Roger Ward and Tatsuro Murakami

The Multiservice Switching Forum —The First Five Years

The Multiservice Switching Forum (MSF) celebrated its fifth anniversary at its October 2003 technical meeting held in Vancouver, British Columbia. With BT and NTT among the founder members, the MSF now has a large membership comprising many leading network operators and global suppliers of telecommunication network equipment. Its mission—to accelerate the deployment of open communications systems that realise the economic benefit resulting from the flexible support of a full range of network services using multiple infrastructure technologies—now well established within the global industry.

This article reviews the work of the MSF—its scope, organisation and achievements. With its unique collaboration framework, the MSF provides a 'one-stop shop' for forward-looking companies and organisations that see the competitive advantage that can be achieved by collaborating on issues of common concern. With a meaningful agenda formulated from five years experience, the MSF is at the forefront of leading carriers' plans for implementing the networks of the 21st century today.

From architecture, through protocol profiling and interoperability testing, the MSF provides a cost-effective framework to develop implementation agreements (IAs) which are of benefit to carriers and suppliers alike. Building on the success of the first Global MSF Interoperability event (GMI2002) held in November 2002, the MSF is now well advanced in its plans for GMI2004—providing another opportunity to demonstrate the commercial applicability of the MSF's work, but this time with a significantly extended range of physical scenarios and IAs applicable to carrier needs.

Introduction

Traditional telecommunication network switching technologies and architectures are today rapidly being eclipsed by network solutions based on equipment technology drawn from the computer industry. The increase in data traffic, the concept of carrying voice at the margin of data networks and the rise in importance of voice-over-IP technology are now enshrined in the business plans of all major operators and suppliers. With increased competition and the growth of substitute products, it has also long been apparent that network operators cannot continue indefinitely to upgrade an increasingly complex mix of service-specific network platforms by reactively purchasing proprietary vertical 'stove pipe' functionality to meet new and future requirements as they arise. While suppliers might relish this prospect, such an approach is unsustainable in the long term as it would simply lead to the duplication of transmission, switching and routing infrastructure, with the cost penalty of having to develop the same functionality over and over again.[1]

To realise practical systems that achieve such objectives, however, requires significant industry cooperation. This is necessary in order to develop an appropriate architectural framework, standards and implementation agreements to ensure adequate interoperability of individual components. Obviously, the traditional standards bodies (for example, International Telecommunication Union-Telecommunications Standardisation Sector (ITU-T), European Telecommunications Standards Institute (ETSI)) and industry fora (for example, the Internet Engineering Technical Forum (IETF)) have a significant role to play. To date however, no single body has had the necessary commercial focus to deliver meaningful implementation agreements that ensure appropriate levels of interoperability for the entire multiservice, multitechnology problem space.

The Multiservice Switching Forum (MSF) is a global association of service providers and system suppliers committed to developing and promoting open-architecture multiservice switching systems. Founded in 1998, the MSF fosters cooperation among its members—the world's leading technology innovators—in the development of open communications systems. Through its technical working groups, meetings and standards efforts, the Multiservice Switching Forum's members are shaping the next-generation communications technology that will define how the world communicates in the 21st century.[2]

Why the MSF?

The successful deployment of an open multivendor multiservice next-generation network is a goal shared by most in the

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telecommunications industry today. It is widely recognised that standards are key to achieving this goal. But standards typically define protocols, and the reality is that in today's industry, protocol definitions are not rigorous enough to achieve multivendor interoperability and the traditional mechanisms for filling missing detail no longer apply.

As a consequence, it is not uncommon for two pieces of equipment compliant with the same standard to not work together. In some cases this is the result of implementation errors, or ambiguity in the standards. But often it is simply because the problem is more complex than that. There is more to multivendor interoperability than defining interface standards, and recent structural changes in the industry mean that major vendors and carriers need to collaborate more than ever to cost-effectively deliver next-generation network solutions.

This is where the MSF helps by bridging the gap between protocols and interoperability, fitting into the value chains of both network operators and suppliers between *technology exploration* and *company specific development and procurement* as illustrated in Figure 1.

The MSF architecture provides the essential framework and common semantic for the definition of a multiservice network. Definition of a set of physical architecture implementations within this framework enables MSF members to focus on a common bounded set of commercially viable scenarios.

MSF implementation agreements (IAs) help get the right focus on key protocols and ensure interoperability between components from different vendors, by specifying options and required functionality for key interfaces.

The Global MSF Interoperability (GMI) programme (especially the high profile GMI2002 and GMI2004 events) provide an opportunity to put the components together in a multivendor, end-to-end network deployment scenario, and verify that everything works correctly.

All of this puts the MSF at the forefront of helping define the telecommunications network of the future.

What are Major Carriers Trying to Achieve from the MSF?

BT perspective

In a global market place, it is necessary to avoid operator specials wherever possible to maximise on economies of scope and scale. In such an environment, individual operator buyer power is limited and it is necessary to embrace new mechanisms to cost-effectively influence the industry on common requirements. The MSF is not a standards body as such, but a forum focusing on meaningful end-to-end system specifications with proven demonstration of global interoperability to meet the needs of global carriers.

The MSF has a meaningful agenda for collaboration and provides an effective means of leveraging the work of others to help deliver BT requirements for its 21st Century Network programme (21C BT). Particular areas of collaboration includes architectural framework, profiling of international standards (for example, H.248, SIP, etc.) and interoperability events. With some five years of proven staying power in the recent very tough industry climate, the MSF has now come of age and BT wishes to exploit this opportunity to the full.

