TMX 880™ MPLS Core Switch

Identifying the Network Path of an ATM/Frame Relay Virtual Circuit Service with an MPLS Core

Economic Study

October 2002

Lucent Technologies
Bell Labs Innovations



Table of Contents

Executive summary **3**

Identifying the VC path through the existing CBX 500®/GX 550™ network **4**

Identifying the VC path through an ATM/FR network with an MPLS core **4**

Implementing an MPLS core based on the TMX 880™ MPLS Core Switch **5**

Solution with a router-based MPLS core **6**

Evaluating the economic impact on management expenses of adding a MPLS core **7**

Conclusion **8**

Appendix A. Identifying the path of VC traffic with an ATM/MPLS core solution **9**

This document is part of a set of three case studies evaluating the economic benefits of a converged MPLS multiservice core. The studies in this series include:

- Economic Overview:
  Cost Justifying a Converged MPLS Multiservice Core
- Economic Study:
  Provisioning ATM and Frame Relay Virtual Circuit Services with an MPLS Core
- Economic Study:
  Identifying the Network Path of an ATM/Frame Relay Virtual Circuit Service with an MPLS Core

Executive Summary

Operators managing ATM and Frame Relay (FR) networks built with the Lucent CBX 500® and GX 550™ Multiservice WAN Switches use the end-to-end configuration and control capabilities of Navis™ Network Management Software (NMS) and the Virtual Network Navigator™ (VNN) multiservice architecture to streamline daily management and provisioning activities.

Depending on the equipment deployed during the migration, service providers may sacrifice these operational efficiencies when they migrate to an MPLS core. This study compares the change in operations and associated expenses of upgrading an existing CBX 500®/GX 550™ switch network to an MPLS core built with the TMX 880™ MPLS core switch against the costs associated with upgrading the same network to a router-based MPLS core.

Instead of evaluating the impact on all operations activities, this study focuses on the impact that migrating to an MPLS core has on one specific task that customer support personnel perform on a daily basis: identifying the path that traffic associated with a specific service or virtual circuit (VC) takes through their network. Although identifying the VC path is only a part of a typical administrator's workload, this is one of the initial steps in identifying the source of service interruptions and non-conformance to Service Level Agreements (SLAs).

...this study focuses on the impact that migrating to an MPLS core has on identifying the path that traffic associated with a specific service or virtual circuit (VC) takes through their network.

Service providers who expand their existing CBX 500®/GX 550™ ATM/FR networks using the TMX 880™ MPLS Core Switch maintain their existing operational environment and cost structure. Because the TMX 880™ switch supports both Navis™ software and ATM-MPLS domain integration, network administrators can quickly and easily identify the VC's specific path through both the ATM and MPLS sections of the network using a single Navis™ NMS screen. Because administrators can continue to identify a specific VC's path in approximately 30 seconds with Navis™ software, today's service operations model and associated expenses remain unchanged.

In contrast, service providers who upgrade using a router or third party switch MPLS core solution without integrated ATM-MPLS features must use an extensive number of separate Command Line Interface (CLI) or Element Management System (EMS) and ATM-MPLS database inquiries to gather route information. Operators may use a separate VC to MPLS Label Switched Path (LSP) mapping database tool to simplify management between the ATM and MPLS domains in their new network. This approach requires approximately 3.6 minutes of additional administrator time to identify the path of each VC.

If a service provider identifies the path of 500 VCs each business day, **using a router-based MPLS core can increase operations expenses by more than $1.0 Million+ annually**—just to identify the VC path across the ATM and MPLS domains. Because identifying the path the VC takes through the network is just one of the initial steps in resolving service issues, the true operations costs to service providers may be much higher.

Identifying the VC path through the existing CBX 500®/GX 550™ network

Today, operators can readily identify the entire path that traffic associated with a specific ATM/FR VC service takes through their multiservice ATM/FR network on a single Navis™ NMS screen, the *Show All PVCs* screen. Administrators use pull down menus to access the *Show All PVCs* screen, which lists the specific switches the VC traffic passes through in the *Circuit Path* field.

