Why Wavelengths:

Optical networks are the gold standard for reliable data transport.

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Business goals and business challenges as interchangeable terms

A new technological revolution is underway, radically changing the context in which enterprises and government organizations operate. Now, Artificial intelligence (AI) has the same mandate as the cloud when it was introduced: it is required to boost customer satisfaction, accelerate time to market, and cut down costs. Besides, both AI and the cloud cry out for an infrastructure that is "always on". Finally, when these two technologies are intertwined, infrastructure typically needs to grow exponentially. Executives deploying AI rely on the cloud, with almost 75% using public, hybrid, or edge and the rest using an on-premises (private) cloud (see Chart 1).

CHART 1: AI deployment models

27%	27%	25%	22%
Public Cloud	On-premises	Hybrid Cloud	Edge

Source: US IT decision-makers survey; Frost & Sullivan

Considering such deployment models, the real-time reliance on AI applications cannot be overstated. The same can be said for many applications that make up the core of today's digitally transformed organizations, as they all reside in the cloud.

Digital transformation has been going on for several years for organizations of all types, including healthcare providers, retailers, financial institutions, and local and federal government. Every step in that journey, that includes cloud migration and now AI adoption, implies an increased dependence on always-on technology and the need for a connectivity solution that provides high bandwidth and low latency. If allowed, every technology decision-maker will add redundancies and diversity to ensure no single point of failure, add protection options that increase network availability, and decrease the cost per bit. It is an ambitious list, and the goal is a solid competitive edge. Let's see why adopting wavelengths services is the shortest path to reach that goal.

> Every step in the **digital transformation** journey, including cloud and AI, **implies an increased dependence on always-on technology**. And it requires a connectivity solution with specific features (high bandwidth and low latency).

Many challenging goals, not that many connectivity solutions.

In pursuit of their core business outcomes (see chart 2), US IT decision-makers prioritize digitalizing operations, migrating to the cloud, and adopting AI. These trends continuously drive demand for high-bandwidth, low-latency data center connectivity options that also reduce cost per bit.

CHART 2: Top 5 Business Outcomes Expected
From Strategic Technology Investments

1. **40%** | Better customer experience

2. **36%** | Greater employee productivity

3. **34%** | Improved business process efficiency and quality

4. **33%** | Faster product and service delivery

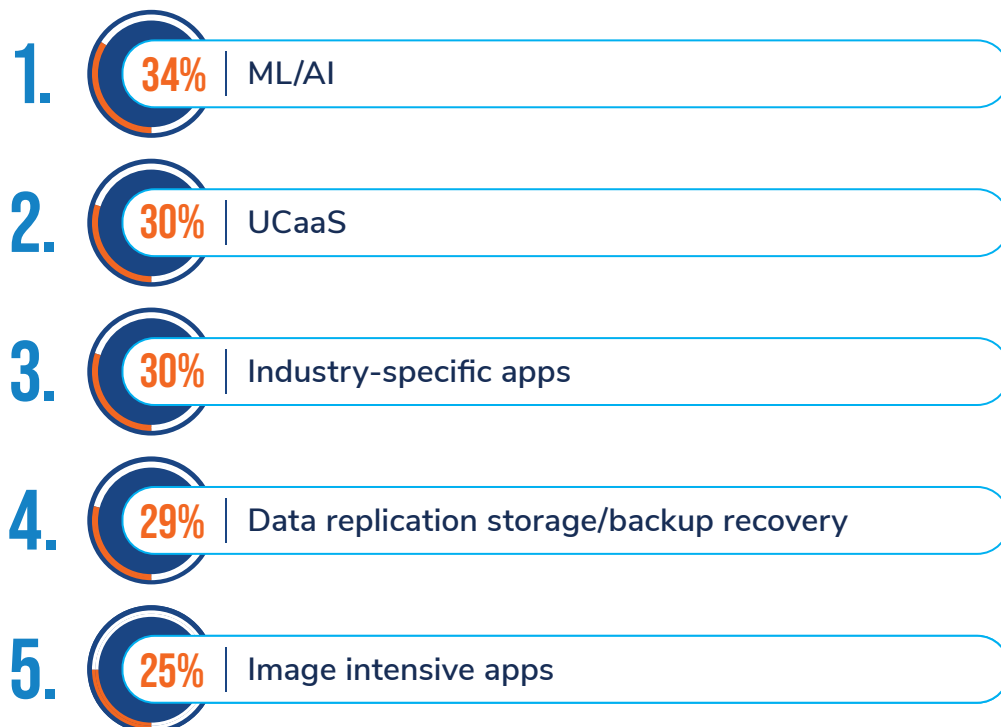5. **33%** | Faster response to market changes