Collaboration on common requirements frees scarce development resources to focus on the things that will enable BT to differentiate its services and products from others. One major strategic objective for BT is to deploy a PSTN-quality voice-over-IP (VoIP) network. By leveraging the work of the MSF through involvement in GMI2004, BT can capitalise on the MSF's work to specify and demonstrate a deployable IP telephony network running over a globally networked IP MPLS core (including a service layer with application server, media server, and service broker functionality).

Figure 1 The MSF value proposition

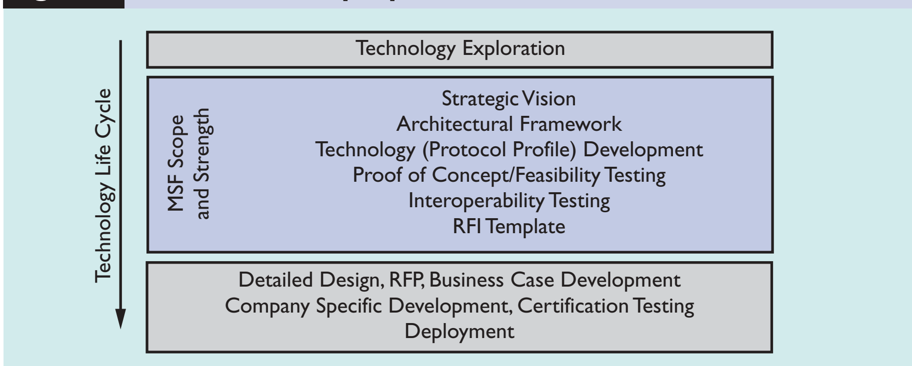


Figure 2—BT Exact, Adastral Park, Ipswich, UK—GMI2002 European Host

To take a lead role in GMI2004 requires world-class test and evaluation facilities. BT Exact has such facilities which are central to its capability to provide world-class support to external customers for:

- business evaluation,
- product testing, and
- network testing.

BT has already demonstrated leverage of its strengths in this area by hosting the European GMI2002 site at its UK laboratories at Adastral Park in November 2002. As well as proving out MSF IA's, the GMI programme is of course an ideal opportunity for both carriers and vendors alike to provide an open showcase for next-generation technology.

By again standing up to the challenge of hosting the next MSF Global Interoperability event (GMI2004—in October 2004), BT seeks to keep the MSF focused on scenarios applicable to the real needs of carriers and accelerate introduction of new technology into its network.

NTT perspective

NTT is undergoing a period of revolutionary change as a carrier that has resulted in the following three strategic imperatives:

- the need to construct an integrated voice and data network,
- the globalisation of NTT's business, and
- NTT's commitment to Internet-related business.

A unique feature of NTT's current networks is that data services account for most of the traffic carried while voice services are responsible for the bulk of the

Figure 3—NTT's R&D Centre, Tokyo—GMI2002 Asian Host

revenue. Therefore, the construction of an economical and large-scale core network and convergence of traffic from various services into that network is a key to supporting the continued success of NTT's businesses.

Secondly, although NTT has long been the primary provider of telecommunication services in Japan, in order to build a competitive network, it is important that NTT does not limit its potential for growth by confining itself to technology unique to Japan but incorporate leading technology from around the world.

Finally, the explosive growth in the use of the Internet has prompted NTT to launch an ISP operation, providing always-on Internet access services and later broadband access services.

Since the objectives and activities of the Multiservice Switching Forum (MSF) are in line with the strategic imperatives described above, NTT has decided to actively participate in the MSF with staff from its R&D centre representing the company, both on the MSF Board of Directors and within the MSF Technical Committee working groups.

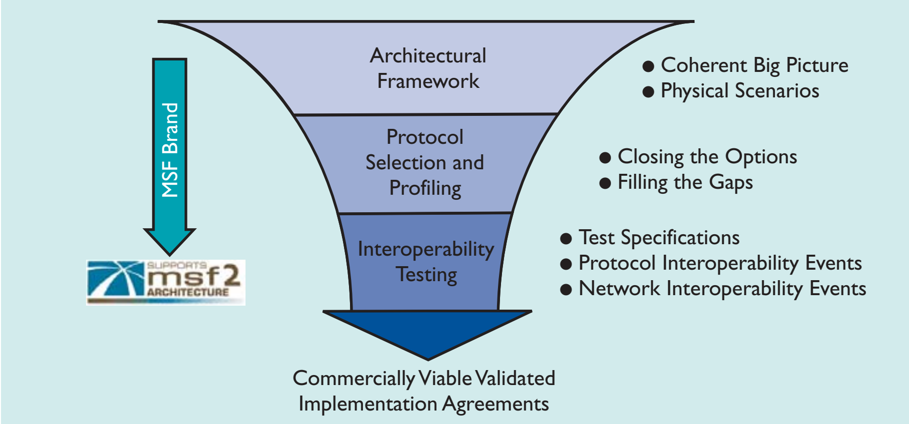
The greatest advantage of the MSF is the mechanism it provides to help carriers and vendors to cooperate with each other in order to build reliable, large-scale and carrier-grade networks economically. It is not surprising therefore that NTT has been using the MSF as a foundation for its technical activities during this period of revolutionary change.

