FUJITSU

Application Note
Data Center Interconnect

Connecting data centers with compact, power-efficient, high-speed transport

Application Benefits

Fujitsu Data Center Interconnect (DCI) applications help solve space and power challenges while reducing costs:

- Compact physical footprint
- Low power consumption
- Scalability to 200G per wavelength
- Open, modular architecture

Functional Elements

Fujitsu DCI applications comprise three main elements, which can be mixed and matched to provide a variety of configurations:

- 1FINITY™ optical networking platforms
- Virtuora® SDN/NFV software suite
- Fujitsu optical services

Macro Trends Driving Traffic Growth

As growing numbers of consumers routinely turn to cloud-based entertainment and Over-the-Top (OTT) services such as streaming music and movies, more and more traffic is passing through and between data centers. Three macro trends are driving rapid escalation in data center bandwidth demand:

- **Evolution to cloud services –** Moving services to the cloud reduces individual capital expenditures and shifts these demands to a centralized data center.
- **Explosion of video and OTT traffic –** To reduce total bandwidth costs, when possible, video and OTT content is cached locally in data centers, driving increased need for metro content delivery networks.
- **Specialized applications that require connected data centers –** Some applications, such as digital media delivery, cloud computing, business continuity and disaster recovery, require multiple interconnected data centers.

Factors Constraining Bandwidth Growth

This growing demand for cloud-based content delivery is putting pressure on the connections among and between data centers, known as DCI. The result is congestion and bottlenecks that have a ripple effect on the speed of content delivery.

There is now an urgent need to boost the capacity and speed of the transport networks that relay information between data centers and to/from Internet Exchange Points (IXPs). At the same time, there is heavy downward pressure on cost, power consumption, and the amount of physical space occupied by data center equipment in general.

Cost Burdens of Co-location Leasing

Lease charges for co-location facilities are based on the amount of rack space and power consumed. Because these charges are such a significant portion of the overall cost of a data center, it is imperative to reduce the monthly cost of space and power in order to reduce Total Cost of Ownership (TCO).

Complex Chassis-Based Systems

Typical data center interconnections use complex chassis-based systems. These integrated platforms are populated with interface cards in a wide variety of configurations that serve multiple functions, such as switching, transponding and DWDM multiplexing. Physical size, wasted space, high power consumption, lack of flexibility, insufficient room for growth, and complicated management procedures are all disadvantages of this type of hardware architecture.

DCI Traffic Characteristics

- DCI traffic predominantly flows across point-to-point connections.
- Bandwidth demands are typically met with DWDM multiplexers rather than ROADMs.
- When leasing space in a co-location facility, it is sometimes more economical to lease a few wavelengths rather than owning and managing DWDM transport systems.
- Most data center traffic is transported over 10G and 100G wavelengths, but increased demand for bandwidth will result in higher rates.

Modular, Scalable, Flexible, Operationally Simple

Small Form-Factor Blade-Based Hardware Architecture

Constraints on rack space are the chief reason why it is no longer optimal to consolidate multiple functions onto a single chassis. A new approach is to separate functional capabilities into standalone 1RU devices, known as "blades."

Advantages of this blade-based, modular hardware architecture include:

- Shorter, more precisely targeted development and release cycles
- Lower cost of entry
- Scalable pay-as-you-grow implementation path
- Faster and simpler deployment and provisioning
- Efficient use of resources such as space and power

1FINITY Optical Networking Platforms for DCI

The Fujitsu 1FINITY platform family is a modular "blade-based" architecture rather than a converged "chassis-based" architecture.

Various 1FINITY platforms can serve different functions in a DCI application. The following platforms are described in this application note:

- 1FINITY T100
  - Transponds 100 GbE signals on a 200G wavelength using 16-QAM
  - Transponds 100 GbE signals on a 100G wavelength using DP-QPSK
- 1FINITY T200
  - Transponds 100 GbE signals on a 200G wavelength using 16-QAM
  - Transponds 100 GbE signals on a 100G wavelength using DP-QPSK
  - Transponds 100 GbE signals on a 150G wavelength using 8-QAM
- 1FINITY T210
  - Transponds 100 GbE signals on a 100G wavelength using DP-QPSK with ultra long-reach
- 1FINITY T400
  - Performs Layer 1 aggregation of 10 GbE into 100G
- 1FINITY S100
  - Provides full-featured E-Line services for 10 to 100 GbE aggregation
- 1FINITY L100
  - Performs DWDM ROADM functions

Application Types

Fujitsu offers five DCI applications. The first four can be deployed for either metro DCI (mDCI) or long-reach uses, and the fifth, submarine DCI, is an inherently long-reach application. The applications are:

- Basic DCI – Metro and long reach
- Access peering
- Remote router access
- Dual-peering with a shared router
- Submarine DCI (long-reach only)

Basic DCI

With the unprecedented growth in OTT and cloud applications, this application easily meets growing need for bandwidth at the interconnection points between data centers. Point-to-point connections can be set up in a variety of configurations.

