# Passive Optical LAN Opens Up Opportunities for B2B Service Providers

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## Executive Summary

Passive Optical LANs connect each desk (and other end points) in a business to a centralized optical switch with point to multipoint fiber. This creates numerous benefits compared to traditional copper based LANs:

- Absence of active equipment between end-points and Optical Line Termination (the 'switch') mean energy consumption is significantly lower;
- also, there is no need to cool down active equipment apart from the OLT itself, which saves on both energy and space;
- the lower need for cabling (because the solution is point to multipoint) saves on occupancy of in-building ducts and risers. It also reduces the weight of cabling with potential benefits in high rise buildings;
- most importantly perhaps, unlike existing copper cabling solutions, once fiber is deployed, it will not need to be revisited for a long time since upgrading the end point equipments and the OLT will be enough to benefit from better speeds, etc.

Passive Optical LAN is a long term gigabit-age solution to business user connectivity in the office. Its need is driven by the increasing reliance on cloud hosted applications, increasing pressure on in-building connectivity to deliver the best speeds and the lowest latencies. However, limiting it to that would position it only as a (better) alternative to existing LAN solutions, when the potential of Passive Optical LAN is much broader.

Telecom Operators rarely have strong positions in the existing LAN market: LANs are commoditized services that require high maintenance, and where competition from smaller local players is fierce. Passive Optical LAN however can be centrally managed, is not commoditized (and unlikely to become commoditized) and plays right into the skillsets that operators have and LAN integrators struggle with.

Even more crucially, Passive Optical LAN complements the existing cloud service portfolios really well, but extending the management capability of the operators all the way to the desk. This would, for example, allow

operators to develop end to end service level agreements that other players in the industry would be incapable of delivering. In other words, it could be a strong differentiating factor for B2B offerings from telecom operators, in addition to an immediate revenue generator.

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# I. The Emergence of Passive Optical LAN

Passive Optical LAN technology has been around for over 10 years, but it stayed mostly confidential until recent years. The main reason is that despite other advantages of Passive Optical LAN implementations detailed below, the capacity offered by connecting each one of a business' end-user's desk with a fiber was considered "over the top". But as gigabit connection to people's homes become more and more widespread, the idea of delivering the same capacity (or more) to the desk doesn't seem so ahead of its time anymore.

Because of this apparent discrepancy between the needs of the end-users and the bandwidth offered, Passive Optical LAN was mostly deployed to serve the needs of landlords in multi-tenant office buildings and for specialized businesses, especially in the hospitality sector. As a consequence, these products were to a large extent disregarded by Telecom service providers and what market existed was mostly deployed and maintained by LAN integrators.

And yet telecom operators have a lot to gain in offering Passive Optical LAN solutions to their large business customers: they have the know how and legitimacy, especially around fiber based products. It would be an opportunity to regain market presence in a segment where LAN integrators are very present. Most importantly, in an age of cloud applications, it would allow for real end to end service assurance and therefore solidify the enterprise product portfolio.

This white paper will detail the opportunities of Passive Optical LAN for telecom operators and make recommendations on how to best approach the market.