With its determination to tackle this revolutionary period with a clear vision, NTT believes that discussion on a target architectural framework is essential, but considers that these deliberations can be far more if the results are eventually verified by interoperability tests. An outstanding feature of the activities of MSF is that they begin with discussion on architecture but then proceed all the way through to the verification of interoperability with the Global MSF Interoperability programme and its global showcase events (GMI2002 and GMI2004).

The first area to benefit from NTT's involvement in these activities is NTT's VoIP service. As the competition in the provision of VoIP services has rapidly intensified in Japan, NTT has been forced to enter the race, even though its greatest revenue source is ordinary telephony. In developing its VoIP service, NTT found it helpful to adopt the MSF architecture and MSF-compliant products. Thus NTT's decision to actively participate in the MSF and provide a site in the Asian region for GMI2002 can be seen to have provided immediate tangible benefit to NTT's successful rapid deployment of a carrier-grade VoIP service.

The revolution taking place at NTT is far from being at an end. In autumn 2003, NTT announced its 'Vision for New Optical Generation'. The technology being discussed in the MSF will form the basis for the network technology to support secure and highly-reliable end-to-end communication, to be realised as part of 'Resonant Communication'—a key element of the vision. In this sense, GMI2004 will be an important event for NTT and the MSF activity as GMI2004 approaches will therefore be a landmark and act as a driving force for new businesses, not only for NTT but for all global carriers.

Figure 4 **The MSF collaborative framework**



How the MSF Works

Structure and membership

The MSF is formally constituted as a non-profit corporation with a small dedicated secretariat headquartered in Fremont, California. Its membership is open and includes most major suppliers and a range of global network operators drawn from Europe, the US and the Far East. As its membership also includes a number of small high-tech companies who are seeking to exploit the gaps in the market, there is a healthy tension which ensures that implementation agreements are driven to provide innovative and flexible solutions to meet the needs of both network operators and service providers.

The MSF is governed by a board of directors, which sets policy, overall objectives and organisational structure. The board membership is openly elected from candidates nominated by member organisations. The MSF has a number of committees, but is primarily driven by contributions from members to the Technical Committee.

The MSF Technical Committee operates in a manner similar to many other standards bodies and fora. Members submit technical contributions, which are reviewed and discussed in face-to-face meetings or via e-mail exploder discussions. The end results are various phases of technical specifications, known as *implementation agreements* (IAs), which are ratified by MSF membership vote.

The MSF collaborative framework

In any collaborative venture, agreeing on a meaningful agenda and the simple logistics of fostering effective communications and meetings between a variety of global players is a significant challenge in itself. The MSF provides a proven collaborative framework, driven by practical service provider input, with well-defined products and brand, as illustrated in Figure 4. By focusing on architectural framework, protocol profiling and interoperability, the MSF touches on all the key areas necessary to accelerate the introduction of multiservice, multivendor next-generation networks. Such an approach ensures that MSF activities are tied to the real world—with an architectural vision tied to the consensus view of the MSF's many members, with the opportunity to ensure detail is worked out as key protocols are identified and profiled and with the interoperability programme provides validation and feedback.

In 2002, GMI2002 was the event that showed the industry that the MSF was serious in its goal of delivering commercially viable IA's and architectural framework. In 2003/4, the MSF continues to pursue this goal by updating its existing IA's based on the results of GMI2002 and attempting to resolve some of the major technical barriers to implementing commercially viable large-scale telephony over IP solutions.

Partnerships

The MSF's policy is to cooperate wherever possible with other forums and standards bodies in pursuit of its strategic directives.

The MSF:

- is recognised by the ITU-T and actively participates in ITU-T initiatives (including the highly successful Forum Summit held in San Francisco in July 2003);
- actively liases with regional standards development organisations such as ETSI (TISPAN) and Committee T1 (in the US);
- has had an active relationship with the IETF (resulting in significant input on the H.248/Megaco specification);

- was selected by the Voice Over Broadband Forum (VOB) as a successor organisation for its work relating to VoIP telephony architecture, protocol selection and profiling, interoperability and test.

While these general relationships have brought significant benefits over the five years of the MSF's existence, recent decisions taken by the MSF Board of Directors have resulted in a number of significant strategic partnerships with other forums to specifically exploit the GMI2004 programme. To date, such collaboration agreements have been signed with:

- The Parlay Group,
- The MPLS/Frame Relay Alliance,
- The SIP Forum, and
- The Telecommunications Management Forum (TMF).

The MSF's Approach to Next-Generation VoIP Network Architecture

The PSTN Equivalence Challenge

The term *voice over IP* (VoIP) describes the transport of voice over IP-based networks. It is a generic term that covers deployments ranging in complexity from hobbyists using the Internet to get free phone calls on a peer-to-peer basis, to full-scale PSTN-replacement networks. In carrier networks, VoIP has been mainly deployed in enterprise networks or as a trunking technology to reduce transport costs in voice backbone networks. However, with many network operators facing eventual equipment obsolescence in their existing narrowband PSTN networks and with the drive to increase revenue by offering new and innovative multimedia services, the MSF expects that end-to-end VoIP solutions will be required to replace the PSTN in the medium term.