Metro DCI

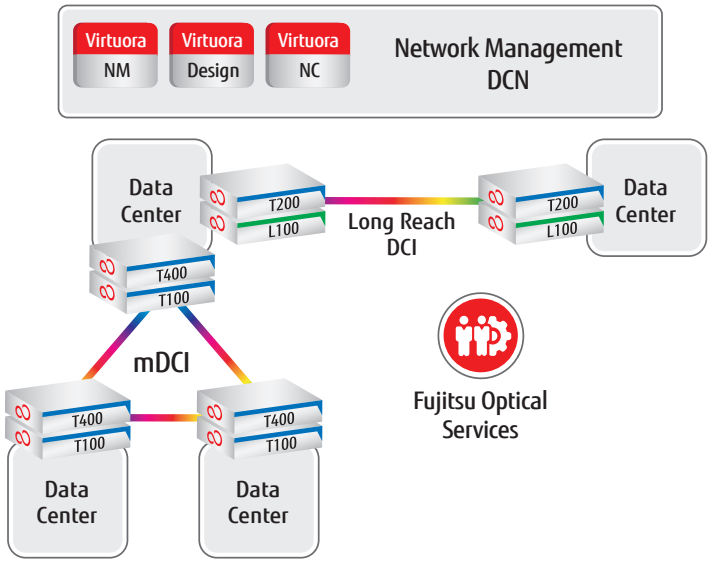
The metro DCI application combines the 1FINITY T100 with other 1FINITY platforms for the following functions:

- 1FINITY T100 provides 100 GbE services across 100G or 200G wavelengths using DP-QPSK or DP-16QAM modulation for reach up to 3,200 km
- 1FINITY T400 can aggregate 10 GbE to 100G at Layer 1
- 1FINITY S100 can aggregate 10 GbE to 100G at Layer 2
- 1FINITY L100 or FLASHWAVE 7120 can provide DWDM mux/demux

Long-Reach DCI

Long-reach DCI applications are available using the 1FINITY T200 in place of the T100, with the same 1FINITY platforms as in metro DCI, as listed above.

- 1FINITY T200 provides 100 GbE services across 100G, 150G or 200G wavelengths using DP-QPSK, DP-8QAM or DP-16QAM modulation for extended reach up to 6,000 km



Basic DCI Application with Long Reach (Top Right)

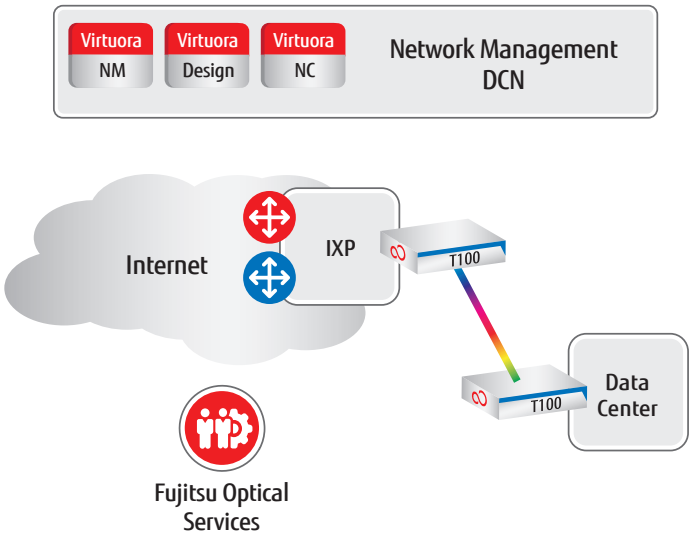
Applications for a Variety of DCI Needs

Access Peering

This application is ideal where a high bandwidth connection is needed between a data center and a peering point. A variety of 1FINITY point-to-point configurations can be set up over time to support increasing demand. Examples include using the 1FINITY L100 for ROADM, mux/demux or even direct connection; Layer 1 or 2 aggregation; long/short reach scenarios; and amplified or unamplified configurations.

