Superfast fiber-optic broadband: challenges and keys to successful deployment
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Digital technologies are playing an increasingly important role in all economic sectors and permeating our daily lives. Telecoms networks provide the vehicle for this digitization. To drive economic development and competitiveness, social inclusion and access to public services, nationwide roll-out of innovative high-performance networks is vital, notably superfast wireline and wireless broadband.

For many years now, Very High Speed Broadband (VHSB) has been one of our top priorities since it provides the foundation for Orange’s “Essentiels 2020” strategic development plan. Our resolute investment in next-generation networks has given us an appreciable competitive advantage by allowing us to offer incomparable connectivity. Fiber-To-The Home, or FTTH, the technology that will carry tomorrow’s Internet, requires a colossal budget of at least 20 billion euros in France alone. To optimize the return on this investment, a rigorous approach is indispensable, based on proven know-how and specialist expertise to choose the right strategies, architectures, and deployment and commercialization plans. Drawing on more than 10 years of experience in rolling out Orange’s own networks in France, Spain, Poland, Slovakia and also on other continents, and in serving as consultants for other operators, Orange and Sofrecom experts can boast unrivaled knowledge of high-speed broadband.

In this booklet they share their experience with us and explain the keys to successful fiber deployment with the aim of proactively contributing to improved connectivity worldwide and of leveraging digital to build a better life for everyone.

I am delighted to present this publication and I am confident that Orange’s experience will contribute to your own success.

Stéphane Richard
CEO, Orange
Introduction

The technological revolution of digital opens up vast possibilities for new services that can boost productivity and economic growth. Large-scale development of new applications such as e-health, e-education, cloud computing, connected home, videoconference and HD television requires very high data transmission capacities, which means we must create and develop new ultra-fast networks. Optical fiber is the obvious choice to provide the highest bandwidth performance, since it can support data rates up to one hundred times faster than copper. The transition to superfast broadband is already underway, but only the biggest telecommunications operators can bear the very heavy investments in fiber-optic infrastructure. Having closely analyzed the network deployment strategies adopted by advanced countries, we are able to present here an overview of the challenges and factors for successful VHSB deployment, which will help our customers to optimize their own investment programs. Innovation increases productivity in all sectors using digital services, so it is important to introduce these services into the global economy as efficiently as possible.
1. Deployment challenges

Economic stakes of fiber-optic broadband: competitiveness and territorial development

In all countries digital development brings major benefits: agile interactions between citizens, merchants, public and private services, administrations and government, easier access to knowledge and education, opening of new domestic and foreign markets for businesses... This societal and economic revolution supported by fast networks is now a global trend. No country can allow itself to stand on the sidelines.

Fiber provides the backbone of digital development which promises improvements in living conditions, business competitiveness, and the efficiency of public services and modernized government. By providing more bandwidth and better quality of service (the Achilles heel of copper networks), optical fiber will bring more equitable access to information for citizens and businesses.

From fiber to FTTH: careful thought required

The prime prerequisite for digital transformation is superfast fiber-optic backbones. FTTx services (Fiber-To-The-Home, Fiber-To-The-Premises, etc.) are possible only over a high-speed access network able to transport vast quantity of data within the country or even across the world. Transport infrastructures and international interconnections are essential. Submarine cables, of which there are now 366 stretching more than 800,000 kilometers, and international programs are vital, notably in Africa (e.g. WARCIP, CAB, RCIP projects) and Asia where global network usage continues to explode.

While optical fiber is the only credible choice for modern network backbone infrastructures, the possibility of delivering services over fiber all the way to the end-user, without loss of quality or data speed, remains the Holy Grail. Yet FTTH is not an end in itself; the connection of the last kilometer remains a fundamental question even when an optical network is operative. FTTH is just one solution among others, what’s more a sometimes expensive one. It is pertinent only if the technical, geographic, financial and marketing conditions are right. This depends on several factors, including the existence of suitable urban infrastructures, geography and topography, favorable regulations, operators’ investment capacity, market needs, and others.

And of course FTTH must enable B2C or B2B services at attractively affordable prices. For telecoms providers, the decision to go for FTTH (or more generally FTTx) rather than wireless access (WiMAX, 4G, etc.), for example, is often complex. The order of the day is to adapt technology to the context, an approach that explains why 80% of Internet access in Africa is over cellular networks.

