

Expanding Demands Need Routing and Switching Performance—from Edge to Core

Applications, content, and data centers

The rapid adoption of cloud technology and applications is having a significant and measurable impact on metro networks, resulting in annual traffic growth between 40 and 60 percent, and even higher in many regions. Video streams and the outsourcing of IT services into the cloud are the main contributors to this voracious and ongoing bandwidth growth. Although bandwidth demand growth is not new to network operators, the unpredictable nature of this growth is, with global mobile traffic speeds growing more than triple and 5G speeds thirteen times higher by 2023. Mobile access is where most consumer traffic demand originates, with no signs of abating.

Network traffic is primarily generated by applications running on tablets and smartphones and has changed how bandwidth is created, how it is being used, when it is generated, and where it is originating, making it unpredictable and extremely difficult to manage. Content has also shifted from local storage, such as hard disks in laptops, to data center storage. This makes the metro network that connects users to their content, and increasingly to applications themselves, the critical factor in determining overall quality of experience.

Growing importance of metro networks

Content is increasingly moving into data centers typically situated tens to hundreds of kilometers away from end-users, as the caching of frequently accessed content close to end-users is the preferred method of ensuring a higher quality of experience, especially concerning video streaming applications. By 2023, it is predicted the number of connected 4K TVs will double (890.6 million), driving more than twice the

HD and nine times more than SD video bit rate to cross the network.¹ This results in insatiable and unpredictable bandwidth demands in metro networks, making this particular part of the global network infrastructure the network transformation opportunity. As such, network operators are challenging the traditional manner of addressing bandwidth growth, which was adding more, larger, and increasingly complex high-touch IP routers throughout the metro network, often in locations where their extensive packet-handling capabilities were underutilized, resulting in significant cost inefficiencies. The goal today is to address surging bandwidth demands more cost-effectively to combat ongoing price erosion.

Ubiquitous Ethernet

Ethernet services surpassed legacy services back in 2012 and increased to \$51.5 Billion in 2019², and projected to \$51.8 Billion by 2025. The opportunity presented is therefore quite clear: Surging metro network bandwidth demands should be addressed using the very latest in Ethernet networking technologies, without the added cost and complexity of supporting legacy services or IP routing whenever and wherever possible, especially when simply aggregating lower rates into higher rates carried to and from data centers hosting content and applications. By keeping Ethernet services in their native format wherever possible, the metro network becomes intuitively simpler to design, deploy, and operate, as many network operators have recently come to experience firsthand. Ethernet is everywhere because it is simple and cost-effective, and it is simple and cost-effective because it is everywhere, which is why metro network operators have rapidly adopted this simple, yet elegant, protocol.

1. Visual Networking Index, March 9 2020, Cisco

2. Vertical Systems Group - ENS, Global Business Trends Worldwide Carrier Ethernet Services 20+ Year Regional View

Changing Ethernet connection rates

Although the shift from legacy services to Ethernet services is quite clear, even within the Ethernet protocol itself, things are rapidly changing. The most significant change is the rapid migration from 1GbE to 10GbE aggregation and switching in favor of 10GbE to 100GbE aggregation and switching. This order of magnitude increase in connectivity rates is driven by more end-users using more powerful devices running applications that consume far larger amounts of bandwidth. Investments in 10GbE Ethernet ports dwarfs all other port speeds, with the biggest declines seen in 1GbE ports revenues over the past few years with no signs of abating³. The continued growth and dominance of 10GbE ports, connections, and services is yielding substantial growth in 100GbE ports, connections, and services either to aggregate multiple lower rate 10GbE connections onto a single 100G wavelength, or 100GbE UNI services delivered right to the customer premise, such as a campus network or high rise building where multiple end-users are serviced at once. If metro Ethernet networks are to be fully optimized, they should be optimized for 10GbE and 100GbE.

Growing importance of power and space efficiencies

Traditionally, to address surging bandwidth growth, additional equipment is acquired and incorporated into the metro network infrastructure, which leads to increased power and space requirements. Over a 15-year lifespan of a data center, electricity alone accounts for 30 to 40 percent of a facility's operational and capital expenditures⁴. This sobering fact is why operators are understandably very concerned with increasing electricity rates since it directly and negatively impacts the corporate bottom line on a monthly basis—so much so that major content providers have opened massive data centers in Finland and Sweden to take advantage of relatively lower energy rates and cool outdoor air that can be used to cool

