infinera®

SECURE METRO CLOUD FABRIC

BUILDING SECURE METRO CLOUD FABRICS WITH CLOUD XPRESS 2

Introduction

Cloud-based services are growing at a tremendous rate, and cloud service providers (cloud SPs) are investing heavily in data center (DC) and network infrastructures to keep up with demand. As they add capacity to scale their data center interconnect (DCI) networks, they are faced with a number of challenges. Equipment density and power efficiency must keep pace with capacity increases to hold data center costs down. Operational efficiency must improve continuously to grow networks without growing staff and operational costs. And in order to address growing security concerns, all data leaving the data center must be encrypted in flight without impacting network performance or complexity. The Infinera Cloud Xpress 2 is designed to meet these challenges, enabling cloud service providers to build and efficiently scale their secure metro cloud fabrics.

Hyperscale Cloud Service Providers

Cloud services and providers vary widely, but a few hyperscale cloud SPs dominate the market, particularly for the public cloud services known as infrastructure as a service (IaaS) and platform as a service (PaaS). Providers such as Amazon, Microsoft, Google, Oracle and IBM not only lead the market today, but they are also growing much faster than the market as a whole. UBS estimates the top four public cloud providers increased market share from 44% to 59% from 2013 to 2015.[1]

Each of the hyperscale cloud SPs has a unique set of service offerings and strengths. For example, some offer a mix of public, private and hybrid cloud solutions, which can be tailored to enterprise requirements, and cloud-based software as a service (SaaS).

But when it comes to cloud network infrastructure, the hyperscale cloud SPs have a lot in common:

- Global footprint with presence in major metros in every theater
- Capacity growth faster than the overall market
- Multiple data centers in most metros

Cloud SPs don't just build one data center in a metro area. Metro DCs are constrained by available space and power, and it's usually impossible for the largest cloud SPs to find single sites in a metro area than can meet their capacity needs. That's why hyperscale cloud networks usually have at least two and often as many as five or more DCs in a single metro area.

Cloud Growth Drives 100G Explosion

In cloud data center networks, the 100 gigabit Ethernet (GbE) revolution is accelerating. The so-called "east-west" traffic inside cloud DCs and between geographically separated DCs continues to grow faster than overall Internet traffic. Cloud SPs have begun upgrading