Additonal options for this application include:

- Adding the T400 or S100 for 10 GbE demands
- Substituting the T200 for the T100 in long-reach scenarios



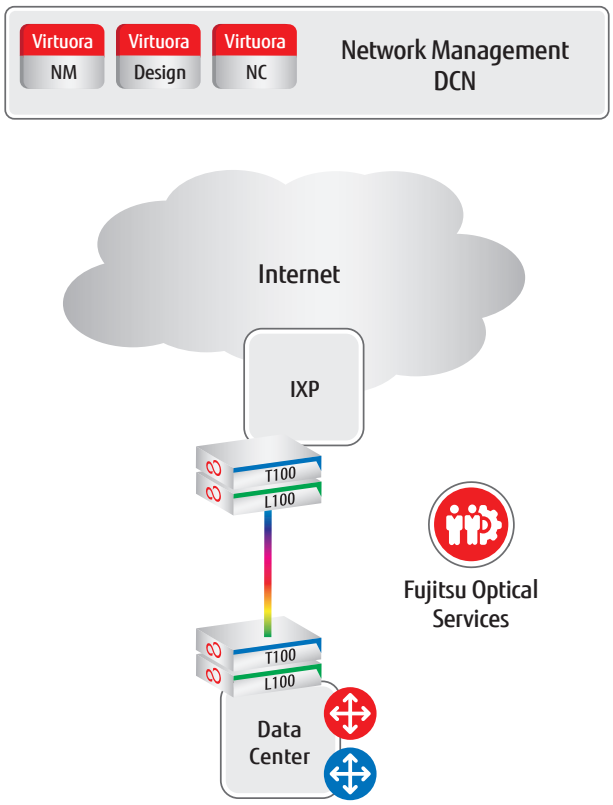
Access Peering Application

Remote Router Access

This application addresses the problem of high demand and limited rack space, especially where a router and a switch are desired at the IXP. A variety of 1FINITY point-to-point configurations can be set up to divert traffic to a router and switch located at a private data center instead. This reduces the space needed at the expensive IXP while maintaining a peering presence at that IXP.

Additional options for this application include:

- Adding the 1FINITY T400 or S100 for 10 GbE demands
- Substituting the T200 for the T100 in long-reach scenarios



Remote Router Access Application

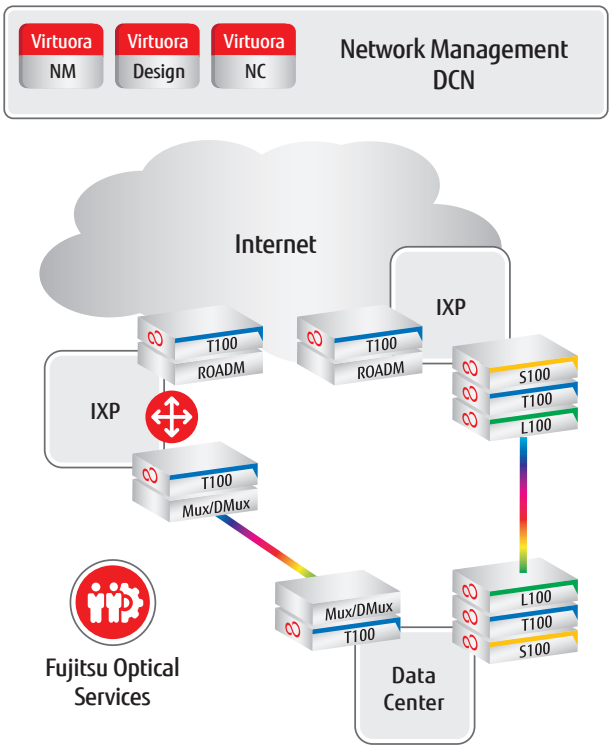
Suitable for High-Resiliency and Long-Reach Deployment

Dual Peering with Shared Router

When increased resiliency is provided using dual access at two nearby IXPs, the cost and space demands of maintaining a large switch and router at both IXPs can be high. A variety of 1FINITY point-to-point configurations can be set up to divert the traffic to a router and switch located at one of the peering points. This reduces the space requirements at one IXP and reduces the overall number of expensive routers and switches, while maintaining dual peering.