Businesses host more than half of their applications in cloud environments on average—to be precise, on multiple clouds, in a hybrid model combining private and public clouds. Moreover, almost three-quarters have declared a "cloud-first mindset" and expect developers to work solely in the cloud.

The process of digitalization challenges connectivity solutions to achieve competitiveness and efficiency. With AI as the new differentiator, the challenge has shifted to effectively integrating devices, applications, and infrastructure (especially this last one). AI use cases require lower latency to support real-time decision-making with greater computing resources and storage requirements. Additionally, the need to optimize bandwidth costs and ease network strain is always present.

Furthermore, organizations face a rapid increase in computing demand from other general or industry-specific applications such as machine learning (ML), unified communications as a service (UCaaS), high-definition video/streaming, algorithmic trading, wireless data transport, and others (see chart 3). Their benefits increase as latency decreases, so there is a clear need to minimize latency for real-time applications.

CHART 3: Top 5 applications causing the greatest growth in your network bandwidth in the next two years

1. **34%** ML/AI

2. **30%** UCaaS

3. **30%** Industry-specific apps

4. **29%** Data replication storage/backup recovery

5. **25%** Image intensive apps

> When asked about their organization's view, US IT decision-makers state, "Digitalization is our top priority: We need to digitalize all operations and processes to stay competitive."

Ultimately, organizations invest in technology to move data efficiently with the goal of pleasing customers (which translates to more revenue or other metrics related to success) and reducing costs (e.g., through productivity, efficiency, and speed).

More bandwidth is not enough. Here are five ways to solve the dilemma.

Digitalization, cloud migration and AI adoption commonly lead to technical challenges that boil down to a challenging dilemma: obtaining high bandwidth and low latency at a low cost per bit.

As for the high bandwidth challenge, it is widely known that wavelengths services (which according to Frost & Sullivan include all native wave services such as 1Gbps -G for short-, 10G, 100G, 400G; most service providers in the US market offer transparent wavelength services, where the service is protocol-independent, allowing customers to run any protocol over the wavelengths) perform at the top. They are available with higher bandwidths than those supported by most operators in their VPN or packet-switched VNS services (including the most recent 400G). The above-mentioned dilemma can be solved thanks to wavelengths' broad range of features (some of them are not that well known):

1. **Low latency and deterministic routing:** By avoiding packet switching, wavelengths minimize buffering and reduce latency. Its deterministic and fixed routing allows route selection based on minimum latency.

2. **Redundancy and diversity with no single points of failure:** wavelengths fixed routing enables redundant connections between data center interconnect (DCI) (now carrying transactional data, not just data replication, making it mission critical) with no single points of failure. Point of presence (POP) diversity or dual network elements can also eliminate such risk. To eliminate the carrier's dense wavelength division multiplexing (DWDM) chassis as a single point of failure, the service can be deployed among a pair of route-diverse circuits.

> **Wavelengths can be configured to ensure no single point of failure.** First, using fixed routing, a pair of route-diverse wavelength circuits can survive a single fiber outage. Then, with POP diversity, the power grid and network element chassis are redundant. Finally, using dual network elements at the ends of the mated pair of circuits eliminates the carrier's DWDM chassis as a single point of failure.

