FUJITSU

Solution Brief
Packet-Driven Networks

An adaptive, packet-based approach to evolution and growth

Solution Benefits
- Modular, pay-as-you-grow expansion
- Dense 1 GbE or 10 GbE to 100 GbE aggregation
- Economical and resource-efficient
- Future-proof, evergreen technology

Functional Elements
Switching Nodes:
- 1FINITY™ S100 1.2 Tbps Switch R 2.1 and 2.2
- FLASHWAVE® CDS R 6.6.2

ROADM Nodes:
- 1FINITY L100 Series Lambda blade R 2.4
- 1FINITY T300 and T310 Transport blades
- FLASHWAVE 9500 R 9.4

SDN Controller
- Virtuora® Network Controller (NC) V 5.0

Introduction

Today, almost all traffic from service providers' residential and business customers is Ethernet-based. Most service providers have an Ethernet network that aggregates and switches that traffic to its destination. Many of these Ethernet networks aggregate onto 10 GbE links, but continuing growth in Ethernet traffic leaves these networks bulging at the seams and growth is urgently needed.

Typically, a carrier-grade Ethernet network is a layered architecture with a variety of GbE-to-10 GbE aggregation rings. These rings feed a 10G-to-100G aggregation ring. Customer traffic is then delivered to destination services such as voice, video and Internet. The aggregation rings may utilize some form of CWDM to reduce the fiber count in large-scale applications with fiber limitations. The core network may also utilize a DWDM ring for fiber and operations efficiency.

A common approach to network growth is to increase capacity with a noncoherent n × 10G DWDM network and add more 10G Ethernet services. While this solution is viable for the near term, it does not accommodate growth to 100G service. When customers begin to demand 100G, a new coherent 100G DWDM network will be needed, or it will be necessary to grow the 10 GbE network into a 100 GbE network.

Typical Carrier Ethernet Network with a Variety of Rings
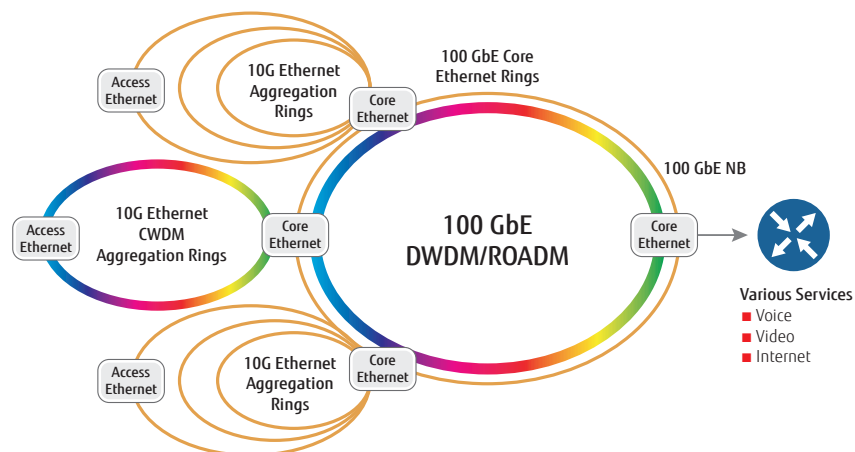
Multilayer Services and SDN Control

The Versatile Packet-Driven Networks Solution

Carrier Ethernet owes its success in large part to its innate versatility, which has allowed it to accommodate many of the countless scenarios presented by service providers and enterprises. Fujitsu brings its 1FINITY family of disaggregated transport products to bear in the Packet-Driven Networks solution. This disaggregated approach allows the solution more flexibility to meet these differing objectives with a Carrier Ethernet foundation that evolves the advantages of packet-optical transport systems (P-OTS).

P-OTS architecture is designed to support multiple concurrent technologies used in metro networks, including Carrier Ethernet, OTN, and/or DWDM/ROADM functions. These systems can perform aggregation at one layer and multiplexing and transport using lower layers. The Fujitsu Packet-Defined Networks solution disaggregates a typical P-OTS chassis using 1FINITY™ switch, transport and ROADM hardware blades to deliver multilayer services and Virtuora software to provide software-defined network control. Importantly, this solution meets growing capacity demands with 100 GbE service delivery.