In Figure 1 below, a VC passes through switches A, B, C, D, and E. When the administrator accesses the *Show All PVCs* screen to identify the VC's specific path, the *Circuit Path* field in that screen would list switches A, B, C, D and E.

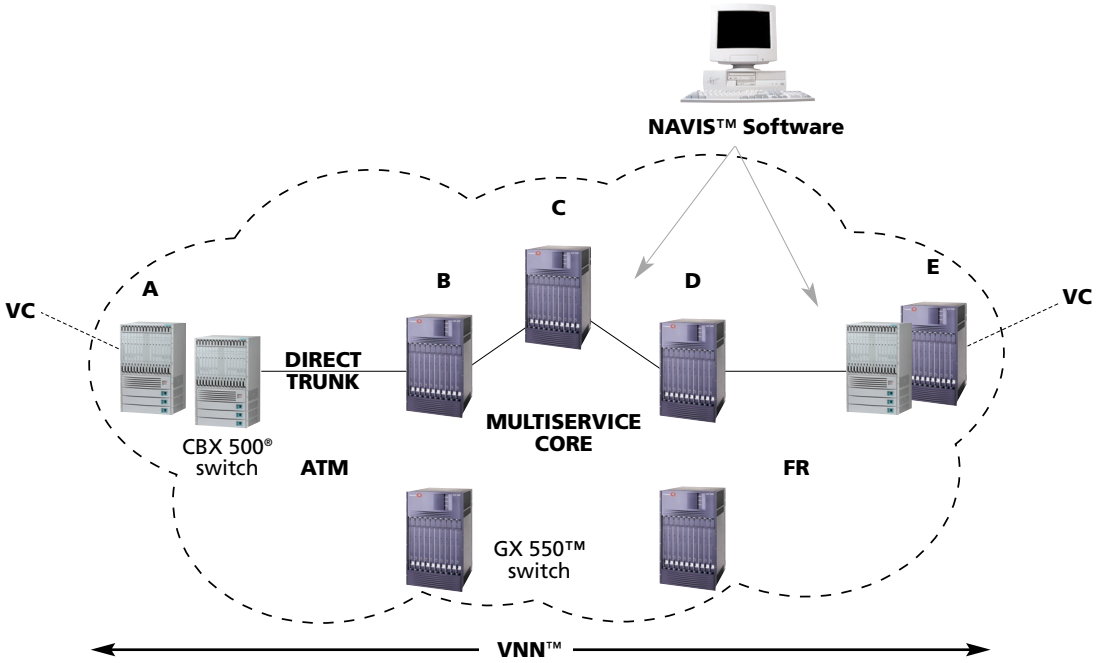

Figure 1: Navis™ NMS automated VC Path Identification

Identifying the VC path through an ATM/FR network with an MPLS core

This section focuses on the impact that the choice of MPLS core has on the daily activity of identifying the path of ATM/FR VC traffic across the network.

When service providers migrate to an MPLS core, they can choose to implement one of three options:

- **An MPLS core using the TMX 880™ MPLS core switch**
  This approach preserves their current Navis™ network management solution and operations environment.

- **A router-based MPLS core**
  Service providers who implement the router-based MPLS core will continue to use Navis™ software and VNN™ to manage the GX 550™/CBX 500® portion of the network (the ATM/FR domain). However, operators will require the use of a CLI to manage the ATM to MPLS cross-connect and router-based MPLS domain.

- **Another vendor's MPLS switch-based core**
  Again, service providers will continue to use Navis™ and VNN™ to manage the GX 550™/CBX 500® portion of the network (the ATM/FR domain). However, service provider operators will require the use of another EMS to manage the ATM to MPLS cross-connect and switched-based MPLS domain.

Implementing an MPLS core based on the TMX 880™ MPLS Core Switch
From an administrator's perspective, introducing a TMX 880™ Release 9.0 MPLS core has no affect on the process and time required to identify the path a specific VC takes across the network. This is possible due to the unique interoperability between the ATM and MPLS domains, end-to-end operations with Navis™ software, and the VNN™ and *Fluid Signaling* support on the TMX 880™ switch.

