White Paper

FUJITSU

Modernizing Legacy SONET/SDH Networks Using Circuit Emulation

In this white paper, we'll describe the current challenges faced by providers as well as the process of modernizing a network using CEM technology.

Many of today's service providers are still carrying traffic on networks based on decades old SONET/SDH equipment. While these network elements are still passing traffic, they are no longer supported by their manufacturer (some of which are no longer in business) increasing the risk of outages and making spares difficult to find.

Equipment from that era lacks the energy efficiency of newer equipment, which results in higher energy costs along with a larger carbon footprint. As a result, the overall cost to operate these legacy networks begins to outweigh the amount of revenue they generate.

Previously, the options for modernizing a legacy SONET/SDH network were limited, leaving providers with few choices. Because of this, many providers opted to do nothing. However, modernizing the network using a Circuit-Emulation Migration (CEM) approach allows providers to migrate to packet-switched networks using low-cost, high-availability Ethernet devices. The CEM approach means providers can keep and maintain customers currently running on legacy systems, while simultaneously eliminating those systems from the network.

The Challenges and Costs of Legacy Equipment

Legacy transport equipment that has reached end-of-life (EOL), while still productive, presents numerous operational challenges each adding to the overall cost of operating a network, such as:

- Higher faults and increased service degradation are increasingly common in an EOL infrastructure. This means time and OpEx that could be better spent on network expansion are instead used to maintain the legacy network.
- Replacement parts are increasingly difficult to find, which results in longer downtimes and a higher risk of a service-affecting outages that make it difficult to restore traffic within the timeframe outlined in a customer agreement (SLA).
- Manual provisioning and lack of automated processes make maintenance activities longer, which increases costs.
- Older technologies have larger footprints that lead to wasted space and reduced abilities to deploy newer equipment, which can be used for newer services or to recover valuable real estate.
- Higher power consumption compared to today's packet-optical technologies, which increases costs for direct power and HVAC.
- Increased power consumption results in a larger carbon footprint than necessary and creates CO_2 compliance issues.
- Management systems supplied by their manufacturer are no longer being supported. This means regular patches and updates crucial to the function and security of their proprietary management systems are no longer available.
- As equipment has aged, fewer qualified technicians are available to support it. This leads to higher operational costs and increased risk of service outages.

Transitioning away from a legacy SONET/SDH network to a CEM architecture addresses these challenges to create a newer, more efficient network while preserving the current customer base.

Bridging the Gap with Circuit Emulation

Circuit emulation allows providers to migrate to packet-switched networks supporting legacy TDM services with lower-cost Ethernet devices. Doing so substantially reduces the cost and complexity of operating the network. CEM enables TDM traffic to be transported transparently over modern packet-switched networks, with the security and reliability previously found only in a circuit-switched network.

Bridging the Gap with Circuit Emulation (cont.)

Transitioning from SONET/SDH network to one based on CEM is a multi-step process requiring careful planning and execution to ensure traffic is migrated safely from the current SONET/SDH environment to the CEM architecture. Effective planning and the right tools are key to minimizing risk while optimizing project accuracy and speed.

Regardless of size and scope, virtually all circuit emulation projects involve the same basic process. A CEM project begins by identifying and auditing the Element Management System (EMS) databases and records involved in the project. The goal of this phase is to identify and resolve any inaccuracies in the records to create the most accurate data map possible. Most carriers have errors in about 20-30% of their EMS datasets. To speedily create the most accurate map of the network, advanced AI-based tooling along with on-site verification is required.

With the databases scrubbed, field engineers confirm that the circuits in the database match those physically connected to the network. While on site, they also check to ensure there are enough available ports to support the migration, gauge the distance between rows and rooms, as well as the availability of power to support any new equipment.

The results from the database audit and site visits are compiled into a complete data map that identifies all circuits by facility, floor, row, and rack. Now, the engineering team can begin the project design that defines the new circuit routing, the number and type of emulators needed, any new panels required, the number and lengths of cabling, as well as other key project considerations.

