infinera®

MANAGEMENT SYSTEM FOR XTM SERIES AND XTG SERIES

DNA-M

Multi-layer Service and Network Management Tool for Packet-Optical Networks

Digital Network Administrator (DNA-M) is a multi-layer network and service management system for the Infinera XTM Series and XTG Series optical and packet-optical networking solutions.

Common Management System for Multi-layer Networks

DNA-M provides one multi-layer management system with complete topology awareness across Layer 0, Layer 1 and Layer 2, resulting in a simplified management architecture and more efficient network and service lifecycle management.

Overview – Architecture

DNA-M is built around a multi-layer TMF608 model, according to TM Forum specifications. This model has complete topology awareness of the network and services across Layer 0, Layer 1 and Layer2, enabling multi-layer management in one system for fast, cost- effective provisioning, fault isolation and resolution without the need for extensive integration with other operations support systems (OSS). With DNA-M, the user can, in minutes and from one graphical interface, configure an optical channel and add a Layer 2 service on top of this
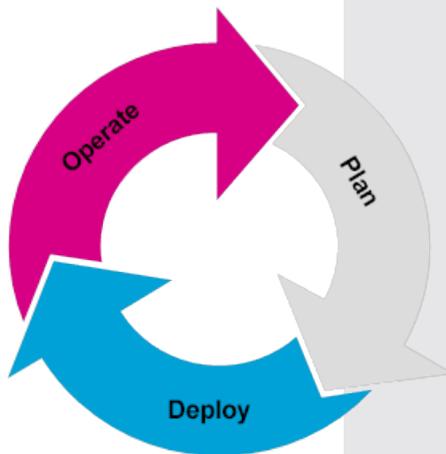
DNA-M Helps Network Operators Deploy and Operate Their XTM Series/XTG Series Network.

Key benefits:

- One common multi-layer management system for XTM Series/XTG Series-based Layer 1 and Layer 2 networks, providing simplified service and network management

- Automated provisioning across Layer 0, Layer 1 and Layer 2 networks

- Automated path computation using embedded path computation elements (PCE), and evolution to full software defined networking (SDN) environment

- Reduced time to resolve networking problems across Layer 0, Layer 1 and Layer 2, providing improved fulfillment of transport service level agreements (SLA)

- Reduced truck-rolls due to easier commissioning of amplified links

- Standardized MTOSI 2.0 northbound interface for easy integration with existing business support systems (BSS)/OSS

- Full support for alien wavelengths and passive equipment, allowing operators to take full advantage of Infinera's flexible networking solutions with maintained end-to-end management

- Web applications providing easy access to and visibility of typical tasks in DNA-M

Channel, or find the root cause for a problem detected for a Layer 2 service even if the fault occurs on Layer 0.

DNA-M extends the flexibility of Infinera's networking solutions into the management layer. Unlike many other optical management systems, DNA-M provides management features for alien wavelengths and purely passive equipment, independent of whether the services are terminated on Infinera equipment or transported as alien wavelengths across the Infinera networking domain. Services may also start on, or traverse, passive filters. For termination on passive equipment, DNA-M inserts virtual termination points in the management system.

The flexibility of DNA-M allows network operators and service providers to design networks in the most optimal way with maintained management.

A Modular Architecture Covering the Network/Service Lifecycle

DNA-M offers a full-featured graphical user interface (GUI) with real-time alarm monitoring, multi-layer root-cause analysis, performance monitoring and point-and-click provisioning and activation.

With its modular architecture, DNA-M provides management for all aspects of the network and service lifecycle, including commissioning, provisioning and assurance. For integration to back-office OSS, DNA-M provides TM Forum Frameworx-compliant web services interfaces based on the TMF608 model to avoid the complexity of the underlying optical network and reduce the time, risk and costs associated with integration.