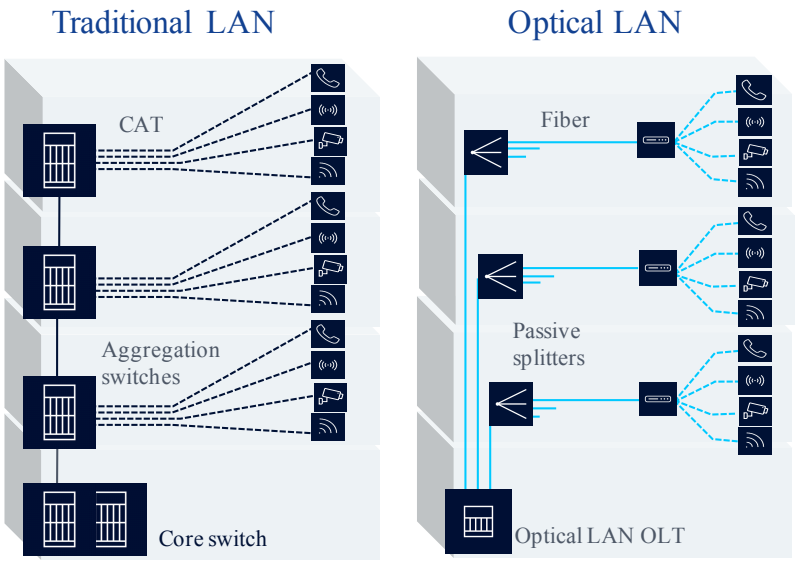
# II. What is Passive Optical LAN

While it isn't the purpose of this paper to describe in detail Passive Optical LAN, it's important to understand its key features and benefits in order to position it ideally for telecom operators. This section will only examine what is strictly necessary for the strategic and marketing positioning of Passive Optical LAN and will refer to more detailed documents for the technology and benefits analysis.

Passive Optical LAN is the use of existing and standardized Gigabit Passive Optical Network (GPON) solutions normally used in telecom networks to connect homes or desks (and other end points) inside the enterprise. Here are the key differences with legacy LAN technologies:

- Legacy LAN solutions use copper wiring (called CAT cable) to connect end points. Practically, this means that in each subsection of the organization (usually each floor, but this depends on the scale) legacy copper-based LANs need an active switch to handle the connectivity to and from the desks (and other end points). Because the switches are active, they generate heat and need to be cooled, which translates into a space requirement on each floor (or other subdivision) and energy consumption both for the switches and the cooling. From the switches, the cabling is point to point, which means that each end point has its own cable back to the switch. The latest generations of CAT cabling allow for Gigabit per second speeds.
- Passive Optical LAN has a central switch (called OLT, for Optical Line Termination), one per business location, which then spreads the signal over a passive network that is point to multipoint. Only a few fiber strands are directly connected to the OLT, one for each floor for example, and then each of those is split using a passive splitter that spreads the fiber around on a 1:32 basis. Because the splitters are passive, they do not require energy or cooling. Since Passive Optical LANs use fiber, they are not limited in terms of available bandwidth. With current generations of PON technologies, they can deliver Gigabit connectivity (actually up to 2.5Gbps) but upcoming generations of PON will deliver 10Gbps or even multiples thereof to the desk without necessitating an upgrade in cabling.

**Exhibit 1: Schematic View of Traditional LAN vs. Optical LAN**



## Advantages of Passive Optical LAN

The first advantage of Passive Optical LAN therefore is bandwidth going forward. Not only does Passive Optical LAN today deliver sufficient bandwidth to the desk for current applications (even cloud based applications), it will not need to be redeployed to match future needs (unlike copper LAN cabling which is speed capped.) It should be stressed, incidentally, that the move towards cloud hosted applications is really the game changer here: latency is very dependent on bandwidth not only in the connection between the business location and the datacenter, but inside the business location as well. If the LAN becomes the bottleneck, all users suffer.

The second advantage of Passive Optical LAN over classic copper-based LAN is the savings on operating the LAN. Since Passive Optical LAN needs neither energy nor cooling on each floor (the OLT is hosted in the IT room, or even outside of the business location in some outsourced contracts), this represents significant savings in energy consumption as well as savings in floor space[1].

The third advantage of Passive Optical LAN over a copper LAN is a decidedly mundane one, but one that is of increasing importance, especially in high rise buildings. Copper cabling is heavy, and since each end-point needs its own cable to the switch it is attached to (and since switches only serve a limited number of end points), that means a lot of cabling in the risers, raised floors and suspended ceilings. That weight is starting to have structural consequences in many buildings, especially since the successive generations of CAT cabling haven't always been removed when new ones are added in. Fiber is not only much thinner and lighter than copper wiring, it would allow for all the copper wiring to be removed in one fell swoop.

Economically speaking, these last two advantages are very significant. Nokia's Bell Labs has calculated that for an enterprise building with 10 floors and 2000 end points, the CAPEX savings of Passive Optical LAN vs. Legacy Copper LAN would be 56% and the OPEX savings would be 54%[2].