The engineering team then begins the project design using data from the database audit and site visits in conjunction with automated, AI-based tools to create two deliverables: a new, optimized circuit plan and a detailed Method of Procedure (MOP). Automated, AI-based tools use optimization algorithms to reduce the amount of manual effort required to create new circuit plans with increased accuracy. These same AI tools generate optimized MOPs, which are designed to reach the desired network plan in the shortest time. Tools like these eliminate wasted effort and cost while increasing speed and accuracy.

While generic optimization tools are available, they provide minimal benefit. To maximize the project's outcome, tooling specific to the project needs to be custom written. At Fujitsu, for example, there is an in-house team dedicated to creating such tools. Some tools, like the company's proprietary Digital Annealer, has many applications and is incorporated in the arsenal of tools that can be used on a variety of projects.

With the newly created network design and MOP as a guide, the process of physically disconnecting, moving, and reconnecting each circuit can begin. The work is typically done during non-working hours and can involve multiple locations. Logistics planning and project management are critical, as a moderate-sized project can involve hundreds of thousands of circuits and multiple tech teams.

The final stage of the process, provisioning, is typically the easiest and quickest phase since it is done online with automated process scripting. An engineer creates a database with the circuit IDs and those of its terminal ports so the script can provision the newly emulated circuits.

Preliminary Engineering Analysis

While most CEM projects begin with the database/records audit, those involving Fujitsu typically start with an Engineering Analysis. During this high-level evaluation, the team analyzes the project's layout, scope, and challenges to find areas where value can easily be added. For example:

- Compressing traffic to reduce the number of new ports
- Migrating associated systems
- Moving traffic further upstream
- Reclaiming/vacating space to save OpEx
- Developing tools to aid migration and reduce costs

Planning requirements

Additional hardware/software requirements

Whereas a like-for-like migration focuses on the network modernization of network elements at one location, CEM focuses on circuits that transverse an entire network, making it vastly more complex. But when done right, a circuit emulation migration enables a long list of powerful advantages, such as:

- Self-healing, self-provisioning network
- Path to a future-ready network
- IP-style, mesh
- IP-based manageability
- Lower OpEx with no spares required
- No institutional knowledge required
- Provides a single pane of glass for managing and maintaining the network
- Additional revenue-generating opportunities

Additional Benefits

The CEM process often involves some pruning and consolidation of the carrier's legacy network elements (NEs), many of which have reached end-of-life. Eliminating these NEs creates its own list of additional benefits:

- Recovery of spares
- Recovery of space
- Power savings
- Higher revenue per square foot
- Reduced carbon footprint

How and Where to Begin

A major CEM project can involve thousands of circuits scattered across dozens of locations. Even if you can move 100 circuits a night, the entire job can take years to complete. This isn't a sprint, but a marathon that needs to be done. Here are some tips on getting started:

Prioritize and parcel

Identify your low-hanging fruit. Start with short hops that carry the most traffic, then slowly broaden your scope.

Look to the edge

You can also start by migrating your legacy TDM systems to CEM edge equipment on a one-for-one basis and then later map that into an IP core.

Start scrubbing

The heavy lifting is reviewing database records and confirming the physical location of the circuits you plan to move. Whatever you can do now will save you time later.

Consolidate where possible

Decades of accumulated legacy equipment offer plenty of opportunity for consolidation, vacating a co-location space, or a site exit. This will improve space usage and network manageability while decreasing the number of circuits to be emulated.

Planning, Pace, and Patience

There's no sugar-coating it: Circuit-Emulation Migration is a complex and long-term project. But for many carriers, it is the best way to prepare for an all-IP environment. Finding the right partner with the experience and resources to help you plan and execute the project should be your priority. Don't let the scope deter you. Create a schedule that's manageable, then allow yourself to settle into a comfortable pace and rhythm.

For more information on how Fujitsu can help you get started on transforming your legacy SONET/SDH network to a streamlined, IP-ready network, click on the link below.

Transform your legacy SONET/SDH network >>

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