Element Management Module

The DNA-M element management module provides the DNA-M platform itself with basic fault, configuration, administration, performance and security management functionality (FCAPS). For small or simple deployments without reconfigurable optical add-drop multiplexers (ROADM) or Layer 2 equipment, the DNA-M element management module provides a low-cost, standalone and out-of-the box management system that enables centralized management without the need for any other OSS. For larger deployments, the
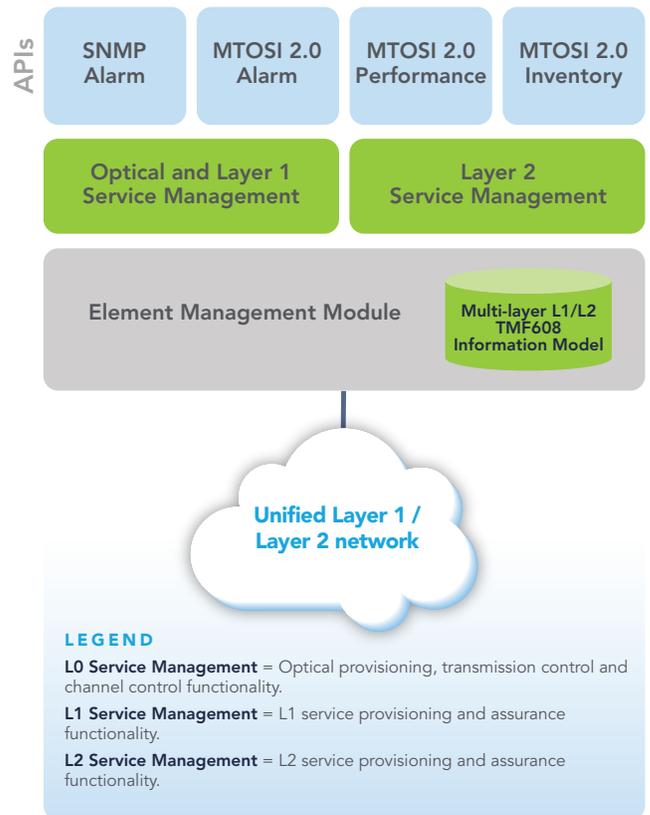

Fig 1. The Modular Architecture of DNA-M Covers the Network and Services Throughout Their Whole Lifecycle.

DNA-M element management module serves as the foundation for advanced service management.

The element management module includes features simplifying daily operations, administration and management (OAM) tasks such as active alarm list and log, node performance statistics, event logging, node inventory, software upgrade, node configuration upload, topology management and user rights. The element management module supports Layer 0, Layer 1 and Layer 2 network elements.

DNA-M offers optional modules to support Layer 0, Layer 1 and Layer 2 service provisioning, service assurance and transmission control.

Optical and Layer 1 Service Management Module

Optical and Layer 1 Service Provisioning

For complex networks with ROADMs or other configurable network elements such as the Infinera mobile backhaul solution, DNA-M offers a Layer 1 service provisioning module. The module provides point-and-click provisioning and activation, including a Multi-Technology Operations System Interface (MTOSI 2.0)-compliant state-machine, to automate the provisioning process and hence reduce the time and cost to set up services. For networks with configurable equipment such as ROADMs, the provisioning application saves up to 90% of the time required to provision a service or network resource.

For ROADM-based networks, the application allows the user to enter routing constraints to force the service to pass or not to pass specified nodes. When the user provisions an optical channel, the application first checks that the channel has not already been used somewhere else along the trail and then automatically configures the ROADM boards and invokes control loops to minimize the need for manual intervention.

The provisioning application supports all XTM Series ROADM configurations in linear, ring or mesh topologies. In addition, the module supports end-to-end configuration of alien wavelengths (mux–mux) and allows the optical channel trail to contain passive equipment (the Infinera XTG Series). For alien wavelengths, the MTOSI-compliant state machine is extended, with a separate state to indicate and track an alien wavelength across the network; each alien wavelength's optical channel trail has a unique name and is treated like any other trail.

Optical and Layer 1 Service Assurance

As network complexity increases, for instance when having multiple ring or mesh topologies, understanding network topology and associations between network elements may become difficult. The service assurance module greatly increases the operator's visibility of the network and service topology by providing a graphical view of the network, reducing time to resolve networking problems.