Of course, just because one technology is better than another doesn't mean that shifting from one to the other is as straightforward as it may sound. There are drivers but also challenges to Passive Optical LAN adoption which will be examined in the next section.

1 Nokia's Bell Labs have designed a LAN Savings Calculator to evaluate the TCO of various LAN solutions. It can be found here: https://pages.nokia.com/9160.How-much-could-you-save.html

2 Source: Comparing the costs of traditional Ethernet-over-copper LAN and Optical LAN: https://pages.nokia.com/9160.Meet-POL.html

# III. Identifying the Passive Optical LAN Opportunity

Passive Optical LAN is both targeted at certain niche verticals and at the more generic enterprise market. The niche verticals are already being addressed, and the benefits are such that demand is rarely the biggest challenge. These vertical markets are mostly centered around hospitality (hotels, stadiums, etc.) and we will not cover them in great detail in this report since that demand already exists. The greater benefit for a player looking to enter the Passive Optical LAN space is the horizontal market: all businesses with desktop employees are potential targets for Passive Optical LAN.

The key driver for Passive Optical LAN adoption is tied to an accelerating trend in the organization of enterprise IT capability: increasingly, IT managers are looking at centralizing applications (especially vertical and business critical applications) outside of employee PCs and also outside of on-site data rooms and into the cloud. In practice this means some form of local or regional hosting (to minimize latency) although some verticals (like financial institutions) rely on more distant solutions to ensure real-time status to employees' contributions. The benefits of such remote application solutions are many for IT organizations, in terms of security, maintenance and hardware requirements.

This move towards remote applications however puts more pressure on the local area network and the data access in terms of capability (bandwidth, latency, stability, etc.) As a direct consequence, organizations that have existing copper LAN cabling that is one or more generations old are likely looking at their upgrade options. Various surveys or market estimates that CAT 7, the latest generation of CAT cabling is still only implemented in a minority of businesses, even though it was released over 5 years ago[3]. But the pressure put by remote applications on the LAN is being felt, and upgrade plans are likely to accelerate as a consequence.

This is a clear opportunity for Passive Optical LAN to be considered on its own as a replacement solution. It is also in the context of a direct comparison with the cost of a copper LAN redeployment that the financial and structural benefits of Passive Optical LAN outlined above are likely to have the largest impact.

It should be stressed however that while cost model comparisons of Passive Optical LAN installation vs. copper-based LAN renewal suggest that even small businesses would benefit, the core target market is going to be in the 100 seats of more on-site medium businesses. Companies offering Passive Optical LAN need to be addressing a central IT function to make a coherent offer. They also need to educate the market to the benefits of optical LAN solutions, and the contract size for smaller businesses might not justify that extra commercial effort at least initially. In the rest of this document we assume that the markets targeted will be in the medium business size and above.

As service providers strive to grow revenue in the Enterprise market, Passive Optical LAN seems like a clear winner, both in revenue generation and in portfolio differentiation.

## Understanding the players in the LAN ecosystem

Unlike other parts of the Enterprise business service ecosystem, the local area network is not one in which Telecom Operators are dominant. Legacy LANs are built from commoditized equipment (cabling and switches) but require a high degree of maintenance. This means that it's a hard business to generate margin from. It's also

[3] See Bishop & Associates' Structured Cabling Technology and Market Assessment

a business where the dominant players are small specialized IT companies. This makes for a very competitive marketplace.