3. **Protection options to increase network availability:** Unlike traditional packet-switched services, wavelengths offer protection options that increase network availability of each circuit in the mated pair. This allows users to not be single threaded for as long when outages occur on one circuit because the protection survives nearly all the outages. This is particularly useful for mission-critical applications as it ensures optimal performance even in the event of hardware or fiber failure.

4. **Layer one encryption for greater security:** wavelengths can be supplied with layer 1 encryption, providing an additional layer of security without penalizing the bandwidth throughput like layer 2 MACSec or Layer 3 IPSec protocols. Customers have control over the authentication keys and no additional latency is introduced.

5. **Cost-effective point-to-point connectivity:** wavelengths offer lower cost per bit for point-to-point connectivity than a dedicated E-Line, and removing any packet steering it minimizes its cost for point-to-point data communications. This is beneficial for data communications without additional segregation or fill, making it especially suitable for point-to-point connections between a central corporate location and a data center or for DCI between data centers.

Wavelengths' features also include dynamic bandwidth options, simple use and upgrading, flexibility that allows several protocols, end-customer performance visibility through control management tools, and (the always sought-after) access to the large footprint and route diversity of recognized network service providers (NSPs).

Because demand for high bandwidth is expected to continue to increase as more organizations adopt cloud and AI, NSPs are rapidly upgrading their network infrastructure (on-net) and adding new routes to provide up to 400G and even 800G links. With fiber-lit buildings, customers can quickly get new services, something that used to take months. Finally, to differentiate their wavelengths solutions, prominent providers deliver value-added services, including view, quote, and order, via the customer portal or bandwidth on demand.

> **Wavelengths have the highest bandwidth and the lowest latency with no single points of failure** and its protection options increase network availability. Wavelengths also have the lowest cost per bit for point-to-point transport. Layer 1 encryption increases security without bandwidth penalty.

Satisfying clients and outpacing the competition is the end game, not following technology trends.

Every leader (whether in a technology group, line of business, or government organization) knows that simply keeping up with technology is not their goal. Their mandate is to satisfy clients and outpace competition, always using as few resources as possible. Thus, chasing technology trends should not be part of that responsibility.

As a connectivity solution that offers high performance, low latency, and low cost, among other benefits, wavelengths are a clear choice as a technology enabler. However, as there is not just one version of wavelengths, the choice could not be obvious, even for those that have already adopted wavelengths.

The usual suspects behind exponential bandwidth and data traffic growth are cloud computing, 5G adoption, and latency-sensitive applications (including online trading or AI-related technologies, like generative AI, computer vision, image or speech recognition, and sentiment analytics) (see Chart 4). Other culprits include emerging trends—like edge computing, augmented reality (AR), and virtual reality (VR)—and existing technologies—like video streaming, UCaaS, and Internet of Things. When also considering the next huge technologies, such as video GenAI, it is clear that high performance and low latency are crucial.