The MSF's approach to VoIP network architecture is explained in some depth in one of the MSF technical reports driving the MSF 2003/4 work programme[3]. In summary, in order to deploy a VoIP network that is capable of providing a PSTN-scale solution the following issues must be addressed:

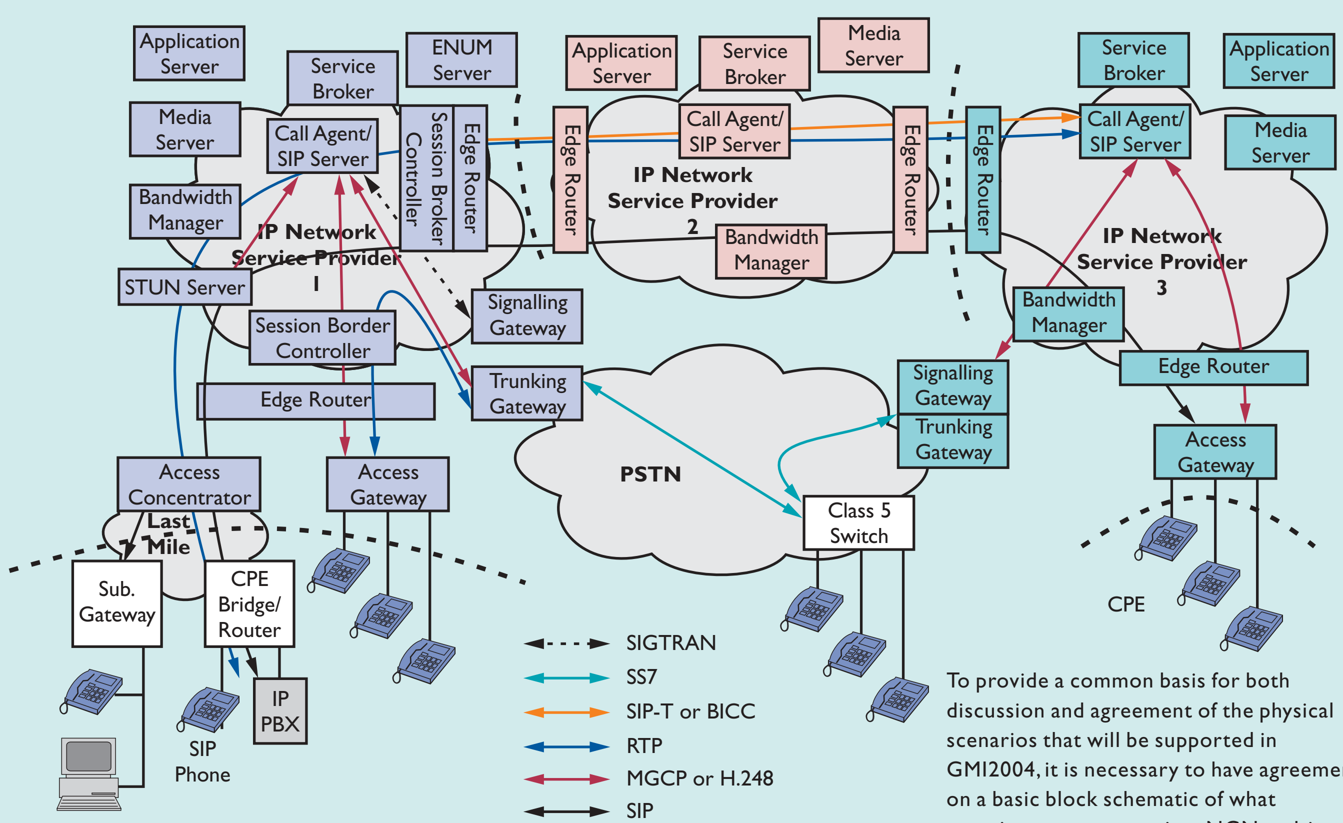
- What *services* need to be offered; for example, full PSTN equivalence, a more restricted 'cheap second line' service, or a simple user-to-user voice service?
- The types of *end-user terminals* supported—POTS phones, PC clients, IP phones or PBXs.
- *Quality of service* requirement for voice to ensure that the agreed quality is provided.
- The *security* risks must be clearly identified and appropriate techniques employed to ensure that the call agents, in particular, are protected from attack.
- How much *bandwidth* is available in the last-mile network, which will affect the choice of voice *codec*, *packetisation period*, and where to use *compression* to best meet the service goals?
- The *signalling protocol* used must support the service set required.
- Regulatory requirements (for example, lawful interception).

The objective of the MSF's work in this area is to identify and characterise the primary issues that must be addressed to define a large-scale VoIP network that is capable of supporting (but not necessarily limited to) full PSTN equivalence. GMI2004 will focus on a service set that provides full PSTN equivalence—what we are calling 'telephony over IP'.

The reference network architecture adopted by the MSF considers the three service provider networks shown in Figure 5. In this diagram:

- Service Provider 1 is offering local access acting as an other licensed operator

Figure 5 MSF next-generation VoIP reference network architecture



To provide a common basis for both discussion and agreement of the physical scenarios that will be supported in GMI2004, it is necessary to have agreement on a basic block schematic of what constitutes an appropriate NGN multi-domain VoIP network.

(OLO). This service provider supports IP phones and IP PBX systems using SIP and POTS phones via either an access gateway (next-generation remote concentrator unit) or a subscriber gateway (using either H.248 or MGCP).