1 UBS, Is the Sky the Limit for Cloud Computing? May 9, 2016]

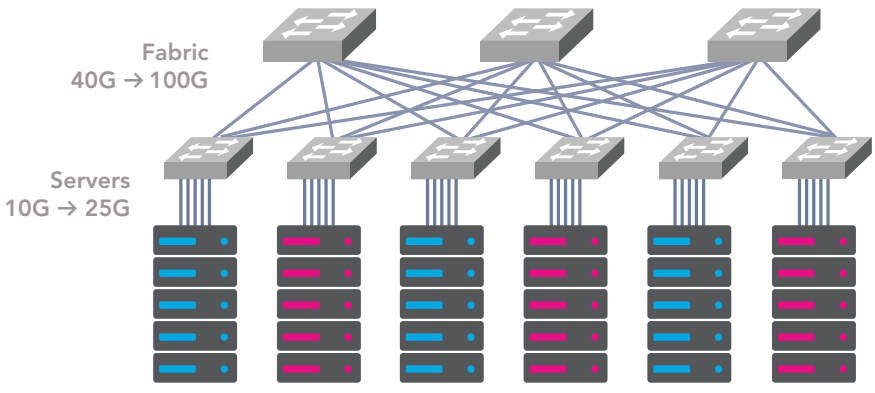

Figure 1: DC F abrics Migrate to 100G

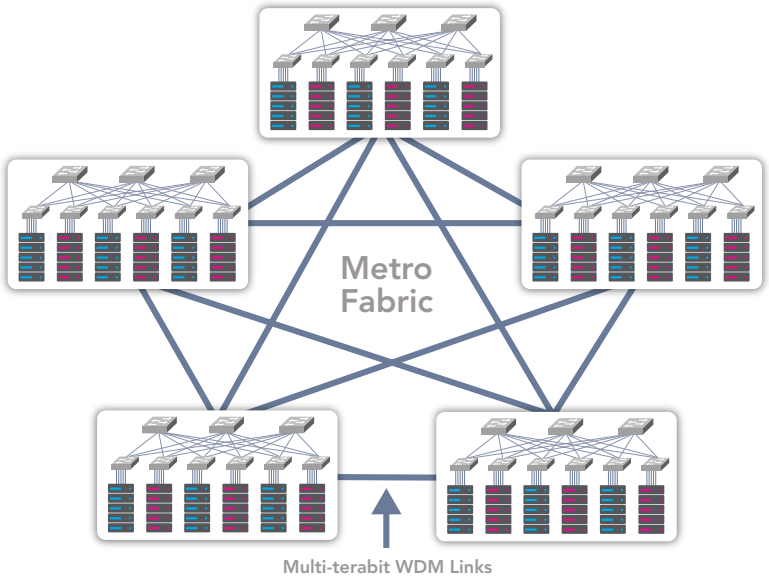

Figure 2: Metro Fabrics Interconnect DCs with N x 100G Links

server network connections from 10 GbE to the new 25 GbE standard, and this in turn is driving intra-DC spine-and-leaf switching fabrics from 40 GbE to 100 GbE.

While initial 100 GbE deployments began in 2015, they only started to accelerate in the second half of 2016. Multiple analysts agree that the 100 GbE boom predicted in late 2016 and early 2017 represents a turning point. Ovum called the 100 GbE fabric evolution a "new data center epoch."[2] Dell'Oro declared that "Cloud adoption of 100 [GbE] will be record setting in 2H16."[3] And LightCounting foresaw a "sharp increase in purchases… by cloud companies," noting that "expectations are very strong"[4].

With cloud SP data center fabrics moving to 100 GbE, the connections between metro data centers need to move to 100 GbE as well. The result is a metro DCI fabric with multiples of 100G on each link.

Cloud Service Provider Application: Secure Metro Cloud Fabric

When hyperscale cloud SPs build and grow their metro DCI fabrics, they have similar architectures, requirements and challenges.

Architecture

- **Rich interconnectivity**: Each data center is fully connected to the other DCs with numerous DCI links.
- **Multiple points of interconnect:** Every cloud must be connected to a variety of customers and peering partners, and most such connections occur at internet exchange (IX) facilities. By connecting to multiple IX sites in a metro, cloud SPs increase ease of interconnection, distribute traffic and enhance redundancy.
- **Terabit-scale DCI links:** As 100 GbE penetrates their networks, each hyperscale cloud DC will typically have links to multiple other DCs and IXs, with each link carrying multiple 100 GbE connections for a total capacity of 1 Tb/s or more, and these links are increasingly encrypted for security.

Figure 3 illustrates a typical metro DCI architecture with encrypted multi-terabit links.

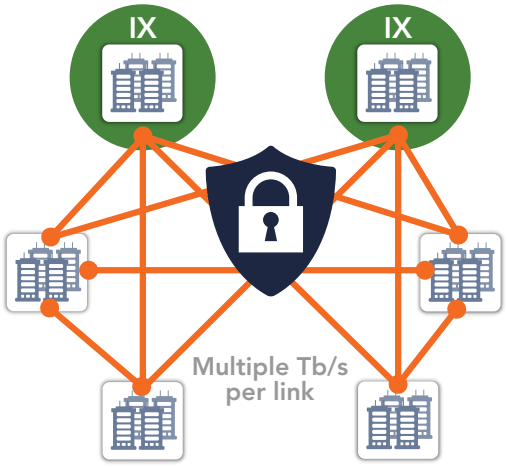

Figure 3: Secure Metro Cloud Fabric Example

2 Ovum, "OFC 2016: More Innovation and Volume for Data Center Intra- and Interconnect," April 2016
3 Dell'Oro Group, "Data Center Ethernet Switch 40 GE Sales Surge in 1Q16 on Strong Cloud Demand, According to Dell'Oro Group," June 2016
4 LightCounting: "Infrastructure Spending of the Cloud Companies Sets a New Record and Deployments of 100GbE Optics in Mega Data Centers Pick up Steam," June 2016