Since MPLS LSPs are uni-directional and ATM/FR VCs are bi-directional, two uni-directional LSPs are required to support each bi-directional ATM/FR VC. With a TMX 880™ MPLS core, VNN™ and *Fluid Signaling* automatically map bi-directional VCs with ATM/FR traffic into pairs of uni-directional LSPs.

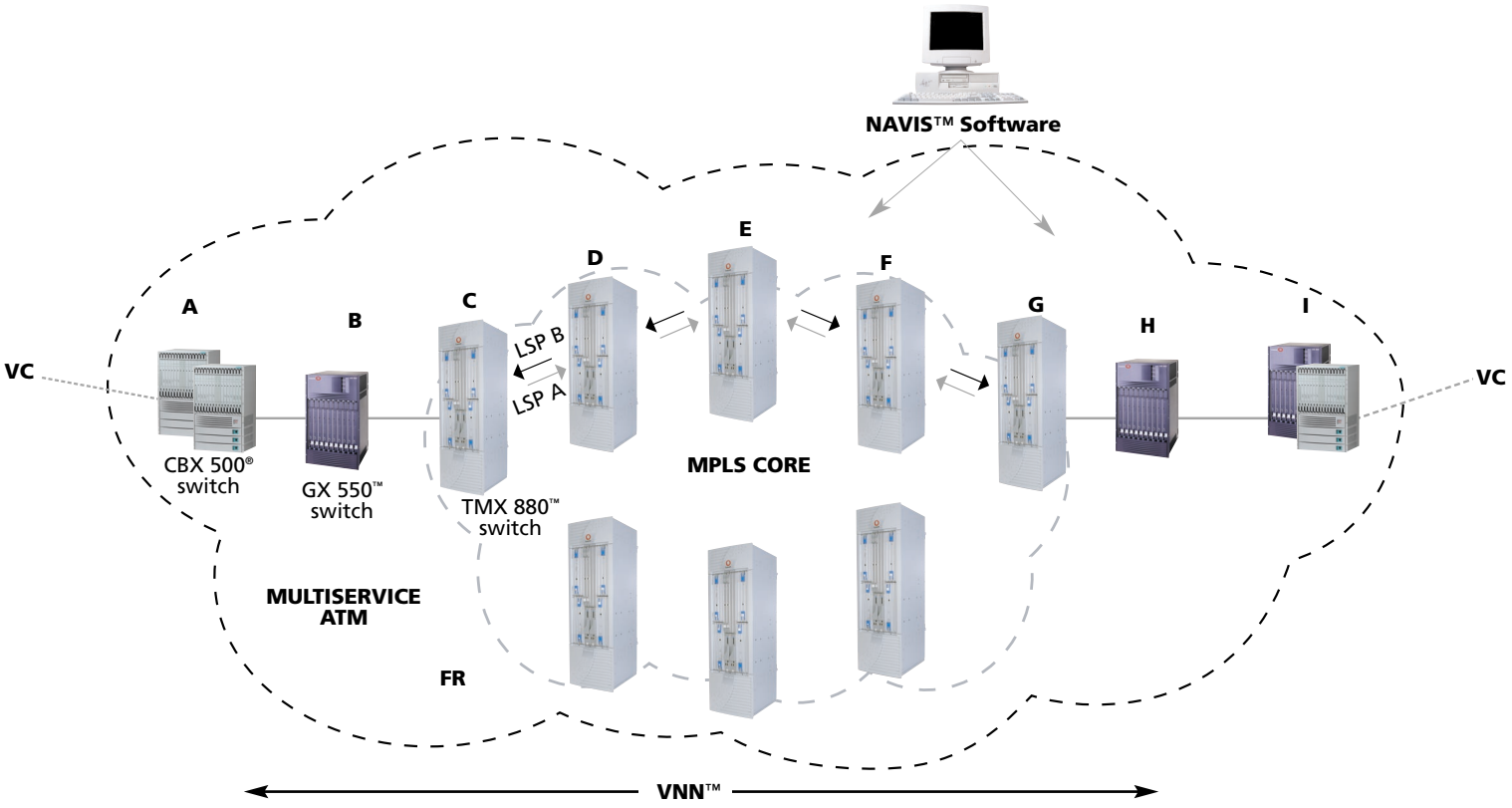

Figure 2: Navis™ NMS automated VC Path Identification with an ATM-MPLS core

... a router-based MPLS core takes 720+% longer to identify the traffic path of a virtual circuit than a TMX 880™ switch-based MPLS core.