Fault information is indicated not only on the map but is also graphically displayed on individual trails, links and ports. To further simplify and speed up troubleshooting, the assurance module also correlates, filters and suppresses alarms and performs root-cause analysis to allow the user to focus on the critical faults to quickly resolve them. Alien wavelengths are treated like any optical channel trail.
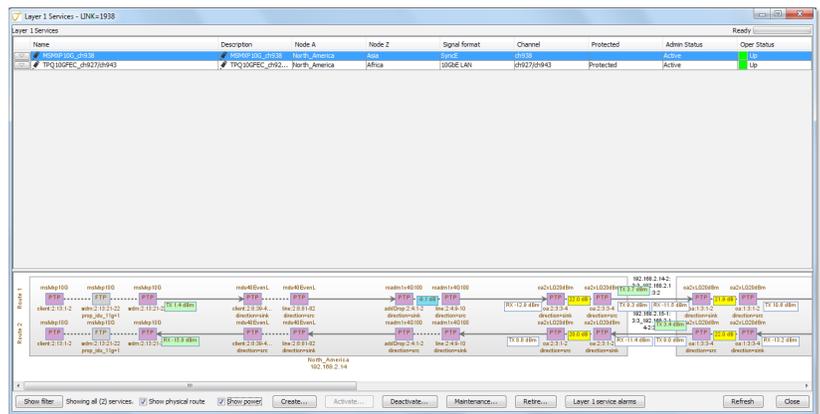

Fig 2. Screenshot from DNA-M Showing Connectivity View of Layer 1.

For larger operators, the assurance module provides business-critical support for their OAM staff, complementing the higher order OSS environment to simplify troubleshooting and daily operations. For smaller operators, the assurance module provides advanced service management functionality for a fraction of the cost of a vendor-independent OSS.

Transmission Control

Transmission control is an optional DNA-M module that simplifies the commissioning of amplified links. Unbalanced amplified systems result in increased numbers of bit errors or even lost communication. Power balancing needs to be performed during the initial commissioning of an amplified link and when capacity is expanded. Links may occasionally also need to be rebalanced since component characteristics can change over time or a configuration error may be discovered.

With transmission control, an operator can commission amplified links in minutes rather than days without having staff on site, reducing the number of truck-rolls. The application works with optical channel monitor (OCM) units, variable optical attenuators (VOA) and amplifiers to read and present the power levels per channel and the aggregated values for amplifiers to ensure that the system is balanced.

Transmission control also allows the operator to instantly change attenuation or amplifier settings from the GUI for faster operations. To reduce the burden on the operator further, the application automatically establishes all associations between VOAs and OCMs. The user interface of transmission control is fully integrated in the user interface of the Layer 1 service assurance module and also extends the troubleshooting capability of the assurance module for amplified systems. Transmission control also supports alien wavelengths.

Layer 2 Service Management Module

Layer 2 Service Provisioning

For XTM Series networks with Layer 2 equipment, DNA-M offers a provisioning module that provides point-and-click provisioning for both native Ethernet and multi-protocol label switching - transport profile (MPLS-TP). The module provides point-and-click creation of tunnels, label switched paths (LSPs) and pseudo-wires to automate the configuration process, thereby reducing the time and cost to provision resources and services.

However, to be able to deliver and provision a Layer 2 service, the optical channels must be configured. One advantage with multi-layer management is that a user can provision an optical channel from the same system before configuring a Layer 2 service to speed up the provisioning process.

The Layer 2 service provisioning module also provides a quick and simple provisioning workflow based on pre-defined service templates and automated path computations, as determined by the embedded PCE.

Layer 2 Service Assurance

The Metro Ethernet Forum states that carrier Ethernet systems must provide the ability to monitor, diagnose and centrally manage a network, using standards-based vendor independent implementations. DNA-M takes this one step further by offering management across multiple layers to further simplify management, increase visibility of the network and reduce operational costs.

The Layer 2 assurance module extends DNA-M's operational model and management processes from Layer 0 and Layer 1 into Layer 2. The module is plug-and-play on top of the Layer 1 assurance module and it not only adds Layer 2 management capabilities but also provides integrated Layer 0, Layer 1 and Layer 2 management from a single graphical interface.

The module provides complementary functionality to established Ethernet standards for fault management such as IEEE 802.1ag connectivity fault management (CFM). The goal of CFM is to monitor an Ethernet network and pinpoint where a problem occurs, while DNA-M provides a graphical multi-layer interface to quickly find the exact root cause of a networking problem, whether it occurs on Layer 0, Layer 1 or Layer 2.