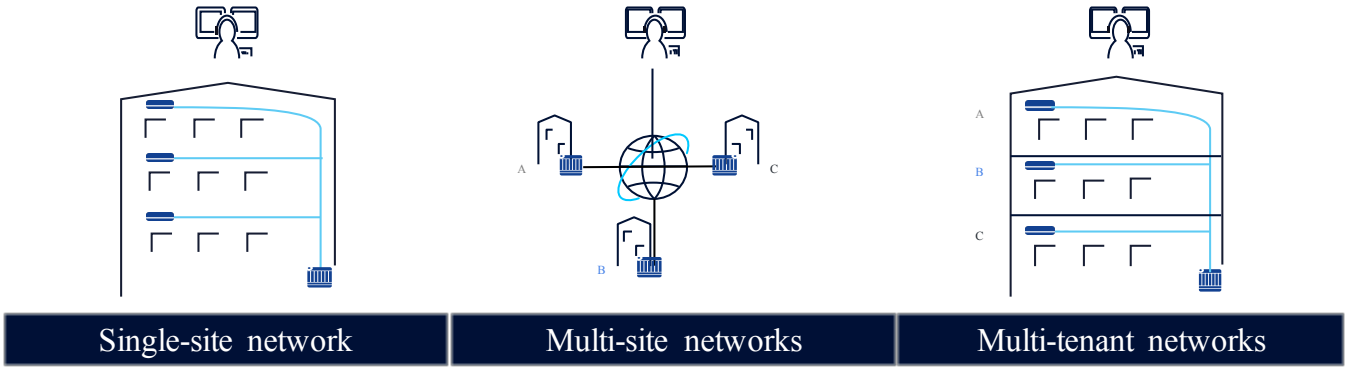
LAN installation and management are often separate considerations. Most legacy LANs were or are installed by specialized IT companies that we will hereafter call LAN Integrators. These are often small, local businesses, certified by the LAN switch vendors and relying on their expertise with that particular equipment. These LAN Integrators aim to manage the LAN as well as install it, but that is not always the case. Most businesses fall into one of three scenarios for LAN management:

- **The enterprise manages its LAN:** a non negligible part of the enterprise market tends to manage their LAN themselves. They may subcontract the installation, but manage it themselves on a daily basis;
- **A LAN integrator manages the LAN:** For LAN integrators the lucrative part of the business is to be managing the LANs, not just installing them. They are the key player in this market today.
- **Building Management:** in large office buildings where multiple businesses are installed, LAN services are sometimes managed by the Building Services themselves. This tends to be truer for smaller businesses, but is a case that occurs with large businesses as well.

Legacy LANs use a very commoditized technology to work with, which allows these players to be effective in this space. Passive Optical LAN however is a lot more specialized. Telecom Operators, who have been deploying and managing fiber infrastructures for decades have a clear advantage there. Furthermore, Passive Optical LAN, with the exception of one OLT and the desk ONTs has only passive equipment in the business premises and is therefore more easily managed, which paradoxically doesn't make it an attractive product for integrators used to the heavier requirements of copper-based LANs.

Passive Optical LAN solutions offer centralized supervision and management solutions that have been designed to manage millions of end points in consumer fiber networks. Compared to the burden of current LAN management solutions, these tools provide faster and easier management capabilities. In fact the OLT doesn't have to be on location for a Passive Optical LAN solution to work. This means that an OLT could be used to manage multiple business locations (in the same area) or simply hosted in the Telecom Operator's network for added resilience and security.

**Exhibit 2: Different Implementation Models for Passive Optical LAN**




In other words, Telecom Operators have a home corner advantage of sorts with Passive Optical LAN. Not only is it more cost-effective, energy efficient and long term proof, it's also something they know and understand better than their competitors.

## The Challenges to Passive Optical LAN adoption

While the opportunity for Passive Optical LAN is clear and present, the challenges are significant nonetheless. They are as follows:

- First of all, the easiest way of selling Passive Optical LAN is during a LAN renewal tenders. This has major implications: the sales opportunity only happens once every few years. The probability of this happening in the near future is highest, but once renewed, it will be much harder to pitch Passive Optical LAN. This may be circumvented by taking a more holistic approach, this is something we develop in more detail in the next section.
- The other challenge, even in the context of renewal tenders is the lack of notoriety of Passive Optical LAN solutions. Legacy LANs are the easy solution, everybody knows what it is and it's "the way things have always been done". This notoriety deficit means customers will need to be educated to the benefits of this new LAN technology. It is key that LAN tender conditions allow for a Passive Optical LAN type of response.
- The third challenge is that in most instances the integrator who is currently managing the LAN contract will not have the skillset (or willingness) to offer Passive Optical LAN and may also be tied to the legacy ecosystem with vendor certifications, kickbacks and other incentives to keep offering the same solutions as in the past. The integrator therefore will fight tooth and nail against Passive Optical LAN.