Requirements and Challenges

When choosing DCI solutions to build a metro cloud fabric like the one in Figure 3, cloud SPs must think about a number of requirements and challenges:

- **Efficient Scaling:** Scaling continuously is a constant challenge for fast-growing cloud networks. No matter how large the capacity of each DCI link is today, higher capacity will be needed tomorrow.
- **Minimizing space and power:** Metro data center space and power are expensive, especially at popular IX sites. Keeping these costs low, with high-density and low-power DCI solutions, is imperative.
- **Operational efficiency:** DCI solutions need to support continuous operational efficiency improvements and increased automation so that networks can scale without increasing the size of the operations staff and the cost of operations.
- **Encryption without sacrifice:** Security concerns continue to grow, leading toward a future where every connection and all data leaving any data center must be encrypted. The only way to achieve this goal without sacrificing scalability, space and power, and operational efficiency is to ensure that line-rate, in-flight data encryption is built into the DCI systems themselves.

Satisfying all of these requirements and challenges requires a DCI solution that is purpose-built for the job, with the right mix of hardware and software capabilities.

Solution: The Cloud Xpress 2

The Infinera Cloud Xpress 2 hits the sweet spot for building a metro cloud. The Cloud Xpress 2 is designed to meet the challenges and requirements enumerated above, enabling cloud SPs to build and efficiently scale their secure metro cloud fabrics.

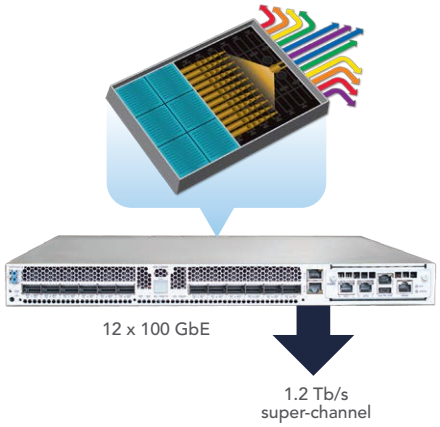

Figure 4: The Cloud Xpress 2 with the Infinite Capacity Engine

Optical Leadership with the Infinite Capacity Engine

The Cloud Xpress 2 incorporates Infinera's groundbreaking Infinite Capacity Engine. With the Infinite Capacity Engine, Cloud Xpress 2 delivers a 1.2 terabit per second (Tb/s) wavelength-division multiplexing (WDM) super-channel in only one rack unit (1RU).

Cloud SPs can start out using a fraction of the platform's capacity and scale up as needed with Infinera's unique Instant Bandwidth capability, which allows point-and-click activation of capacity without requiring any new hardware installation or configuration.

Cloud SPs growing DCI links above 1.2 Tb/s can also very simply stack multiple units together, and manage them as easily as a single unit, to scale capacity up to 27.6 Tb/s per fiber pair.