Service providers who implement the TMX 880™ MPLS Core Switch can continue using Navis™ software to manage the network. This total Navis™ network solution means that the administrator can continue to use the *Show All PVCs* screen to view the entire path the VC or associated LSPs take through both the ATM and MPLS domains.

In Figure 2, a VC passes through switches A, B, C, D, E, F, G, H and I. When the administrator accesses the *Show All PVCs* screen to identify the VC's specific path through the service provider portion of the network, the *Circuit Path* field in that screen lists all of the switches in the entire path across both the ATM and MPLS domain.

This consolidated view of the ATM-MPLS traffic path offers administrators the same one-step efficiency that they enjoy today with their existing CBX 500® /GX 550™ multiservice network. Since this view is drawn from the Navis™ software common database, which also acts as the master database for the switches, the path information is automatically up to date and reflects the results of any network restoration activities that may have occurred since the service was originally provisioned. (Note: Operators can access statistics from this screen by clicking on the *statistics* button.) This activity continues to take less than 1 minute per VC.

Solution with a router-based MPLS core.
If the service provider adds a router-based MPLS core to their CBX 500® /GX 550™ ATM/FR network, administrators will:

1. Continue to use Navis™ software to identify the path in the ATM/FR domain at each end of the overall solution
2. Use a VC to LSP mapping database to identify the MPLS tunnel name and LERs at each end of the MPLS core
3. Use the CLI to execute a show command for the LER (In figure 3, switch C or G) to identify the IP address of the switch that is the next/previous hop
4. Record the switch information
5. Repeat this process on the other LER
6. Repeat this entire process until they have identified each LSR (In figure 3, switches D, E, and F) in the path
7. Repeat the entire process to identify the path that flows in the opposite direction in the MPLS core (the associated uni-directional LSP)

Assuming that the path through the MPLS core passes through 2 Label Edge Router (LER) and 3 LSRs, this process takes **approximately 4.1 minutes**—3.6 minutes longer than required for identifying the path across a TMX 880™-based MPLS core and existing ATM/FR solution. This represents a **720%+ increase** over the interval for identifying VCLSPs over a TMX 880™ switch-based MPLS core. (See Appendix A for a summary of the key activities and estimated times to complete each activity.)

In practice, how long this activity takes depends upon the number of LERs and LSRs in the VC traffic's path. Increasing the number of LSRs in the path increases the activity time. Decreasing the number of LSRs in the path reduces it. In addition, if the router or third party switch in the MPLS core has information on the entire path that is accessible to operators, they may use this information from each LER to reduce the amount of time it takes to trace the VC path.