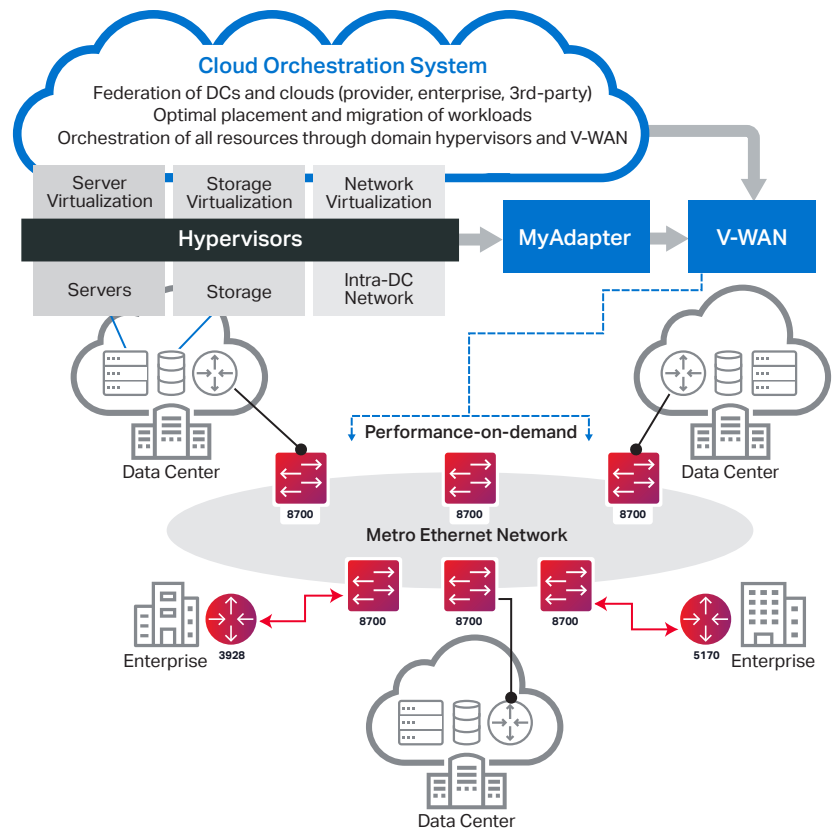


Figure 1. V-WAN application relationship to cloud orchestration systems, MyAdapter data center automation application, and the programmable 8700 Packetwave Platform

internal data center equipment. Iceland is becoming a data center hub, even though it sits alone in the Atlantic Ocean and thus requires long distance submarine networks capacity to be accessed, due to the abundance of inexpensive and renewable energy sources, and a very cool climate. Clearly, reducing energy consumption has become a key challenge to address for data center and network operators.

Available space has become increasingly limited with some data center and central office operators having to remove existing equipment to free up space before new equipment can even be installed. As enterprises continue to migrate their local IT infrastructure into the cloud, supply and demand market dynamics take over, resulting in significantly increased collocation costs since the available supply of precious space, and often power, is outpaced by market demand.

Routing and Switching eGuide
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Consumption-based demand profile

Although business traffic accounts for only approximately 26 percent of total devices and connections by 2023⁵, it

3. Service Provider Routers and Switches Market Tracker, June 17, 2020, Omdia

4. Will Energy Prices Power US Datacenter Growth or Short-Circuit Energy Efficiency, 2013, 451 Research

5. Visual Networking Index, March 9 2020, Cisco

still represents a disproportionate amount of revenues for network operators, and is therefore extremely important to overall revenues. A growing portion of this business traffic is related to the continued migration of enterprise IT infrastructure into the cloud due to the emergence of reliable and cost-effective Software-as-a-Service, Platform-as-a-Service, and Infrastructure-as-a-Service.

The virtualization of compute and storage is now mature; however, the virtualization of the network connecting end-users to leased compute and storage is still in its infancy. Enterprises have become accustomed to a consumption-based business model for cloud-based business services and are now looking for similar models being ported to network services, instead of the static and rigid connectivity of today. It is not a matter of if but when consumption-based demand for Network-as-a-Service will take off and it is happening now.

Complexity kills

IP routers are widely acknowledged to be complex and expensive to own and operate, often requiring highly trained professionals, and thus should only be used in parts of the network where the specific role they were designed for is absolutely required. Far simpler and cost-effective Ethernet aggregation and switching equipment should be used whenever and wherever possible to significantly reduce the overall cost and complexity of operating metro networks. From a network service provider perspective, an appreciable amount of hard-fought connectivity service wins are actually cancelled and lost because they simply take too long to turn up and customers move to a competitor. This agility gap is mainly due to overly complex networks that are difficult to operate, often due to manual, time-consuming, and error-prone operational models. A primary reason for the growing ubiquity of Ethernet is its simplicity, which not only narrows this agility gap, but also reduces capital and operational expenses.

Best of the data center

Substantial investments targeted at significantly reducing both power and space requirements related to intra-data-center networking equipment has resulted in merchant silicon that enables incredibly dense switching and aggregation designs that consume minimal amounts of power and space. Programmability and the drive toward Software-Defined Networking (SDN) techniques have also been applied to address challenges beyond the data center itself. As Ethernet continues to replace legacy services in the metro, it only makes sense to consider what has transpired in the data center, and apply it to carrier-grade Ethernet platforms to leverage economies of scale

Learn more about our
Routing and Switching solution



while enabling seamless native Ethernet connectivity to and from data centers.