- Service Provider 2 is acting as an IP transit carrier and supports SIP and SIP-T or BICC signalling through its network. Service Provider 2 has no directly associated customers or subscribers.
- Service Provider 3 is offering local access acting as an OLO, but only supports POTS phones using an access gateway. SIP signalling is supported but is terminated by the SIP server rather than using a SIP phone or other CPE device.

As the major driver for such solutions is to provide a transition for traditional PSTN networks, it will be a requirement for VoIP networks to be able to interconnect with legacy PSTNs for many years to come. Key to providing PSTN equivalence is a scalable and robust solution for quality of service (QoS). In particular such a solution must ensure that network disruptions do not impact stable calls unnecessarily, that emergency calls can be carried in even the most extreme circumstances and that the voice service is isolated from any unexpected peaks in the higher volume data services, while sharing the same infrastructure.

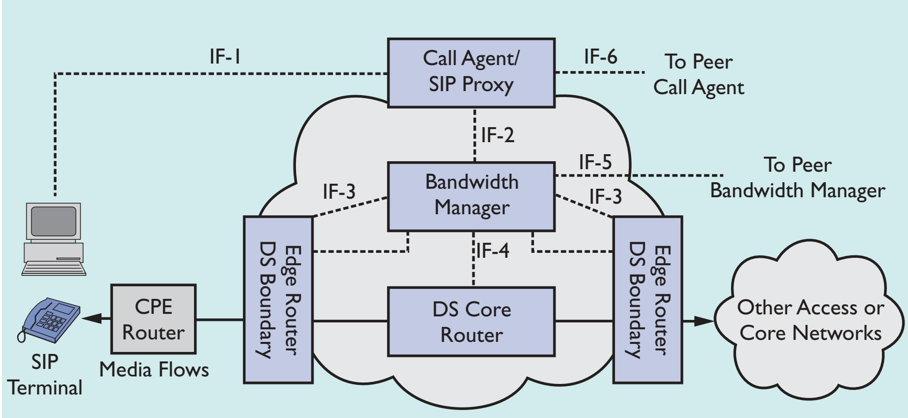
VoIP quality of service

The MSF's approach to VoIP QoS draws on the work of 3GPP and PacketCable and is explained in some depth in another of the MSF technical reports driving the MSF 2003/4 work programme[4].

Given the difficulties with respect to scalability and security that any VoIP QoS solution faces and given the currently available tool set for solving such a problem, the MSF has concluded that:

- The IETF Intserv architecture is not considered suitable for the support of VoIP QoS. The high volumes of call attempts that will be required to be supported by any voice network means that the use of Intserv would place an unacceptable burden on the edge and core routers. The MSF recognises that it may be necessary to interface with access networks that support Intserv and in these cases RSVP should be passed transparently through the MSF network.
- The MSF propose that a Diffserv architecture should be used to provide QoS by deploying Diffserv boundary functions at the edge of the network and providing suitable mechanisms to control the admission of individual flows into the network.

Figure 6 MSF VoIP QoS framework



- Within the core network QoS mechanisms should be provided that guarantee service but that do not require knowledge of individual user flows. There are a number of suitable technologies, of which MPLS-TE is the most promising; however, alternative solutions such as aggregated RSVP and asynchronous transfer mode (ATM) may also be applicable in some networks.
- To enhance scalability and to allow call control functions to be abstracted from the underlying network, separate bandwidth managers should be deployed to act as an interface between the network-specific bearer control and allocation functions and the application-centric call control functions.

These broad conclusions lead to the solution framework for a pure VoIP call illustrated in Figure 6.

The functions of each of the illustrated core network components in providing QoS is as follows:

- *Call agent* (also known as *media gateway controller*)—The call agent is responsible for providing the call control functions and handling call/session establishment between end-points within the network. It must also provide secure mechanisms to identify the user and tie a particular call set-up attempt to a traffic flow in order to prevent spoofing.
- *Bandwidth manager*—The bandwidth manager is responsible for providing the required QoS from the network. It is responsible for the setting up and tearing down of bandwidth within the network and for controlling the access of individual calls to this bandwidth. It is responsible for installing the appropriate policy in edge routers to police the media flows on a per call basis. Within any network there may be a number of bandwidth managers, however each bandwidth manager has sole responsibility for the aggregate bearers that it has created and is the sole arbiter as to whether a call may have access to the reserved bandwidth.
- *Edge router*—The edge router provides Diffserv boundary functions and applies the appropriate policy to individual media flows under the direction of the bandwidth manager. The edge router must contain security functions to ensure that only authorised flows are allowed access to the network resources.
- *Core router*—The core routers are responsible for passing traffic through the network in large volumes while providing Diffserv core functions. In practice this means supporting a separate internal traffic queue per Diffserv class.

The MSF is not directly concerned with defining the behaviour of the access network because it recognises that MSF networks must operate with a variety of such networks, including cable, Ethernet and ATM-based DSL access networks. In order to interoperate successfully with an MSF core network the access network must provide a mechanism for guaranteeing QoS. This may be achieved in a number of ways; for example by using Intserv, Diffserv or by deploying hybrid ATM IP solutions (such as those outlined by the FS-VDSL organisation). An essential component of the access network solution is the CPE as it provides key policing and shaping functions for traffic flowing towards the core network.