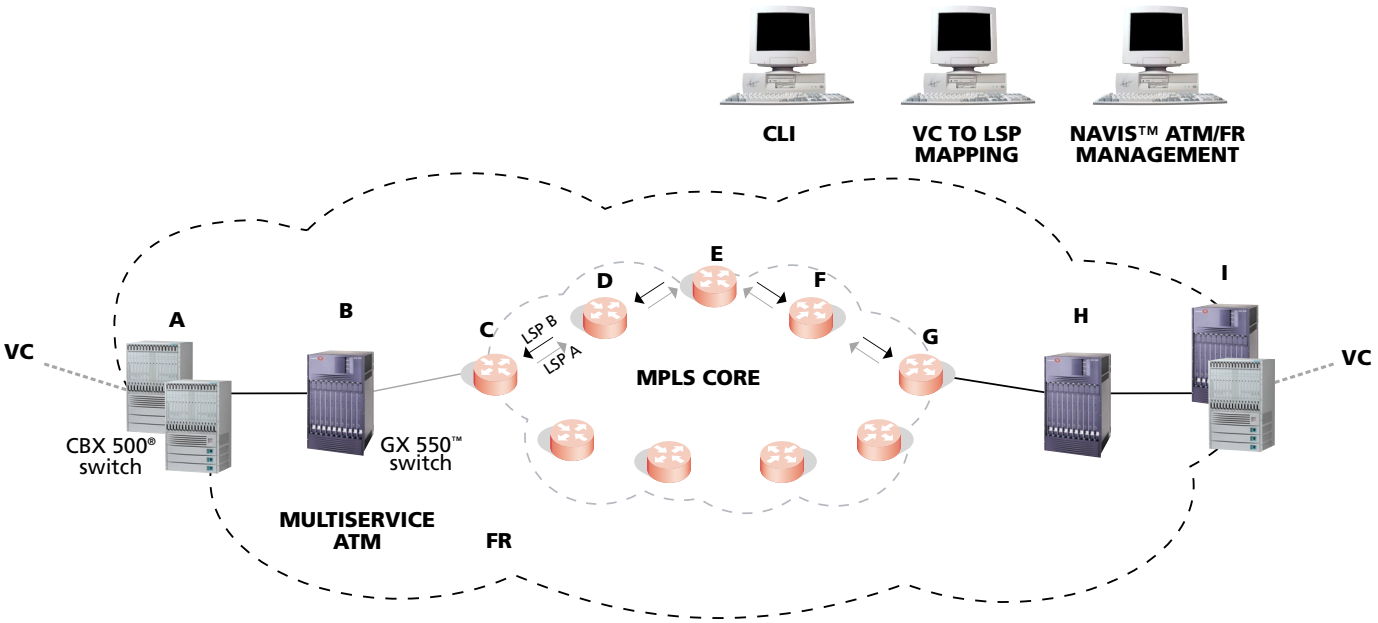

Figure 3: Manual VC Path Identification with a Router-Based MPLS Core

Service providers may also choose to use a separate VC to LSP mapping database tool to simplify the process of identifying the ATM to MPLS domain linkages. However, using a separate database increases the risk of using inaccurate data. Errors associated with manual data input and the challenge of ensuring that the database administrator is kept up to date on all relevant switch changes and network restoration activities can affect the quality of the information in this database. To minimize this problem, operators may be able to set up the network management database to automatically replicate topology change information to the VC-LSP database.

Evaluating the economic impact on management expenses of adding an MPLS core

As the previous section shows, a service provider's cost for identifying the path of a VC across the network remains unchanged when that provider implements a TMX 880™ MPLS core switch managed by Navis™ Network Management Software. In contrast, service providers who implement a router-based MPLS core will realize an incremental annual cost increase of at least $1.0 Million—just to identify the path of 500 ATM VC services each business day (see Table 1).

In addition, using the automated solution available with the TMX 880™ switch and Navis™ network management software reduces the chance of errors that can further increase labor costs and lead to end-user dissatisfaction.

Deploying an alternative router or switch-based MPLS core requires operators to use two or three management systems (Navis™, CLI or EMS, and the VC to LSP mapping database) to identify the path. If a third party vendor develops a GUI-based tool to manage the ATM to MPLS cross-connects for router MPLS solutions, operators will still have to use at least two systems—Navis™ software for the ATM/FR domain and the third party system for the ATM to MPLS cross-connect and MPLS domain. In many cases, operators will still have to use the CLI or EMS to manage other router features. Using multiple management systems greatly increases equipment and training costs for these service providers.

#VCs/DAY	ANNUAL INCREMENTAL COST	
	MPLS core built with TMX 880™	Core based on routers or third-party MPLS switches without integrated ATM/MPLS features
200	No change	$ .4M+
500	No change	$ 1.0M+
1,000	No change	$ 2.1M+
Assumption:	• VC path on MPLS core is through 2 LERs and 3 LSRs • $133/hour loaded labor rate ($100/hour with 75% productivity)	
Calculation:	(3.6 minutes/VC x 500 VCs/day) / 60 min/hour x $133/hour x 5 days/week x 52 weeks/year = $1.0M+ annual incremental expense with a router/third party switch MPLS core.	
Note:	A plus is added because service providers will most likely perform this task more than 5 days per week as part of the troubleshooting process for a VC.	

Table 1. Annual incremental cost associated with identifying the VC path over an MPLS core

The Lucent TMS 880™ switch feature set enables service providers to maintain their current profitable ATM/FR operations environment and cost structure while realizing the benefits of an MPLS core.