1FINITY Hardware

The functional keystone of the Packet-Defined Networks Solution is the 1FINITY S100 1.2 Tbps Ethernet switch. The 1FINITY S100 platform offers dense 1 GbE or 10 GbE to 100 GbE aggregation in a flexible 1RU blade with a full suite of features including:

- MEF E-Line and E-LAN services
- Multiple classes of service with bandwidth guarantees
- Y.1731 per-service performance metrics
- G.8031 and G.8032 automatic sub-50 ms fault management
- Link aggregation (0:N LAG)

Fujitsu Platform Interoperability

While this solution features the 1FINITY S100 as the switch element for transporting 10 or 100 GbE services across an Ethernet ring network, a Fujitsu Packet-Driven Network may also contain other hardware elements. For instance, the Fujitsu FLASHWAVE CDS is a good choice as an Ethernet access device for 10 GbE aggregation. In a fiber-constrained scenario, the Fujitsu FLASHWAVE 7120 can work with the S100 for efficient wavelength service delivery.

Additionally, two alternatives are available for a DWDM core optical network. If the network has an existing Fujitsu FLASHWAVE 9500 Packet ONP, then that system can be used as the ROADM platform for provisioning 100G wavelengths across the network. If not, then the 1FINITY L100 Lambda platform can replace the existing optical ROADM for the same purpose. In the Fujitsu brownfield network option, the 1FINITY S100 can be used to leverage existing FLASHWAVE CDS or FLASHWAVE 9500 infrastructure and extend the life of those systems.

Transponder and Direct-Connect Options

The FLASHWAVE 9500 ROADM can be used with the 1FINITY S100 switch in two ways. If the 100G wideband optical module of the S100 is installed, then that 100G interface can utilize a transponder card within the FLASHWAVE 9500 to transmit 100G services over the FLASHWAVE 9500 DWDM. Alternatively, the S100 has a 100 GbE narrowband DWDM interface that can connect directly into the FLASHWAVE 9500 ROADM,

thereby eliminating the need for a separate transponder. Typically, the economics are better with this direct-connect option.

G.8031/G.8032 Protection

Two ITU-T standards handle path protection: G.8031 Ethernet linear protection switching and G.8032 Ethernet ring protection switching. G.8031 is a path-based, working-and-protect mechanism that can switch to an alternate route in less than 50 ms, while G.8032 is a bridged, ring-based mechanism that can reverse around the ring in less than 50 ms. Both standards offer equivalent protection and the choice between the two is a matter of preference.

Virtuora Software

Operationally, Virtuora Network Controller (NC) provides SDN/NFV-based network management and service delivery. Virtuora NC interacts directly with network devices through southbound interfaces using standard protocols, while operators and northbound software systems interact indirectly with the network through Virtuora NC's REST APIs. This solution uses the Virtuora Network Management suite for element, fault and performance management, as well as network analytics. Resource discovery, service activation, and path computation appplications are provided by the Virtuora Packet and WDM Control suites.

Fujitsu Integration Services

The Fujitsu Network Integration team works as a trusted partner helping operators meet the challenges of modernizing and deploying next-generation networks. Our expert project managers and engineers provide efficient, timely communication and coordination with vendors, ensure the project is planned and executed on time, help minimize financial and other risks, and resolve issues. Network integration services include:

- Consulting
- Design and planning
- Systems integration
- Installation, test and turn-up
- Maintenance and support

Functional Summary

The following functionality is supported in this release:
- 10G to 100G Ethernet aggregation
- Direct 100G DWDM connections
- E-Line and E-LAN services
- G.8031 and G.8032 protection
- Access and core device interoperability

Diverse, Adaptable Functionality

Practical Deployment Options

The Fujitsu Packet-Driven Networks solution can be deployed in a variety of scenarios, including options 1–3, illustrated on this page.