CHART 4: Top 5 applications in terms of adoption

46% Computer vision, image recognition

44% Sentiment analytics

42% Face recognition

42% Speech recognition

38% Natural language processing
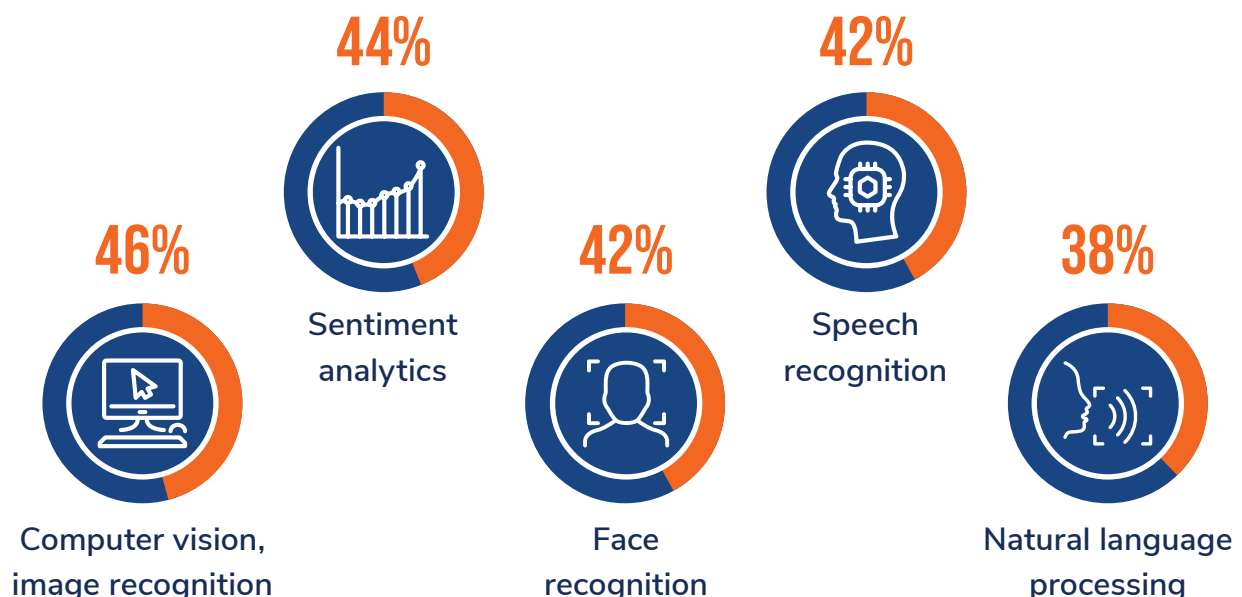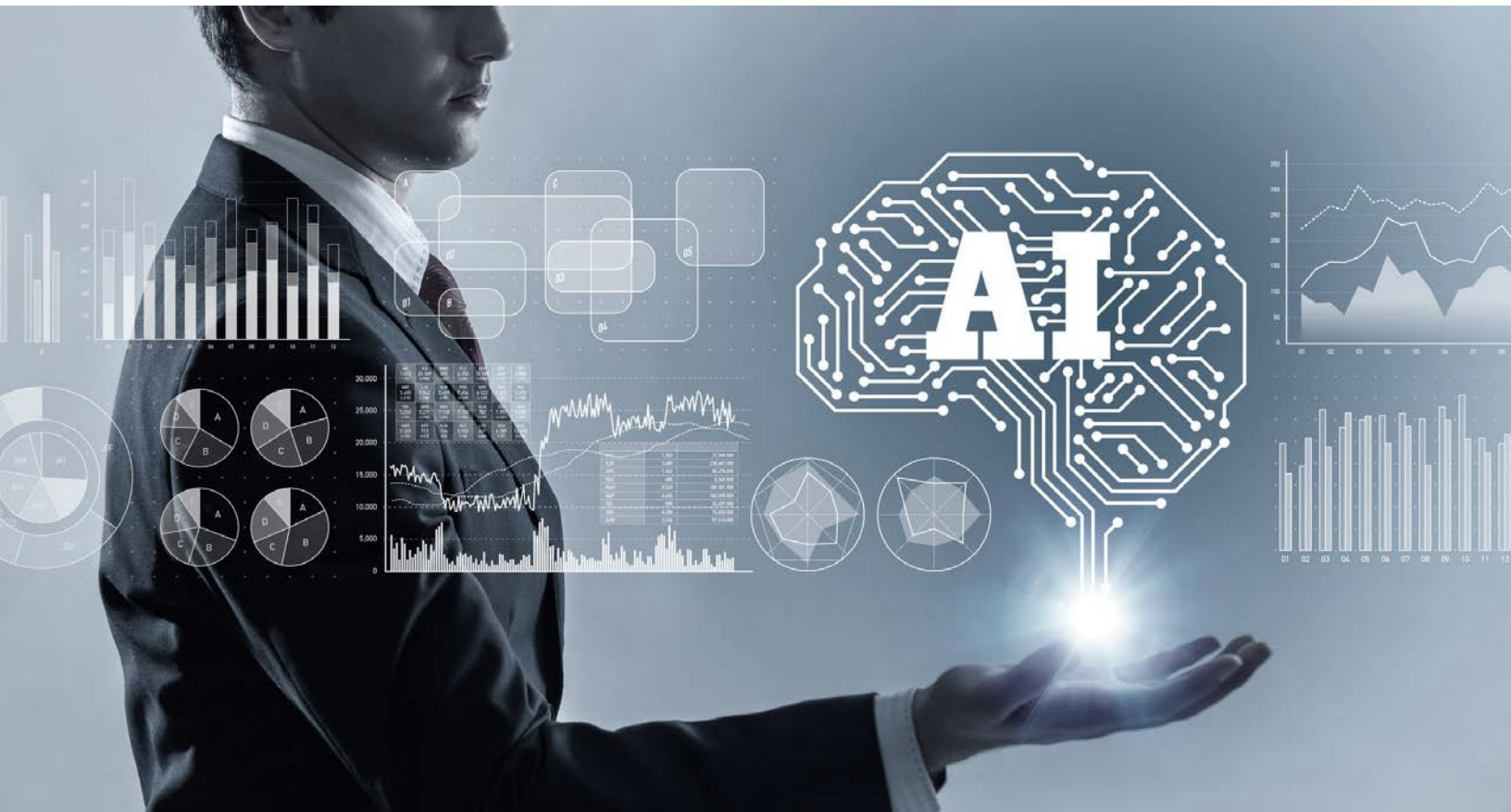
As these technologies grow in use, there is a struggle to drive down costs (or at least keep them at bay). Current pricing for one 400G link is three to four times that of a 100G link, which can vary depending on the client, but price is not the only variable: much higher bandwidth is vital. In addition, the customer's 400G router port costs can be lower than the cited prices. Nonetheless, as NSPs continue to build out infrastructure and competition intensifies, prices are expected to decrease.