The Global MSF Interoperability Programme

Creating value for MSF members

The primary objective of the Global MSF Interoperability (GMI) Programme is to demonstrate how the work that is done in the MSF can provide significant added value to members in real-life networks. It is particularly important to be able to demonstrate that by using the implementation agreements of the MSF, vendors can produce multiservice system products that deliver the services that carriers and other providers need in a multivendor environment.

The GMI test events thus provide an industry showcase that:

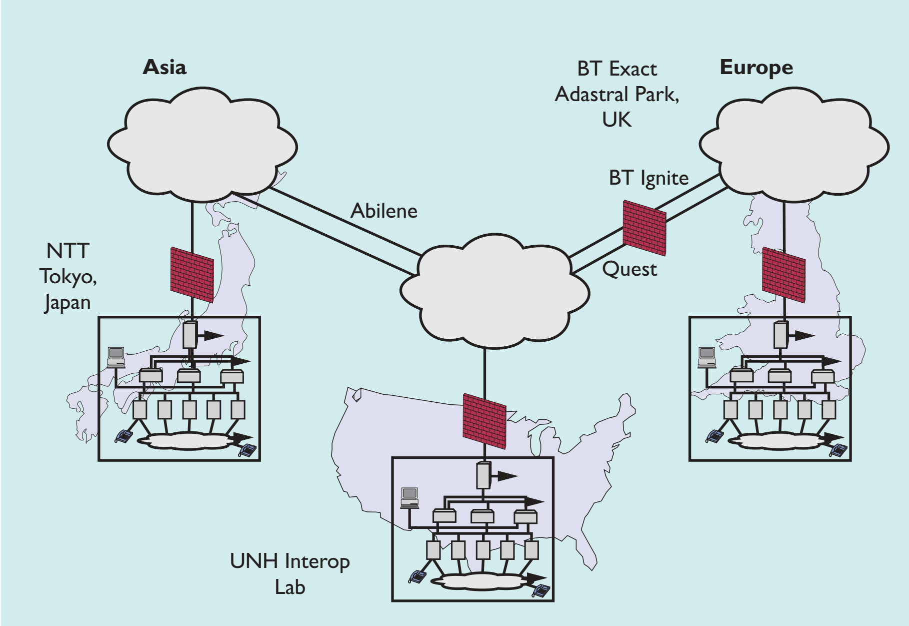
- demonstrates to carriers that flexible, best-of-breed products are available (a reality),

- provides vendors a cost-effective environment to demonstrate the interoperability of their NGN products, and
- displays the global interoperability capabilities of the MSF architecture and implementation agreements.

In order to capture industry attention, actual deployment of multiservice multivendor multiprovider capability needs to be demonstrated. The highly successful initial GMI test event, staged in November 2002 and known as *GMI2002*, was both global in concept and reality, being staged in the Europe, Asia and the US simultaneously.

Following this success, plans are now well advanced for the next event—wider in scope and more rigorous in depth, to be known as *GMI2004* and targeted for October 2004.

Figure 7 **The GMI2002 network**



GMI2002

In the UK, BT Exact provided facilities to support the Global MSF Interoperability 2002 programme at its Network Assurance Laboratory located at Adastral Park, Ipswich. In Japan, facilities were provided at NTT's Musashino Research and Development Centre in Tokyo. In the US, the facilities were provided by the University of New Hampshire Interoperability Laboratories. The global network connecting these sites is illustrated in Figure 7. The design of the event thus maximised local attendance and gave all participants the opportunity to demonstrate their products on a real global network, rather than using just laboratory simulation.

Testing within this global network comprised four voice scenarios and one data scenario. This grouping is referenced as MSF Scenario Set 1. The scenarios chosen resulted from the work of the MSF Physical Scenario Task Force (PSTF), who set out to define the most relevant scenarios, based on reasonable maturity of current technology, to meet the needs of real-life network operators. Eight possible scenarios were considered as a result of MSF member contributions. After extensive analysis and prioritisation, the final five were chosen around which to base the core of GMI2002.

The task force also defined the feature-set to be demonstrated for each voice scenario. In the event, not all participants were required to support all of the selected scenarios. However, each participant was required to support at least one scenario with the associated feature sets. Each scenario utilised the H.248 (Megaco) control protocol between media gateways and media gateway controllers.

Hosts, participants and the wider MSF membership all considered GMI2002 to be a great success. While reporting of the detailed test results is outside the scope of this article, such information is freely available on the MSF web site[5].

Voice scenarios

The main voice scenarios are described below and are illustrated in Figure 8:

- *VoATM and TDM* The purpose of this scenario is to validate TDM-to-ATM and ATM-to-TDM voice-based call flows based on Megaco and BLES signalling.
- *VoIP and TDM* The purpose of this scenario is to validate TDM-to-IP and IP-to-TDM voice-based call flows based on the new protocols such as SIP and SIP-t as well as Megaco and MGCP methods of signalling.
- *VoIP Trunking* The purpose of this scenario is to validate TDM-to-IP-to-TDM voice-based call flows based on the new protocols such as SIP and SIP-t as methods of signalling.
- *VoATM Trunking* The purpose of this scenario is to validate TDM-to-ATM-to-TDM voice-based call flows based on the new protocols such as BICC and SIP-t as methods of signalling.