The module discovers and tracks the operational state of Layer 2 services and the underlying Layer 0 and Layer 1 trails supporting the services. Fault information is indicated not only on the map but also graphically on individual trails, links and ports. If the reason for a networking problem resides on Layer 1, the user can access features in the Layer

1 assurance module to quickly resolve the problem without having to change system or interface.

The module also presents G.826 performance statistics for Layer 1 and Y.1731 statistics for Layer 2.
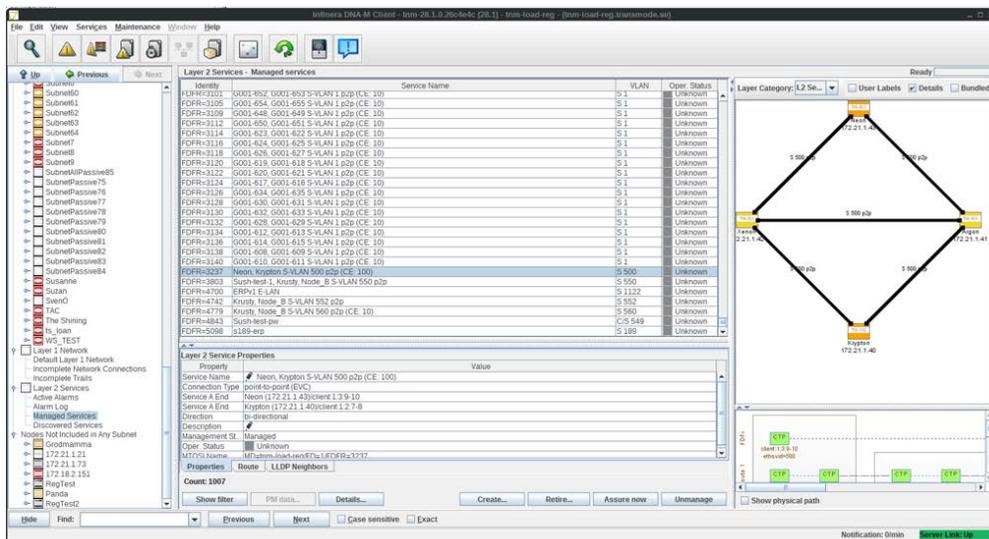

Fig 3. Screenshot from DNA-M Showing a Point-to-point Service with Associated Details.

Web Apps For Typical Tasks in DNA-M

In order to provide easy access to and visibility of typical tasks in DNA-M, a range of web apps has been created. Two examples of these web apps are the Alarm Dashboard web app and the Upgrade Analysis web app.

The Alarm Dashboard web app provides a graphical overview of the alarm severity level ranging from critical, major and minor to warnings. This web app is ideal for big-screen on wall placement in a Network Operations Center (NOC) providing a quick overview of the XTM Series network alarm status.

The Upgrade Analysis web app significantly reduces planning and documentation time during network upgrades.

Fig 4. Screenshot of the Alarm Dashboard Web App

Specifications

Scalability	Up to 10,000 network elements per server Up to 40 simultaneous clients
Features	Configurable User Groups Audit-trail and SYSLOG support Root-cause alarm analysis MTOSI 2.0 compliant state-machine Interface to Radius Support for XTM Series and XTG Series Automated path computation with the PCE
Layer 2 Support	IEEE 802.1ad Q-in-Q SVLAN ITU-T G.8032 Ethernet Ring Protection IEEE 802.3ad Link A Link Aggregation Group (LAG)
MPLS	MPLS-TP Pseudo-Wires
MEF Services Support	E-LINE (EPL and EVPL) E-LAN
Southbound Interfaces	SNMPv3 (XTM Series) SFTP for configuration backup
Performance Monitoring	Layer 1: G.826 Layer 2: Y.1731
Northbound Interfaces	SNMP and MTOSI 2.0 XML/web-services interfaces for alarms, inventory and performance

Hardware and OS Requirements

Server Requirements	Windows Server 2008 R2 64-bit (x86-64) Intel Xeon 2.0 GHz or equivalent Red Hat Enterprise Linux 6.5 or 7.0: Dual Intel Xeon 6-core 2.5 GHz
Supported Client HW	Intel Pentium 2.0 GHz
Supported Client OS	Windows 7 Professional Windows Vista Business Windows XP Professional

Specifications and Features Are Subject to Change

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