> **Nine out of 10 US IT decision-makers** state their organizations have already **deployed AI or plan to deploy** it in the next 2 years.

Selecting the right partner for wave services is also essential for infrastructure build-out. To achieve the full benefits of wavelengths and meet the demands of mission-critical applications, the underlying network needs to be reliable and meet the speed, latency, and bandwidth requirements of the newer applications coming online.

What is your competition doing? High bandwidth, at full speed.

All types of organizations crave near real-time access to cloud, AI, and confidential data, and of course the highest bandwidth available is the edge everybody wants. Early adopters of wavelengths include content providers, system integrators, cloud service providers, resellers and other organizations competing to maximize data transit efficacy. Wavelengths services, as the highest bandwidth and lower latency offering available as a managed service, are helping them leverage cloud and AI to obtain a strategic advantage and achieve success in its various forms.

> **Wavelengths services,** as the highest bandwidth and lower latency offering available as a managed service, **are helping them leverage cloud and AI** to obtain a strategic advantage and achieve success in its various forms.
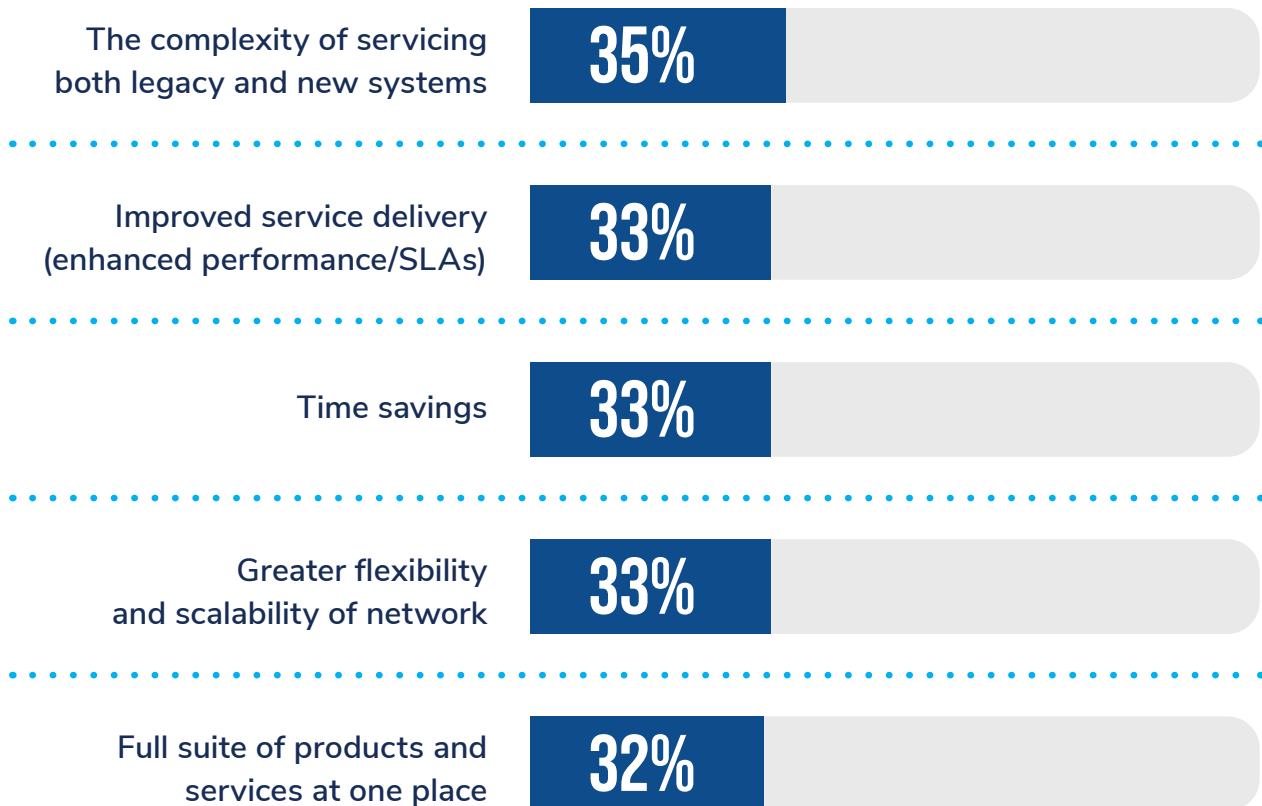
However, capitalizing on advanced services and technologies (like network as a service, WAN connectivity, and managed multi-cloud connectivity) is too challenging to accomplish alone.

More than 60% of US IT decision-makers say they engage with a third-party provider for managed network services. But not all providers are created equal, and it is key to partner with one proficient in a wide range of solutions (see Chart 5).

CHART 5: Top 5 factors that influence the choice
of a managed network services provider

Factor	Percentage
The complexity of servicing both legacy and new systems	35%
Improved service delivery (enhanced performance/SLAs)	33%
Time savings	33%
Greater flexibility and scalability of network	33%
Full suite of products and services at one place	32%

Capitalizing wavelengths: data centers, content, or the other way around.

Leading enterprises or government entities leverage technology to satisfy customers at competitive costs. Sufficient bandwidth, low latency, efficient network architecture and control over performance and security are means to that end. Efficient data center interconnection (DCI) is also often on that list.

Wavelengths stand out in connection with DCI and data center access from hubs that aggregate branch or customer traffic. Virtually all medium or large enterprises, NSPs, and government entities deploy this connectivity technology in such scenarios. Wavelengths advantages include cost optimization for point-to-point links that are already highly utilized, and at a lower cost than layer 2/ layer 3 VPN products because expensive switching equipment is not needed for permanent connections between two points. They also offer the lowest latency, highest reliability, and least cost per bit.