Additional options for this application include:

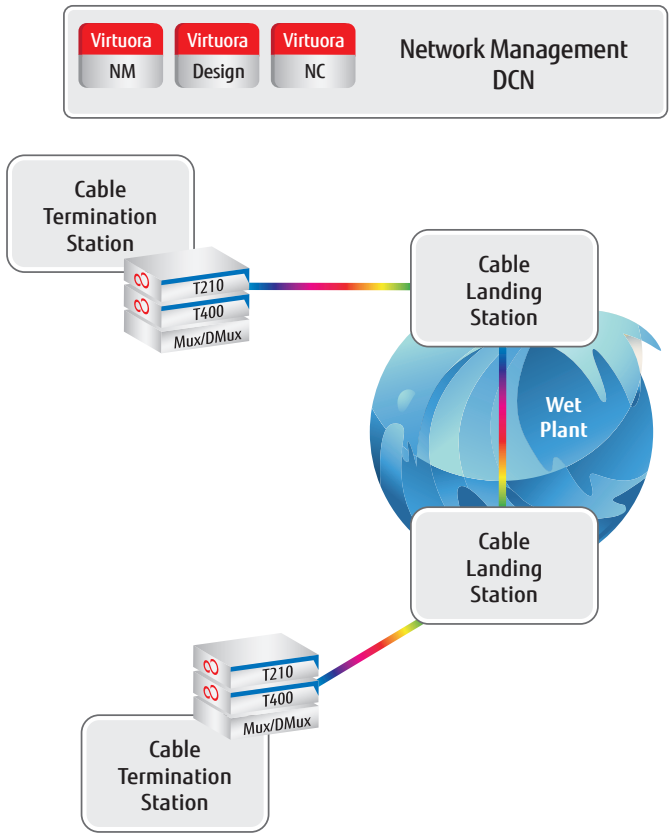
- Adding the 1FINITY T400 or S100 for 10 GbE demands
- Use the 1FINITY T200 instead of the T100 for long-reach scenarios



Dual Peering with Shared Router

Submarine DCI

The growth in DCI traffic also extends to intercontinental data center connections. Intercontinental routes almost always traverse deep ocean and long distances. The 1FINITY T210 can be used in sub-sea applications, with the 1FINITY T400 or 1FINITY S100 added for 10 GbE services. Typically these sub-sea applications use an existing DWDM muxponder and long-reach transponders.



Submarine DCI

Complete Solutions: Hardware, Software and Services

Software Control for DCI Applications

The Fujitsu Virtuora suite of SDN/NFV software products provides software-defined, virtualized network control, management and orchestration. Virtuora boosts the performance and increases the operational simplicity of physical and virtual infrastructure in 1FINITY DCI applications, using the following software platforms:

- Virtuora Network Controller
  - Provides an open-source framework for a collection of applications and interfaces, enabling control and management center of the virtual network
- Virtuora Design and Planning
  - Provides a comprehensive design, planning and inventory solution with robust reporting tools and multi-technology support
- Virtuora Network Management
  - Combines element, fault and performance management with network analytics to optimize service delivery in a multilayered network

Virtuora provides the following functions to support DCI:

- Coordinating services between data centers
- Managing and requesting services between data centers
- Enabling dynamic allocation of services
- Managing physically distributed data centers as a single entity

Services Expertise to Support Successful Implementation

Successful implementation depends on the right expertise. A team of optical network integration experts can provide this crucial expertise during the design and planning phases, as well as during deployment. Optical networking experts help you anticipate or avoid obstacles, control costs, minimize delays and maintain high quality standards.

Most ICPs have plenty of IT talent, but a lack of qualified optical networking staff can be a deterrent to the move to an owned network. The economic benefits of moving from leased services to managing your own optical equipment are impossible to ignore once traffic volume and the number of wavelengths reaches a certain point. Delaying the move to owned optical equipment only increases your service cost. Fujitsu offers optical integration services that close this skill gap and enable you to reap the benefits of an improved cost structure and greater control of your business.

Fujitsu offers the following services to support your successful DCI implementation:

- Optical network design and planning
- Optical fiber characterization and testing
- Supply chain, logistics, inventory and project management
- Installation and deployment
- Optical network maintenance and support

Increase Density, Reduce Power Demand, Control Costs

By choosing a Fujitsu 1FINITY DCI solution to provide connections between data centers or between a data center and an IXP, you can achieve significant long-term economic benefits. 1FINITY DCI solutions break through traffic bottlenecks while dramatically increasing density and reducing power usage at the optical, transponder and Ethernet layers. By deploying a DCI solution based on 1FINITY, you can reduce capex and opex, cut time to market for new services, and ultimately merge your data centers into a single managed network.

Fujitsu Network Communications, Inc.

2801 Telecom Parkway, Richardson, TX 75082
Tel: 888.362.7763

us.fujitsu.com/telecom

1.0/01.17