In order to ensure that each feature worked in a global environment, three defined signalling types were identified for use in the trial. These signalling methods were utilised as access or egress methods for the call flows to be used. By using the protocols listed below, the MSF was able to show true global functionality by focusing on major access methods used within the Asia Pacific, North American and European arena:

- Japanese variant (J-ISUP),
- North American variant (ANSI ISUP Version 2), and
- European variant (ETSI-ISUP).

Figure 8 **GMI2002 scenario set 1 (voice)**

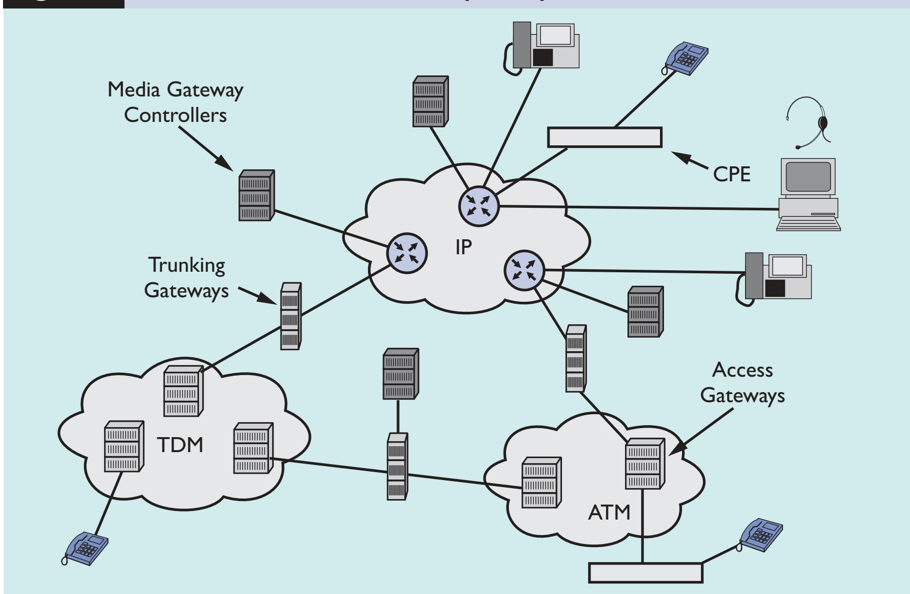
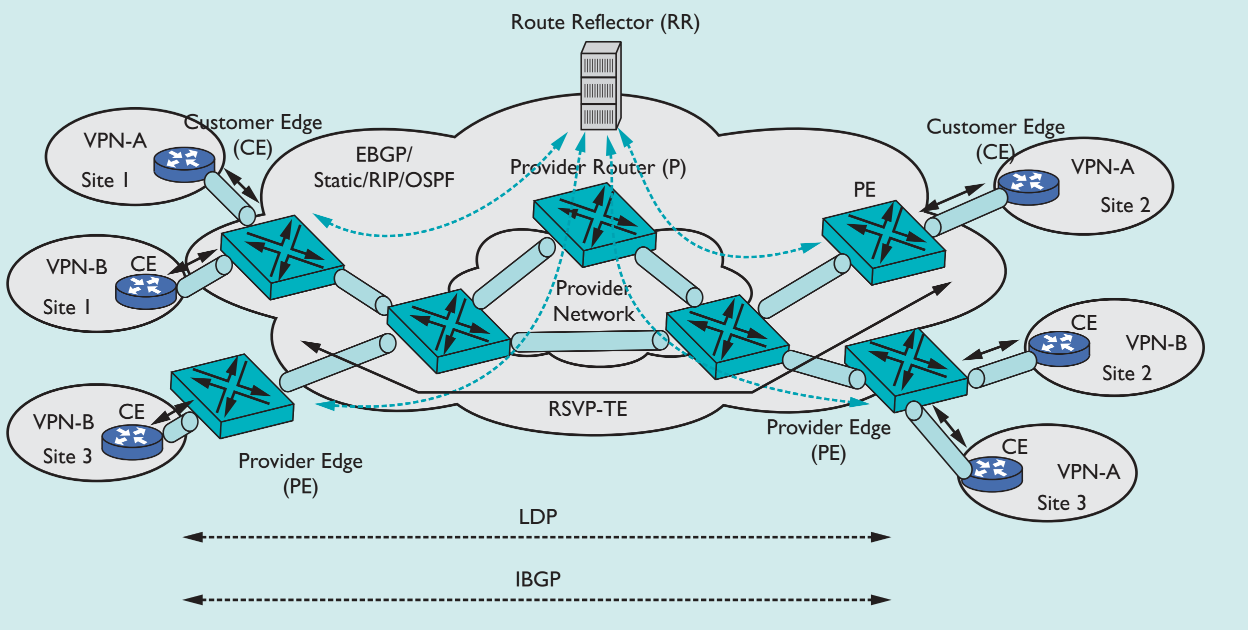


Figure 9 MSF scenario set 1 (MPLS data)



Data scenario

A key driver for the MSF in this area was the need to have a captive environment as a focus for the MSF's proof of concept work on QoS-capable networks. The main data scenario adopted in GMI2002 is illustrated in Figure 9.

This scenario defined an architecture that enables a carrier to deliver a data access service to end-users providing multiple level of quality of service, *viz*:

- premium service,
- high-priority service, and
- best-effort service.

The premium service is categorised as the highest service grade and it guarantees bandwidth and delay of data transmission between the premium VPN sites. It also guarantees availability of the network and minimises the effects of possible congestion type scenarios.