Fiber enhances national image, attractiveness and competitiveness

Fiber nevertheless remains the favorite choice in all markets. Nationwide FTTH connectivity provided by operators is today perceived as a strong indicator of societal modernity. In practice, fiber is used above all in new constructions, new districts, even new towns (for example, Diamnadio in Senegal) and new business parks. One reason for this is that governments and operators sometimes lack key prerequisites such as a reliable national address system, geocoded databases and precise, up-to-date maps.

Despite such difficulties, we should bear in mind that the provision of very broadband access has major impact on national image, attractiveness and competitiveness. Fiber helps attract foreign investment by providing infrastructures that meet the criteria of international groups. At a "general public" level, it offers tourists the same modern services that they enjoy at home. It encourages the emergence of new business parks and competitiveness clusters. It facilitates the development of innovative entrepreneurial ecosystems in which local talent and startups can thrive (Fintech, EdTech and Healthtech projects alone attracted almost 30% of startup investment in Africa in 2016. By speeding national and international data exchange, fiber enables the use of remote and hosted services (storage, security, SaaS, etc.), it allows the creation of national and regional datacenters, and it facilitates national and international cooperation.

1 | Source: Le Monde.
A vector for social and territorial development

In 2015, landline Internet access prices were five times higher in emerging countries than in developed ones. The world’s citizens have never enjoyed equality in terms of access to information! Despite announcements of global Internet coverage, inequalities still persist. Moreover, the inequalities have changed: many more people now enjoy at least some connectivity, but bandwidth and quality of service (QoS) are by no means uniform. In some countries, however, fiber has been combined with other access technologies to connect “the last mile” as a means of opening up isolated rural populations and notably bringing them public healthcare and education services. In other countries, fiber-based services aid industry and agriculture; they are a vector for social and economic development. For example, fiber makes life easier for entrepreneurs, VSIs and SMEs by bringing them security, reliability and services that are not possible over ADSL. Talent and ideas are everywhere. Bringing high-quality VHSB to businesses at an affordable price is an excellent way of supporting entrepreneurial initiative and creativity in any country. Who could have imagined five years ago that the “Yabacon Valley” in Nigeria and the “Silicon Savannah” in Kenya would exist today?

Fiber can carry not only raw data, but also essential services such as education, healthcare and public administration, as well as economic services (such as OTT). This progressively gives countries an opportunity to develop local enterprises able to compete with big international players. iROKotv in Nigeria and the pan-African VOD service BuniTV are good examples. The arrival of Netflix in Africa in 2016 is further proof of the maturity of local infrastructures and their ability to live up to consumer expectations.

Stimulating competition

Investment and infrastructure sharing schemes are vital for bringing fiber all the way to (or very close to) the end-user, and they enable synergies between operators. Subject to rigorous regulatory control and clear competition rules for operators, cost sharing and combined efforts make fiber roll-out faster and more efficient. Such schemes encourage competition, which helps bring good-quality access and affordable B2C or B2B services to much larger populations. In addition to sharing between telcos, it is important to develop cooperation between operators and distribution players. Many industries such as oil, electricity and road and rail operators deploy fiber networks to serve their own business. These very high-speed trunks are often underexploited, which is a pity since they could contribute to the economic development of the regions they traverse. The result in Africa is that more and more players owning a fiber-optic network are positioning alongside conventional operators. Examples include ONCF (railroad) in Morocco and Sonatrach (oil/gas) and Sonelgaz (electricity/gas) in Algeria.

Specific challenges in every market

B2C market: democratize access to information, accompany the evolution of needs and anticipate future digital usages.

In addition to the complexity of fiber deployment, operators face marketing challenges that differ according to market maturity. On the most mature markets (where FTTH is most easily implemented), fiber brings a promise of new services such as 4K, content, cloud gaming and online storage. The most modern services become a reality with unprecedented comfort and user experience. On emerging markets, fiber helps to democratize quality Internet access and stimulate new offers and services. Only 15% of Africans have Internet access at home, while 29% of them already use broadband on their cellphone. Although fiber is not expected to substantially change this balance, at least in the short term, it will enhance residential connectivity and even drive mobile Internet growth by providing transport infrastructure that lives up to users’ expectations.