With option 1, multiple S100 blades can be connected on an Ethernet ring to create a network with both G.8031 and G.8032 protection switching. The Ethernet nodes can operate at 10 or 100 GbE.
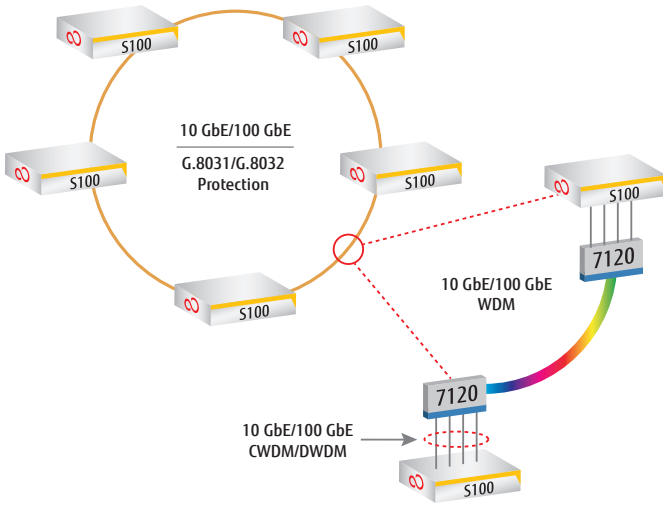

Option 1: 1FINITY S100 10 GbE or 100 GbE ring

With option 2, the S100 can be used to increase the Layer 2 function of networks with a FLASHWAVE P-OTS in place. Starting on the network edge, the S100 can provide protected 10 GbE aggregation from multiple FLASHWAVE CDS systems. To access the core network, the S100 can use a 100 GbE wideband optical module to connect to a 100G transponder in the FLASHWAVE 9500 for transport across the DWDM ROADM network. Alternatively, a 100 GbE narrowband optical module in the S100 can provide a direct connection into the FLASHWAVE 9500 ROADM, bypassing the need for a transponder.
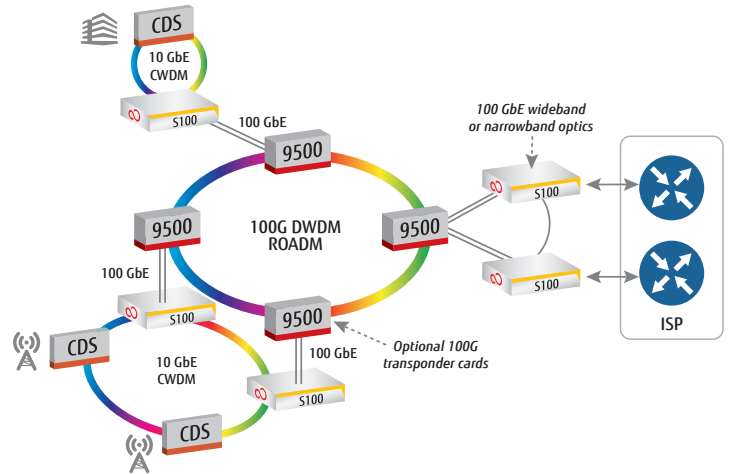
Option 2: FLASHWAVE 9500 100G ROADM Ring with Subtended 1FINITY S100 and FLASHWAVE CDS 10 GbE Aggregation