The Infinite Capacity Engine also enables high density and low power consumption. Compared to the 500 gigabit per second (Gb/s) super-channel Cloud Xpress platforms, which already offer very high density

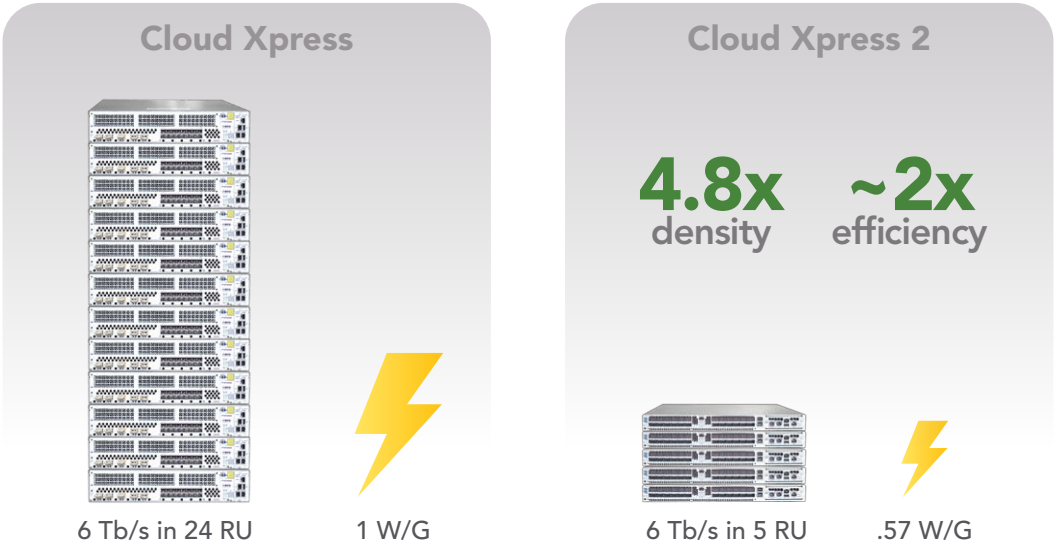

Figure 6: Density and Efficiency Improvements in the Cloud Xpress 2

and efficiency, the Cloud Xpress 2 delivers 4.8 times the density and roughly twice the power efficiency.

Finally, the Cloud Xpress 2 with the Infinite Capacity Engine delivers built-in security with state of the art in-flight data encryption. Encryption is becoming a critical requirement for cloud SPs and other network operators, and Infinera was the first to deliver a compact DCI solution with built-in encryption on the Cloud Xpress, based on the Media Access Control Security (MACsec) protocol and standards-based, state-of-the-art encryption technologies. The Cloud Xpress 2 extends the same encryption solution and scales it to a whole new level of capacity. And the Cloud Xpress 2 is designed to support Layer 1 encryption as a complementary alternative, with the same software architecture and operations model, giving cloud SPs the choice to use either solution.

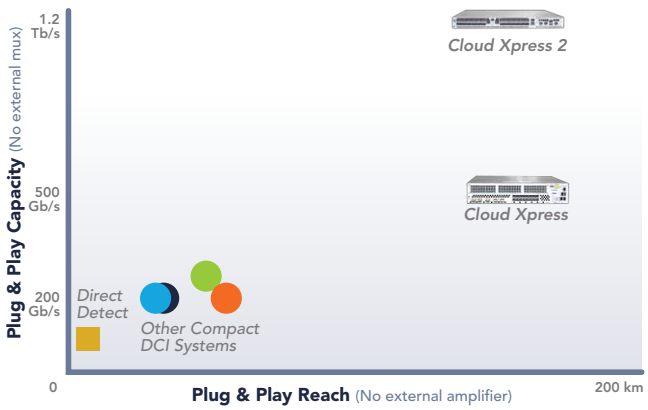

Figure 7: The Cloud Xpress 2 Boasts Superior Plug-and-play Reach and Capacity

Simplicity and Automation

The Cloud Xpress 2 extends the simplicity and automation advantages that are built into every Cloud Xpress model, which enables cloud SPs to meet their operational efficiency goals.

Since its introduction, the Cloud Xpress Family has made DCI simple, with its rack-and-stack appliance form factor and easy 1-2-3 configuration. Every Cloud Xpress model is simple to operate, and incorporates capabilities that make the complete DCI solution simpler, such as super-channel output and built-in amplification.