B2B market: access to the digital world for all enterprises

The potential benefits of fiber for enterprises are extraordinary. B2B users are already familiar with complex – and expensive – connections to operators’ networks, leased lines for example. Fiber brings a radical paradigm shift with the possibility of exploiting enormous bandwidth (as well as top-notch QoS) at a much more affordable price. This is a radical change for operators too on certain segments, notably B2B access offers which were formerly too expensive for most businesses, especially small and mid-size ones. Fiber therefore makes the compelling promise of boosting business activity and opening market opportunities for enterprises, and of expanding operators’ customer bases – provided they accept the shift from a business model based on margin to one based on volume.

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3 | Yaba is a suburb of Lagos, Nigeria, where technology companies raised $109m in 2016 – Source: Le Monde.
4 | Kenya moves up to third place in the African rankings in 2016, with $92.7m raised by 21 start-ups in the “Silicon Savannah” – Source: Le Monde.
5 | Streaming service of Nigerian origin, launched in 2011.
6 | Streaming service in Kenya, launched in 2012.
7 | In 2007, Sonatrach and Sonelgaz launched AECA, a joint venture whose role is to exploit their optical networks.
Launched in 2013, France’s "Plan France Très Haut Débit" high speed broadband program aims to provide totally nationwide VHSB Internet access by 2022.

This strategic and ambitious national program has a budget of €20 billion over ten years, including €3.3 billion of public funds. The players are both private and public: operators, local authorities and the State. Responsibility for the steering and implementation of VHSB deployment is delegated to the recently-created "Agence du Numérique" that will also work to harmonize technical offers and tariffs. The agency assures strong yet flexible management to adapt to evolutions. By working closely will all the stakeholders, it has already succeeded in tripling France’s fiber-optic broadband coverage – in just three years!

In practice, how did you impose your management of this project?

Our high-speed broadband mission was created at the Government’s initiative in 2013. Our approach is necessarily pragmatic, since running a project of such vast scale obviously takes time. Success will require strict yet flexible supervision. While at all times remembering the Government’s ambition, we must make allowance for private operators’ preoccupations and the constraints imposed on local authorities.

It was important for us to build a flexible working framework enabling all parties to do their job; our governance system aims to ensure the durability and operational efficiency of the new networks. Our goal has been to define, as objectively and transparently as possible, a baseline of recommendations and good practices to ensure deployment consistency across the country. Thanks to our actions, we have doubled our national VHSB coverage in three years, notably in large built-up areas. Coverage has substantially improved in small communities too, and in rural areas Public Initiative Networks are really taking off.

Have you met any difficulties?

There have obviously been obstacles to overcome: technological evolutions, reforms of local government management, deals between operators, not least the SFR-Numericable merger. We had to remain flexible to assure stability and to reassure. To guarantee the success and the durability of the VHSB plan, we adapted to each situation while respecting the defined framework.

I might add that our VHSB team always keeps in mind its mission statement: it’s not our job to supervise everything permanently. We make sure that everything is running smoothly and then hand over to the players once all issues have been resolved.

What would be your advice for countries wishing to launch their own plans?

To make the plan work, consensual political backing is essential. VHSB deployment is a societal project and a collective responsibility which from the very start must federate all interested parties: private and public operators, private enterprise, training organizations, the regulator (ARCEP in France), and so on.

The government can support the launch by financing certain projects, but it must encourage private financing to take over by guaranteeing a return on investment for all participants.

A fiber deployment takes time. It requires firm but flexible governance to adapt to changes in the national or local context.

Fiber must be promoted as an accelerator of growth not just for businesses and operators but above all for territories. Superfast connectivity is incontestably compelling for families and enterprises alike, and therefore a generator of revenues for territories. To draw maximum benefit from VHSB, even before rolling out the fiber we should be thinking seriously about the usages and public services we can offer the population and later make sure that these services are widely appropriated.

Finally, I might mention that we have formed a specialist VHSB team which is ready to share our experience and good practices with other countries.
The fiber market

Heterogeneous deployment

FTTH is now predominant worldwide in terms of both investment budgets and the number of subscriber lines. Asia is the trailblazer leading the way, as illustrated by its numerous national development programs, the dynamism of local players and affirmed consumer demand. The situation is more contrasted in Europe and North America due to greater technological fragmentation (VDSL, cable, etc.). But the situation is fast evolving...