Option 3 evolves the aggregation configuration in option 2 by adding a new 1FINITY ROADM into the core network. The S100 wideband optics connect to the 1FINITY L100/L110 ROADM through a 1FINITY T300 transponder with 100 GbE client ports. Alternatively, the S100 narrowband optics can connect directly to the L100/L110, bypassing the need for a transponder.
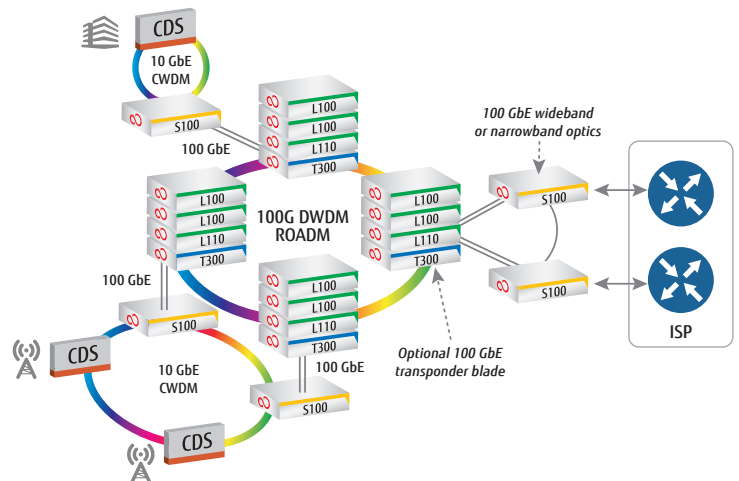
Option 3: 1FINITY 100G ROADM ring with subtended 1FINITY S100 and FLASHWAVE CDS 10 GbE aggregation

Low-Risk Capacity Growth

Solution Benefits

Modular, Pay-as-You-Grow Expansion

The 1FINITY disaggregated platform's modular architecture results in low initial investment and efficient scalability. It is possible to deploy just what is needed when it is needed, knowing that future capacity needs can be met with pay-as-you-grow expansion. Until now, the only option has been to "predict" traffic growth and deploy to match the prediction, while hoping you are correct. In this kind of scenario, outcome variability is a problem, given the cost and disruption of substituting a larger shelf after the fact, not to mention the cost of wasteful over-deployment. The flexible Packet-Driven Networks solution minimizes risk, enabling the network to grow responsively, one 1RU blade at a time.

Dense 10G to 100G Ethernet Aggregation

Ethernet networks offer time-tested, flexible, adaptable value. The Packet-Driven Networks solution allows an Ethernet switching network to address traffic growth by extending smoothly to 100G.

Economical and Resource-Efficient

With the ability to accommodate access networks, perform 100G aggregation and leverage a DWDM network, the Packet-Driven Networks solution is highly flexible and versatile and favors very economical outcomes. The ability to leverage existing access and DWDM networks also fuels resource efficiency. Additionally, DWDM optics give a standalone ring greater reach than standard Ethernet optics, even though the DWDM multiplexer is not used. A long-reach DWDM optic can accommodate up to 80 km between S100 nodes, while a standard Ethernet optic can only stretch up to 40 km.

Future-Proof, Evergreen Technology

The Packet-Driven Networks solution not only supports current needs but also positions the network for the future. This modular blade-based solution can address a variety of possible contingencies:

- A coherent 100G DWDM network can be easily added
- Future 100G or even 400G services can be accommodated
- New transport or DWDM advances can be incorporated

Developing the Right Planning Strategy

Network planners have various options for a strategy that meets immediate and near-term needs based on accurate predictions for growth and anticipated service roll-out. The 1FINITY pay–as-you-grow architecture provides the needed capacity over a typical 12- to 24-month timeframe and also has the scalability to support unknown needs beyond that.

Some network operators have found their options limited with 10G-based networking when 100G began to enter volume deployment. 1FINITY provides an open optical system that supports flexible spectrum, and thus enables faster adoption of future services, such as 400G and 1T, without disrupting the optical layer.

Conclusion

In an increasingly competitive environment, providers must deploy larger amounts of bandwidth faster, with a high level of service assurance. However, delivering the needed capacity presents significant challenges. Service providers need a flexible packet-based solution that reduces expense and risk, yet enables adaptive evolution and embraces software-defined management and control.

The Fujitsu Packet-Driven Networks solution provides versatile options for network operators seeking flexibility, scalability and resiliency. New 1FINITY blades are compatible with deployed FLASHWAVE P-OTS, thereby eliminating the need for forklift upgrades and simplifying pay-as-you grow scalability with best-in-class modularity. Advanced, layer-two switch optics enable options for delivering 100 GbE services over DWDM networks that cut cost and speed implementation. Operational efficiency, path protection, and simplified network management reduce risk and ease the burden of running a network designed for high-performance and future growth.

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