> **For organizations that rely heavily on data centers, efficient interconnection is critical.** Offering AI features to end users or enabling them to employees implies a new challenge. And the underlying connectivity infrastructure must be up to the task.

However, AI is already putting pressure on bandwidth, latency, and data centers. Following its success in summarization, writing, and image creation, GenAI is expected to extend its reach to various industries as nearly every software vendor strives to incorporate it into numerous applications. For the same organizations cited above, offering AI features to end users or enabling them to employees implies a new challenge. And the underlying connectivity infrastructure must be up to the task.

Capitalizing wavelengths: moving high-definition video.

Wavelengths find frequent application in the realm of high-definition video and are a cost-effective alternative to high-priced satellite solutions. This technology can transport high-definition TV (HDTV) content from various venues, including the National Basketball Association (NBA) or National Football League (NFL) games, Formula 1 races, concerts, and various live events. The destination points for this content include production facilities and network operations centers (NOCs).

The substantial bandwidth demands of HDTV make wavelengths particularly well-suited for this purpose. Links starting at 100G and, more significantly, those operating at 400G, can convey numerous high-definition video feeds to a production facility. Transmission can occur before the director selects a live feed, potentially reducing the necessity for production trucks and on-site traveling crews at the event venues. Additionally, this solution effectively enhances the network's HDTV video quality, upgrading it from 720p to 1080p. Its advantage over satellite transmission is expected to be further amplified as the industry progresses towards 4k HDTV.

> **Moving high-definition video** is vital in a wide range of scenarios, such as transmitting NBA games, Formula 1 races, or rolling out new global training for a multi-national company.

Looking at other details, such as in the context of a dedicated (private) DWDM network characterized by a national scale set of nodes, wavelengths can offer complete equipment diversity, layer 1 encryption, and pre-positioned capacity that is specified but not financed by the customer. This arrangement gives the customer the flexibility to incorporate additional circuits swiftly, in a matter of days rather than weeks, without the need to make upfront payments for pre-positioning. The private network is designed to facilitate layer 2 packet aggregation within the private nodes, which enables bundling diverse customer requirements into the wavelengths' links, particularly at locations like live events venues. It empowers customers to utilize the links for various applications, including instant replay and other functions alongside live broadcasts. Furthermore, it opens opportunities for the resale of virtual bandwidth and content across virtual circuits to the customers connected to the venue's private network.

Aside from HDTV, all types of organizations are increasingly using video for various purposes, including remote work, internal and external communications, marketing and sales, and training. A measure of such growth could be the online video platforms (OVPs) market (which includes partners that sell to these organizations). The global OVP industry is proliferating, with forecasts indicating revenues growing more than 10% CAGR from 2023 to 2029. The trend toward video-centric strategies will increase and enterprise video platforms will dominate the industry over the next seven years.

The winning strategy is to use the proper connectivity solution to bind together diverse technologies and applications.

Dealing with an increasingly changing landscape has become the norm, and top decision-makers continue to be evaluated based on their use of technology to solve new challenges. Cloud migration and AI adoption are aimed at related goals— improving revenue and customer satisfaction, speeding product launch or market entry, and reducing costs—all of which require low latency, a high bandwidth connectivity infrastructure, and real-time capabilities.

> The shift to the **cloud, and the increasing reliance on AI and other applications** that are central to digitally transformed organizations, **require the right connectivity infrastructure**.

The move to the cloud is a years-long process and each step involves increasingly relying on technology. AI adoption is a new layer of technology, with radical implications, and it needs a solid connectivity infrastructure. Wavelengths services can solve these challenges as they deliver a lot more than high bandwidth—they provide low latency, redundancy, diversity with no single points of failure, protection options that improve network availability, and low cost per bit. No wonder why adoption is so swift.

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