The high-priority service is categorised as the second-highest service grade. It guarantees minimum bandwidth of data transmission and provides higher priority in data transmission compared with the last QoS level best-effort service.

GMI2004

As a follow-up to the very successful GMI2002 event, the MSF will host a second round of interoperability testing to demonstrate a full end-to-end voice-over-IP network. Capable of demonstrating key management functions with quality-of-service, security attributes and inclusion of value-added services, this event will focus on demonstrating PSTN-equivalent VoIP network for both traditional black phones and soft clients in scenarios that support a rich base of applications that will equal and surpass what is available in existing PSTN networks today.

Known as *GMI2004*, this event is scheduled for October 2004 and will be hosted by BT, NTT, KT (Korea Telecom) and Qwest.

In order for an event such as this to succeed, a great number of resources need to be harnessed and coordinated. Monitors and demonstration software will need to be run in all of the regional sites to show the reality of the multiservice switching systems that are created. This will require not only the underlying technology to support the scenarios that have been defined, but will also involve management applications that will be supported and illustrate the power of the underlying technology.

Participants will be invited to contribute to the following list of network elements and equipment. Each participant may chose to support a single element or multiple elements from the following list dependent upon their specialty. However, each participant must comply with the scenario descriptions and requirements as published by the MSF:

- call agent (media gateway controller),
- media gateway (trunking gateway/access gateway/line side gateway),
- signalling gateway,
- element manager,
- network manager,
- core IP routers,
- SIP proxy,
- application servers,
- bandwidth manager,
- service broker,
- CPE/PBX,
- soft user clients, and
- IP-based phones and digital handsets.

Conclusions

The MSF has come a long way since its inaugural meeting held in Orlando, Florida, in December 1998. From its early focus on functional architecture and ATM nodal implementations, the MSF has now developed a collaborative agenda based on the needs of its members as they set about specifying, developing and purchasing the

Acknowledgements

The achievements of the MSF under the BT Presidency and described in this article would have be impossible without the enthusiastic support of the MSF Board of Directors, the MSF technical leadership, the MSF membership and colleagues in BT. While it is not possible to mention everybody here, I am particularly indebted to Tatsuro Murokami of NTT, Chris Gallon (Protocol and Control Working Group Chair), Fujitsu, and Paul Drew (Architecture Working Group Chair), MetaSwitch, for their help with this article. For support and Presidential encouragement when times got hard, I must mention my colleagues in BT, particularly Mike Bick, Ken Mills and Adrian Sapwell and, of course, Alysia Johnson and the MSF secretariat.

Roger Ward
MSF President

essential components of 21st century next-generation networks today.

With its GMI series of networked global test events, the MSF has a clear programme to prove the value of its implementation agreements to carriers and vendors in real-life interoperability scenarios. The technical solutions being refined by the MSF technical committee for demonstration in GMI2004 will be key components of carriers networks for many years to come. By collaborating in areas where it is sensible to collaborate, MSF members save scarce resources to focus on the key developments that will ensure business success in the race to implement 21st century technology.

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Roger Ward
BT Exact

Roger Ward has been heavily involved in the MSF from its foundation in 1998. In June 1999 he was elected to the MSF Board of Directors and, in September 2000, he was elected MSF President. In his work with the MSF, he has done much to help achieve the forum's current focus on multi-vendor interoperability and the very successful GMI2002 and GMI2004 global interoperability programmes. Based in the UK, he started his BT career in 1974 after graduating with an honours degree in Electrical Engineering from Cambridge University. Since then he has had a long distinguished career in the industry holding a variety of key positions. In the 1980s, he had design authority responsibility for key aspects of both System X development, BT's local exchange competitive procurement programme ('System Y'), early deployment of Centrex in the UK and the derived services network (DDSN). During the 1990s he was responsible for advanced platforms and intelligence strategy, working with MCI on the merger project which led to BT's next-generation switch deployment in the UK trunk network. He holds an M.Sc. degree in Telecommunication Systems from Essex University and an M.B.A. from Warwick University, the latter being achieved after being selected by BT to participate in Warwick Business School's inaugural Integrated M.B.A. programme. He is a Chartered Engineer and a Member of the Institute of Electrical Engineers, and currently heads up Future Switched Network Strategy within BT Exact.

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Tatsuro Murakami
NTT

Tatsuro Murakami has been a member of the MSF Board of Directors since 2002. He received the B.S. and M.S. in Physics from Tokyo Institute of Technology, Tokyo, Japan, in 1979, 1981, respectively. He joined Musashino Electrical Communication Laboratories, NTT, in 1981. He has been engaged in research and development of communication network architectures, and communication switching software. From 1984–1986 he was at NTT Basic Research Laboratories, where he was active in research of the formal description method of service specification. From 1987–1990 he was at NTT Software Development Center, where he was active in development of NTT switching system (called *D70*) software. From 1991–1997 he was active in research and development of the software development environment for communication switching systems at NTT Network Service Systems Laboratories. From 1998–2001 he was active in the development of the new signalling transfer point for the NTT SS7 network, and research and development of VoIP systems at NTT Network Service Systems Laboratories. Currently, he is working on establishing NTT's next-generation communication network architectures, and planning the overall research and development strategies toward NTT's next-generation communication networks. He is Executive Research Engineer, NTT Service Integration Laboratories.

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