### WIRELINE VHSB TECHNOLOGIES

Wireline very high speed broadband is defined in terms of a minimum data rate, which today is generally accepted to be 80 Mbps. VHSB encompasses several technologies supporting different speeds. FTTH is the fastest.

**FTTH/B**: Fiber To The Home/Building means fiber is deployed up to base of the building after which the copper subscriber line is used.

**FTTN**: Fiber To The Neighborhood.

**FTTC**: Fiber To The Curb.

**FTTLa**: Fiber To The Last Amplifier.

**VDSL**: Very-high-bit-rate Digital Subscriber Line (DSL) is based on the same technology as xDSL: signals are carried on a copper pair, simultaneously and without interference with voice telephone.

IDATE reports\(^1\) that there were 505 million wireline VHSB connections worldwide at the end of 2016, which is more than the half the total wireline broadband Internet base. Two-thirds of these VHSB users are on FTTH (see the box), well ahead of cable (20%) and VDSL (12%). Yet great disparities exist between countries and regions.

**Asia, a pioneering market still driving FTTH**

Asia has always led the way on FTTH, driven by ambitious national projects and proactive industrial policies adopted as early as the 1990s in South Korea, Japan, Singapore and Australia\(^2\). Moreover, Asian countries have high population densities, high-rise residential buildings and a tradition of aerial cables less expensive than buried ones. The fiber explosion was also aided by the early arrival of new players driving down access subscriptions and stimulating strong bandwidth demand through triple-play offers and immensely popular online games and user-generated content. At the end of 2016, most of these countries had an effective fiber penetration rate\(^3\) of 66% to 95%. Gigabit offers have been commonplace for several years.

Zoom on Asia-Pacific user base (Dec. 2016, millions)

<table>
<thead>
<tr>
<th>Region</th>
<th>Share of Total</th>
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<tbody>
<tr>
<td>Asia-Pacific</td>
<td>75%</td>
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<tr>
<td>Other</td>
<td>25%</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>71%</td>
</tr>
<tr>
<td>South Korea</td>
<td>6%</td>
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<tr>
<td>Japan</td>
<td>11%</td>
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\(^1\) On the basis of 1 billion customers (World FTTx Market Database) - versus 895 million for Ovum WBIS (August 2017) and 855 million for Point Topic (April 2017).


\(^3\) Effective penetration rate = homes connected / homes passed (connectable).
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[All Things Considered]

Other countries too are benefiting from government incentives to develop broadband and thereby the national economy: Malaysia since 2008, Vietnam since 2016 and the Philippines since 2017.

The example of China remains the most significant: its “Broadband China” plan has led to massive infrastructure investments and made the country the world FTTH leader as early as 2013. Operators continue to invest, even in rural zones, while lowering their tariffs and promoting services and content.

China’s dynamism and ongoing deployments across Southeast Asia are sure to make 2017 another year of strong growth. Eyes are now turning to India where the local telecoms troublemaker RelianceJio introduced its 4G offer to coincide with the important annual Hindu “Diwali” festival in October 2017.

American telcos and cablecos racing to gigabit speeds

In the United States, in the past wireline VHSB has been sold essentially by cable operators, with patchy coverage of about 137 million homes of which 60 million were effectively connected via FTTx/Docsis 3.0 at the end of 2016. In comparison, only 13.7 million homes were on FTTH at that time (up 16% year-on-year) out of a total of 30.4 million passed (connectable) homes. The FTTx footprint remains limited for two reasons: first, the big telcos (AT&T, Verizon, CenturyLink, Frontier) concentrate on the densest zones, and secondly, in some areas they have opted for other connection technologies. It is interesting to note that over the last three years a thousand small but very aggressive local players have installed almost half of all new connections in the country.

The race to Ultra Broadband (UHD) started in 2010 when Google announced its Google Fiber plan to roll out 1 Gbps networks through local partnerships. Although its offering (850 Mbps downlink, 700 Mbps uplink)8 has not been as successful as expected, the network through local partnerships. Although its offering (850 Mbps downlink, 700 Mbps uplink)8 has not been as successful as expected, the offer to coincide with the important annual Hindu “Diwali” festival in October 2017.