The Cloud Xpress 2 has built-in optical amplification that enables reach of up to 130 kilometers. This eliminates the need for amplifiers on most metro DCI links. Thanks to this and the 1.2 Tb/s super-channel output, the Cloud Xpress 2 delivers a combination of plug-and-play reach and capacity that is superior to alternative solutions, simplifying network deployment, configuration and ongoing management. Several cloud SPs have even developed network designs specifically to take advantage of these capabilities so that their entire metro cloud fabric can be built on the Cloud Xpress 2 without external multiplexers, amplifiers or other optical line system components.

Since the initial introduction of the Cloud Xpress, the world's first purpose-built DCI platform, Infinera has continued to innovate to enable network operators to automate and scale data center inter-

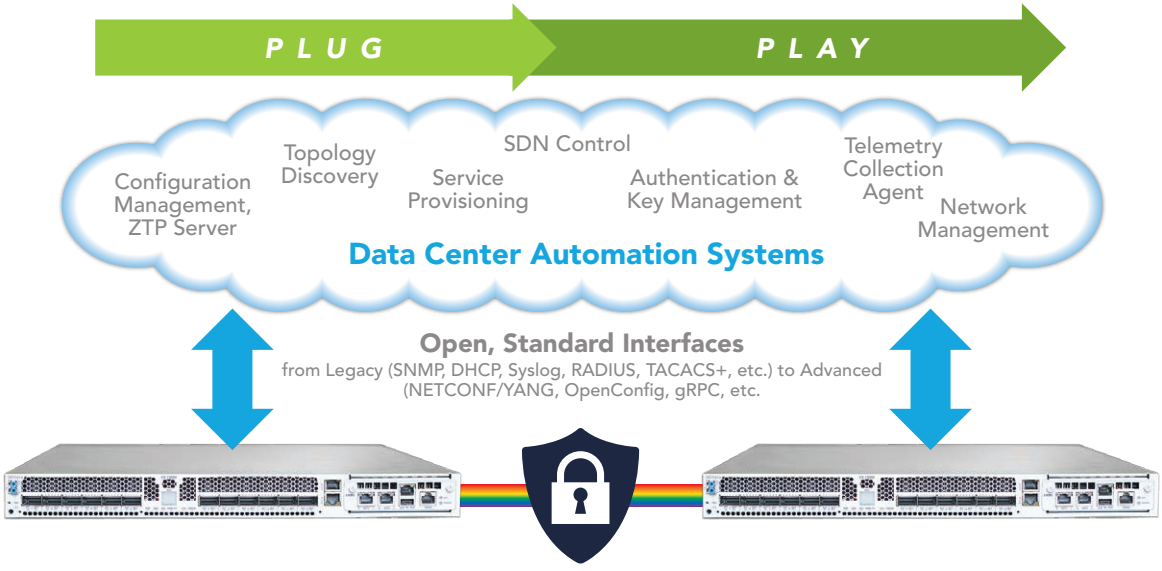

Figure 8: The Cloud Xpress Family Incorporates Extension Automation Support

connect. Now every Cloud Xpress, including the Cloud Xpress 2, boasts a wide range of automation capabilities such as topology auto-discovery, zero-touch provisioning support, and standard application programming interfaces (APIs) for programmability and streaming telemetry.

With this combination of a simple operational model, including superior plug-and-play reach and capacity as well as extensive automation support, the Cloud Xpress 2 enables cloud SPs to rapidly scale bandwidth between data centers and achieve their operational efficiency goals.

Summary

Hyperscale cloud service providers are making the move to 100 GbE to build and scale their cloud networks in metro areas around the globe. To succeed, they need a purpose-built metro data center interconnect solution that can deliver multi-terabit scalability with security, simplicity, and operational efficiency. The Infinera Cloud Xpress 2 is optimized to simply scale 100G data center interconnect for secure metro cloud fabrics.

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