Best of the Metro Network

Coherent-based DWDM optical networks comprise the dominant technology present in the global network infrastructure including metro, regional, long-haul terrestrial, and even submarine, allowing it to enjoy the same advantages of ubiquity at Layer

8700 Packetwave Platform

- By combining the best of the data center with the best of the metro, network operators now have a real opportunity to significantly simplify metro networks to yield substantial and tangible business benefits.

The Best of the Data Center

- Doubled 10GbE and 100GbE density that unleashes substantial savings of 50 percent or more in both power and space
- Programmability via open interfaces making the network itself an application-enabler
- Widely acknowledged simplicity of Ethernet networking for reduced overall operational complexity

The Best of the Metro Network

- 100G WaveLogic Coherent Optical Processors for massive and reliable metro network scalability
- WaveLogic Photonics offering optical network flexibility, simplicity, resilience, and advanced OAM
- Intelligent fiber analytics applications for simplified management and control of the photonic layer

Compelling Economics

- Operational simplicity and economies of scale offered by Ethernet-centric network technologies
- Built-in network intelligence for rapid, autonomous turn-up and provisioning of new services
- Integration of coherent DWDM, routing and switching for reduced network equipment count

0 as Ethernet enjoys at Layer 2. Spectral efficiencies and operational simplicity advantages associated with coherent technology are the reasons 100G coherent systems form the foundation of backbone networks today. Other notable metro network innovations enable agile optical networks that incorporate gridless, colorless, directionless, and contentionless capabilities coupled with embedded intelligence that allows network operators to proactively and reactively maintain the health of the metro network, which is now table stakes for end-users, be they man or machine. The metro has become the key component in determining end-user experience, and must always be available.

Combining the best of the data center with the best of the metro network

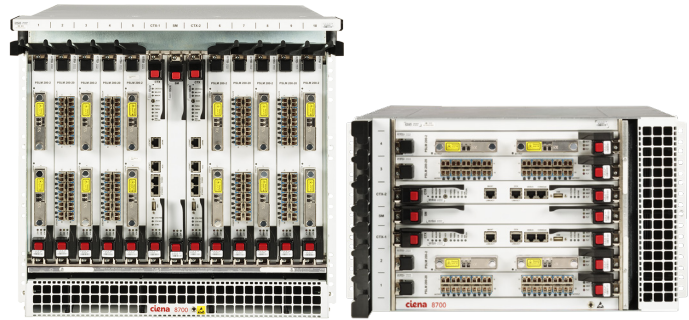
Metro networks connect users to and from data centers, so it makes sense to adopt and integrate the best of metro networking technologies with the best of the data center technologies. This combination creates a new class of product purpose-built for simply and cost-effectively accessing content in data centers via the most popular rates of 10GbE and 100GbE. What results is the industry's first programmable Ethernet-over-coherent-DWDM switch that offers the highly coveted benefits of scalability, simplicity, density, and programmability, all within an environmentally friendly platform that yields unprecedented reductions in both power and space. Integration of these data center and metro network technologies makes sense, and due to the continued integration of optoelectronics, it has now become a reality, and just in time.

Performance-on-demand

By designing an Ethernet-over-coherent-DWDM platform that is fully programmable from its inception, the network becomes an application-enabler where service innovations are only limited by the imagination of software developers. By allowing end-users, man or machine, to access on-demand network connectivity when and where it is required, advantages over today's fixed and rigid network connectivity are achieved, such as the increasingly important goal of narrowing the agility gap experienced by many network operators. Standard open interfaces to programmable network equipment are the application enabler and completely change the business dynamics of networks.

Open SDN

The SDN architecture creates the dynamically responsive network platform for the self-service, application-driven era, with network applications providing network operators with powerful business-impacting and -differentiating capabilities. Although applications are understandably at the forefront of the SDN discussion today, due to the tangible business benefits they provide, it should be highlighted that without a programmable underlying network infrastructure layer, SDN simply cannot deliver on its promise.



The new metro network: simple, scalable, and programmable

For the foreseeable future, the metro part of the global network infrastructure is where network operators have the most to gain from network transformation initiatives. Ciena, the network specialist, understands the need to address today's—and tomorrow's—challenges and trends. The innovative 8700 Packetwave Platform allows network operators to benefit from these transformation opportunities by combining the best of the data center with the best of the metro network into a new class of product, a programmable, multi-terabit Ethernet over coherent DWDM, packet-fabric that was purpose-built to revolutionize metro Ethernet networks by leveraging simplicity, scalability, and programmability. It just makes sense.

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