Conclusion

The Lucent TMX 880™ MPLS solution brings the ATM/FR connection-oriented experience to MPLS with integrated ATM-MPLS operations. This unique feature set enables service providers to maintain their current profitable ATM/FR operations environment (Navis™ software and VNN™) and cost structure while realizing the benefits of an MPLS core. In contrast, alternative MPLS core solutions with operations requiring the use of other management tools, such as CLI or EMS, increase the cost of offering ATM/FR services. (See Table 2, below.)

Number of VC paths identified	ANNUAL INCREMENTAL COST	
	Total Network Navis™ Solution with VNN™ Managing CBX 500®/GX 550™ with a TMX 880™ MPLS Core	Navis™ Solution with VNN™ for CBX 500®/GX 550™ Management and CLI for ATM to MPLS Cross-Connect and Router MPLS Core Management
Time to identify the path of a VC	No Change in current operations	Additional 3.6 minutes each
200 VCs/Day Path identification	No Change in current operations	Additional $ .4M+ annual expense
500 VCs/Day Path identification	No Change in current operations	Additional $ 1.0M+ annual expense
1,000 VCs/Day Path identification	No Change in current operations	Additional $ 2.1M+ annual expense

Table 2. Impact on current ATM/FR operations of adding an MPLS core

Appendix A. Identifying the path of VC traffic with an ATM/MPLS core solution

This appendix identifies the specific activities and estimated time required to identify the path that a specific VC service takes across the ATM and MPLS core network. This activity could be initiated in response to a client complaint on the performance of their ATM VC relative to their SLA or as an initial step in the trouble-shooting process. Adding a router-based MPLS core to a CBX 500®/GX 550™ ATM solution increases the total administrator time and operations costs associated with identifying the VC's path. Using a router-based MPLS core results in the operator spending up to 4.1 minutes to identify the path for a VC service—a **720%+ increase** from the current interval without an MPLS core (or with a TMX 880™ switch-based MPLS core).

Identifying the VC path can be broken down into two pieces. Operators continue to use NavisCore™ to identify the VC's path in the CBX 500®/GX 550™ ATM part of the network. Operators then use the CLI to identify the path in the router MPLS core portion of the overall network solution.

A. CBX 500®/GX 550™ switch part of the network

Administrators use information in the NavisCore™ circuit path field on the Show All PVCs screen to identify the path of a VC service that VNN™ has selected in the ATM network—just as they do today. Operators use the VC circuit name to access this information within 30 seconds.

B. Router MPLS core part of the network

To identify the path within the MPLS core, the administrator will typically:

1. Access a separate VC to LSP mapping database tool to identify (and record) the MPLS tunnel name and LERs (~15 seconds)
2. Execute a CLI query on each LER to identify (and record) their next/previous hop LSR (~30 seconds)
3. Repeat the same command to individually identify (and record) each additional LSR in the path (~15 seconds each)
4. Repeat the entire process to identify the path in the opposite direction in the MPLS core.

For traffic that passes through 2 LERs and 3 LSRs, identifying the path through a router-based MPLS core can require an additional 3.6 minutes of administrator's time. The total estimated time to identify the path in both directions in the MPLS core for a solution with 2 LERs and 3 LSRs and in the ATM domain is **4.1 minutes**.

The estimated times in the previous process were benchmarked using routers in a lab environment. The total estimated time to identify the path in both directions in a production MPLS core network of traffic that passes through 2 LERs and 3 LSRs is **3.6 minutes**. This reflects the above lab network benchmarks plus 60% to account for time spent logging onto the system and correcting occasional errors, as well as the increased thinking time and slower response times associated with more complex networks.

To learn more about our comprehensive portfolio, please contact your Lucent Technologies Sales Representative, Lucent Business Partner or, visit our web site at www.lucent.com or www.lucent.com/products/multiservice switching

CBX 500®, GX 550™, TMX 880™, VNN™ and Navis™ are trademarks or registered trademarks of Lucent Technologies Inc.

Specifications are subject to change without notice.

Copyright © 2002 Lucent Technologies Inc.

All rights reserved
MSS v1 10/02

Lucent Technologies
Bell Labs Innovations

