactions per second to comfortably manage millions of CPEs.

However, to collect fine-grained performance information from all CPEs in real time requires much higher CWMP interaction rates and specialized processing for the resulting data volumes, which is usually difficult to add into an existing ACS setup that focuses on provisioning and maintenance.

The Axiros AXTRACT Appliance allows an operator to add high-volume real-time collection of key performance indicators (KPIs) into an existing setup without affecting the existing ACS installation for all other functions. Collecting the KPIs can be achieved by deploying the AXTRACT Monitoring Appliance in line between the CPEs and the current ACS as shown in Figure 17. Regular TR-069 interactions are forwarded between the ACS and CPE as before, however, the AXTRACT Monitoring Appliance also queries additional parameters from the CPE at regular intervals.

![Figure 17: AXTRACT monitoring appliance deployment](image)
Key Features of the AXTRACT Monitoring Appliance:

- Scalability to thousands of interactions per second and millions of devices
- Transparent to existing ACS traffic
- Freely define properties to be collected per device group, so AXTRACT can monitor any attribute the device offers for use in various service scenarios such as VoIP or IPTV
- Flexibility in aggregation, storage, and export of the collected data
- Integrated dashboard to control the appliance as well as to report on the collected data

![AXTRACT Dashboard](image)

Figure 18: AXTRACT dashboard
References

**Broadband Forum**
1. BROADBANDSUITE™ SOLUTION SERIES, Enabling IPTV Service Delivery, Version: 0.22, November 12, 2008 (extensively quoted in Sections 3, 4, and 5 of this paper)

**TM Forum**
2. TM Forum's Frameworx  
   www.tmforum.org/TMForumFramework/1911/home.html  
3. Business Process Framework (eTOM)  
5. Application Framework (TAM)  
   www.tmforum.org/ApplicationFramework/2322/home.html  
6. Telecom Application Map, The BSS/OSS Systems Landscape, Release 3.1, GB929, Version Number 3.4  
7. TM Forum Interfaces  
   www.tmforum.org/TMForumInterfaces/5733/home.html  
8. MTOSI  
   www.tmforum.org/BestPracticesStandards/mTOPMTOSI/2319/Home.html  
10. OSS/J  
    www.tmforum.org/BestPracticesStandards/OSSJ/2896/Home.html  
11. TR-150, End User Device Management, Release 1.0  
    www.tmforum.org/TechnicalReports/TR150EndUserDevice/37161/article.html

**JDSU**
12. White paper: NetComplete® Home Performance Management (PM)
Other Sources

JDSU
- NetComplete® Service Assurance Solution
- Application Note: FTTx Access Networks and Services Quality Assurance and Testing Methodologies

Broadband Forum
- Broadband Forum (formerly DSL Forum and IP/MPLS Forum)
  www.broadband-forum.org/
  www.broadband-forum.org/technical/download/TR-069_Amendment-2.pdf
- TR-098: Internet Gateway Device Data Model for TR-069
  www.broadband-forum.org/technical/download/TR-098_Amendment-1.pdf
  www.broadband-forum.org/technical/download/TR-104.pdf
- TR-106: Data Model Template for TR-069-Enabled Devices, Issue: 1 Amendment 4
- TR-126: Triple-play Services Quality of Experience (QoE) Requirements
- TR-140: TR-069 Data Model for Storage Service Enabled Devices
  www.broadband-forum.org/technical/download/TR-140_Issue1.1.pdf
- TR-181: Device Data Model for TR-069, Issue: 1
- WT-160 - IPTV Performance Monitoring and Diagnostics

TM Forum
- Best Practice: Video over IP SLA Management, Application Note to the SLA Management Handbook, Release 2.0, GB938, Version 1.10

Home Gateway Initiative
- Home Gateway Initiative
  www.homegatewayinitiative.org/
- Home Gateway Technical Requirements: Release 1, Version 1.0; July 1, 2006
  www.homegatewayinitiative.org/publis/HGI_V1.0.pdf
Contributors

- **JDSU** (www.jdsu.com)  
  Jean Schmitt  
  Nisha Parbhakar

- **Axiros** (www.axiros.com)  
  Gunther Klessinger  
  Bokaemper Martin  
  Kurt Peterhans

- **Broadband Forum** (www.broadband-forum.org)  
  Robin Mersh  
  Laurie Gonzalez

- **Bull** (www.bull.org)  
  Malo Jennequin