While these challenges may seem daunting, the picture changes somewhat when you look at Passive Optical LAN not as a standalone LAN solution but as a key component of an end-to-end solution. This is where the opportunity lays particularly for B2B Telecom Operators, who can leverage advantages that no other player in the market can easily muster.

# IV. Passive Optical LAN as a key component of end-to-end cloud services

As mentioned in the opening of this paper, the move towards cloud is a key driver for LAN renewal, and therefore for Passive Optical LAN adoption. A recent study showed that 95% of businesses have some application in the cloud already. 58% of businesses define themselves as heavily invested in Cloud Applications.[4] Furthermore, 89% of respondents rely on Public Cloud services (ie. with outsourced management) and 72% rely on Private Cloud Services (maintained by the business IT itself.) It should be noted that most businesses use both Public and Private Cloud Services (for different applications) but that the trend seems to suggest applications gradually shifting from Private to Public Clouds.

This is significant in terms of the positioning of Passive Optical LAN offerings because it means that the scope of Cloud Application contracts is expanding. Until now, many companies relied on third parties to handle data access to their sites and (usually) data center hosting, but they managed their application servers themselves. As these contracts get broader, the position of telecom operators in this market becomes stronger, and Passive Optical LAN could reinforce it even more.

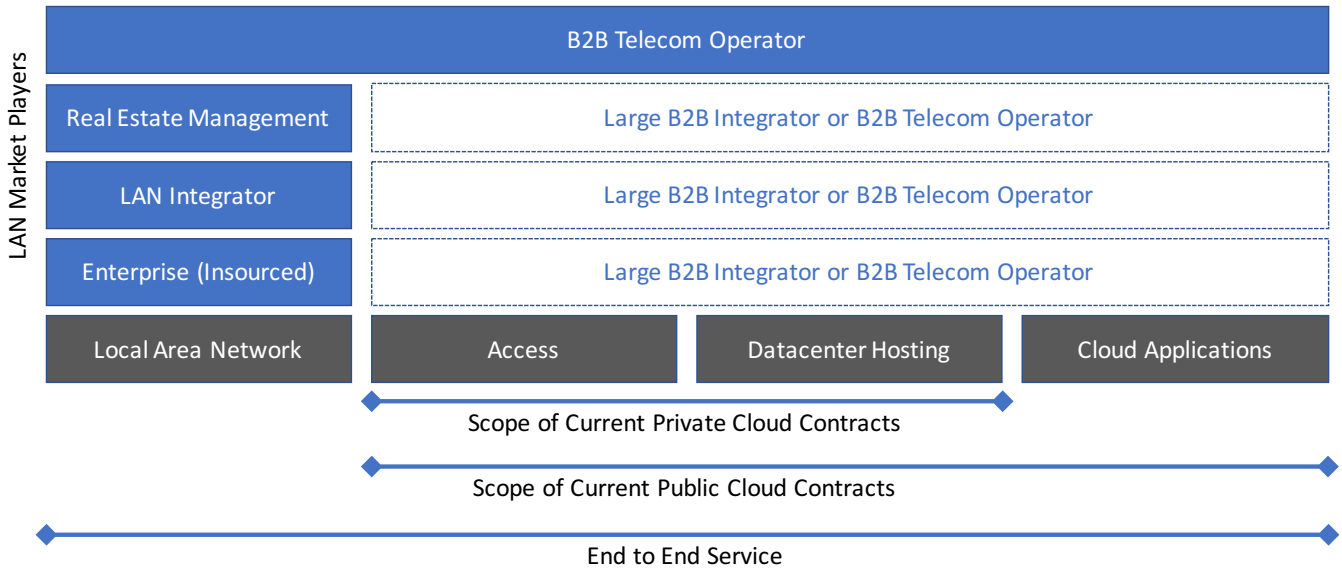
The LAN function is rarely part of these contracts currently, for a number of reasons:

- Some businesses insource the LAN management;
- Some businesses rely on specialized LAN integrators to manage the LAN function;
- Either way, businesses consider (rightly) that they cannot get Service Level Agreements (SLA) on Cloud Applications that would include the LAN function, so the tenders are issued either as an integrated contract including access, hosting and (in the case of Public Cloud Services) the management of the Application Servers or as separate contracts for access and hosting.

In short, the scope of Cloud Service Contracts is increasing, and it is only a natural extension that LAN should become part of these contracts. Existing players in the LAN market (Telecom Operators excepted) however have limited capabilities and/or appeal to move into Passive Optical LAN. This creates a discontinuity in outsourcing contracts for most market players except Telecom Operators as highlighted in Exhibit 3:

[4] RightScale 2017 State of the Cloud Report

**Exhibit 3: Components of an end to end cloud service.**




*Source: Diffraction Analysis*

In summary, Telecom Operators are the only players in the market who currently have the capabilities and assets to handle an end to end cloud service (from the user to the managed application), and Passive Optical LAN is the key to ensure Service Level Agreements extend to the user's desk. This could constitute a very important element both in positioning their cloud offers and in conquering a part of the LAN market that has traditionally been insourced or outsourced to specialized LAN integrators.

## Scoping the opportunities for telecom operators

So really, there are two opportunities for telecom operators when looking at Passive Optical LAN:

- The straightforward one is to offer Passive Optical LAN as a longer term, more cost-effective and energy-efficient substitution to copper-based LAN. This opportunity is tied to LAN renewal cycles and will be met with competition from LAN integrators whose incentives are to continue with legacy technologies;
- The more holistic one is to integrate Passive Optical LAN as part of a broader portfolio of cloud enabling solutions. This will disconnect Passive Optical LAN from LAN renewal opportunities and instead tie it to a broader enterprise shift towards Public Cloud Services. It will allow operators to compete with existing LAN integrators on their own terms but also offer Cloud Service features that B2B Integrators cannot easily offer.

While these two complimentary approaches apply to both the Medium Enterprise (ME) market segment and the Corporate market segment (interestingly, cloud services are more prevalent in the ME segment than in the Corporate segment, likely due to less complex implementation) Telecom Operators should probably at first focus their efforts on the Corporate segment: the payback for this segment being educated to the benefits of Passive Optical LAN will be higher, and customer education to the lower market segments will happen (in part) through press coverage and case studies of the Corporate customers.

## Operator Passive Optical LAN: KDDI's Example

Japanese operator KDDI launched Passive Optical LAN in 2014. At first, the offer mostly allowed for customer wins in the hospitality sector (hotels, resorts, stadiums) and in the retail business, especially large shopping malls. Gradually though KDDI started seeing interest from factories and office buildings. The main driver for demand is still LAN replacement, mostly due to office moves, LAN renewals and businesses feeling the limited capabilities of their current LAN installations.

However, their Passive Optical LAN offer is now well integrated in the portfolio and seen as an enabler of remote applications, cloud security, enterprise wi-fi and unified communications. Furthermore as Japanese businesses look to modernize with the approach of the 2020 Olympics KDDI believes that Passive Optical LAN opportunities will become more frequent. KDDI sees Passive Optical LAN as a increasingly important component of their global portfolio.

# V. Conclusion

Passive Optical LAN represents an important opportunity for Telecom Operators in the enterprise business. Not only does it have the potential to represent a short term revenue upswing in B2B activities, it represents a key part of a forward looking Cloud Service portfolio, and one that will create a strong differentiation.

The timing is ideal for optical LAN solutions to be pushed on the market by Telecom Operators as cloud service adoption increases and puts pressure on current LAN solutions to deliver better performance. In this context, Passive Optical LAN offers:

- A **future proof** solution that will not need to be reinvested in every 4 or 5 years as bandwidth demand increases;
- A solution with **lower CAPEX** than a legacy LAN replacement;
- A solution with **lower OPEX** than a legacy LAN replacement, and a **greener** one as well as energy savings form an important part of that solution;
- A **flexible, easily managed** solution that will make it easier for Telecom Operators to deliver high quality service;
- A **key component of an end to end cloud solution** with SLAs all the way to the desktop that only Telecom Operators will be able to offer.
- Therefore, a **strongly differentiating** offer to include in one's B2B portfolio.

Telecom Operators will find in Passive Optical LAN offerings a fast response to the opportunities opened by cloud service adoption, especially amongst customers in the medium enterprise segment and above with promise of new revenues but also a key enhancement of their broader cloud service portfolio.

*This independent research was funded by Nokia.*

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# Diffraction Analysis: Our Research

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Below we present some research reports and white papers published by the Diffraction Analysis team. The reports can be purchased separately on our website: [www.diffractionanalysis.com/publications](www.diffractionanalysis.com/publications)

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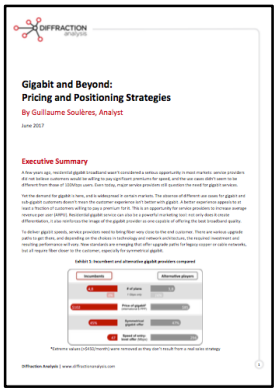
## Gigabit and beyond: Pricing and positioning strategies


DIFFRACTION analysis

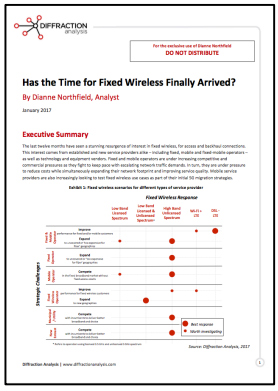
Gigabit and Beyond:
Pricing and Positioning Strategies
By Guillaume Soulères, Analyst

Executive Summary

In a lot of markets, the demand for gigabit is already there. The better user experience appeals to some customers that are ready to pay a premium for it, and can represent an opportunity for service providers to increase their ARPU.

With an analysis based on 75 gigabit offers, this reports aims to answer a few questions for service providers: what benefits should be expected? Which characteristics should the gigabit product have (upload speed, data cap…)? How to include it in the service provider's portfolio (number of plans, speed of entry-level offer…)? At what price should residential gigabit be sold? Should it be discounted or bundled?

## Has the time for fixed wireless finally arrived?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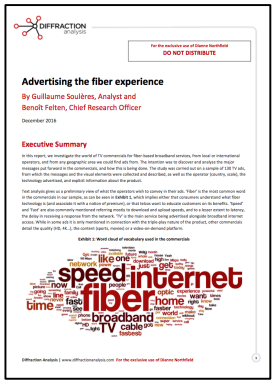
Has the Time for Fixed Wireless Finally Arrived?
By Dianne Northfield, Analyst

Executive Summary

This report explores these technology evolutions in detail, examines the regulatory framework in which they may be deployed, the comparative performances and the costs to deploy. Most importantly, it answers the following questions:

- As a fixed operator, and based on current technology choices, does Fixed Wireless represent a threat or an opportunity?
- As a mobile operator, do these Fixed Wireless technologies enable competition with fixed operators?
- How can a new entrant in the market use Fixed Wireless to accelerate deployment and acquire sizeable market shares?

## Advertising the fiber experience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Advertising the fiber experience
By Guillaume Soulères, Analyst and
Benoît Felten, Chief Research Officer

Executive Summary

Advertising telecom offers is a challenging task, and even more so for innovative solutions: finding the right message to convince potential customers is tricky, especially since market maturity greatly impacts how well they grasp the benefits of a technology.

With an analysis based on the visuals, messages, and information of 130 TV commercials created by operators from all around the world, this report provides answers to marketing concerns. The texts from the commercials were transcribed, and translated when necessary, and are also shipped with the report.

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