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Western Europe finally wakes up, but fiber is still a minority technology

After years of hesitation, fiber is at last taking off in Western Europe, with 16.4 million FTTH/B lines at the end of 2016, a 50% increase over two years. Of all homes served by fixed-line VHSB, 26% are now on FTTH compared to 30% on VDSL and 46% on cable (FTTx/Docsis 3.0). Eastern Europe (including Russia) is a long way ahead due to its undereveloped cable services and the mediocre quality of its copper networks. FTTH accounted for 80% of all wireline VHSB connections at the end of 2016.

The slower take-off in Western Europe is caused by strong financial and regulatory constraints on key factors such as duct sharing and total unbundling. Some operators have chosen to migrate to solutions better adapted to the local context, for example FTTC in the United Kingdom. Others have employed solutions that exploit the maximum capacities of copper. The decision of Belgacom, Swisscom, TDC and in particular Deutsche Telekom to deploy VDSL in the early years of this century has left them all at the bottom of the European FTTH/B rankings with a joint total of only 1.6 million fiber customers at the end of 2016 (source: IDATE).

Inversely, some Scandinavian and Baltic countries were very quick to adopt FTTH. At the end of 2016, 80% of Norwegian and Swedish homes and 100% of those in Lithuania and Latvia are passed by fiber. In fact, Latvia is the European champion in terms of fiber penetration in homes (45% in late 2016), ahead of Sweden and Lithuania (~41%).

Since 2015, Spain and France are showing the way in Western Europe: together they accounted for almost two
thirds of new fiber subscriptions and half the connectable base at the end of 2016. Telefonica has been driving the movement since 2013 on the Iberian peninsula which had 4.9 million lines at the end of 2016. Fiber is now being deployed rapidly thanks to simplification of administrative procedures and urban management rules that often allow cabling across facades. By July 2017, the FTTH base grew to 5.7 million lines, overtaking ADSL (5.6 million) for the first time. Thanks to its early rollout, Telefonica is still the leader on fiber, but Orange is now moving fast and Vodafone recently concluded an alliance with Telefonica.

In France, following clarification of the regulatory context in 2013, operators restarted their FTTH deployments in an increasingly competitive market. Regarding marketing, Orange and SFR were the first to propose promotional 3-play offers to incite ADSL subs to migrate to fiber with, in most cases, free connection to the home. By the end of June 2017, Orange had 1.69 million FTTH subs and 7.9 million passed homes, compared to SFR’s 2.1 million VHSB subs and 10 million FTTH/B passed homes. While Orange takes its fiber all the way to the end-user, SFR stops at the bottom of the building (FTTB) in 90% of cases. Iliad (Free) and Bouygues, both of whom had slowed their rollout, have accelerated again since two years and in June 2017 they had respectively 420,000 (+68% year-on-year) and 171,000 (+150%) FTTH customers. Most operators are in phase with the national broadband plan which foresees 20 million fiber-connectable homes in 2022 (SFR is even aiming for 22 million).

Despite these good results, the climate has been tense since the beginning of 2017 with the new Macron government wishing to bring forward the date of nationwide broadband and high-speed broadband coverage by two years to 2020. French operators are claiming fiscal and financial compensation and there are several disputes between Iliad, SFR, Bouygues and Orange. In this context, SFR has said it will cover the entire country without public money, although it has not disclosed details of its roadmap and the credibility of its plan remains to be seen.

In other markets, the situation is evolving fast in reaction to regulatory or competitive constraints or opportunities. Germany has just allocated €4 bn to support local Public Initiative Network (PIN) projects in zones overlooked in the fiber-optic plans of Deutsche Telekom and cable operators. Italy has an ambitious plan that will cost the treasury €6.8 bn to bring VHSB to 85% of the population by 2022, and the United Kingdom launched a £400 m fiber investment fund in July 2017.

Legacy players such as Deutsche Telekom and KPN still opt mainly for FTTN+VDSL, so the FTTH movement is increasingly driven by challengers. Vodafone, the most active since late 2015, continues to publicize its deployment of a European 1 Gbps network in Spain (joint venture with Orange), in Ireland ("SIRO" joint venture with Irish electricity utility ESB), in Portugal (network sharing with multimedia company NOS), in Italy ("OpenFiber" joint venture with the utility Enel), in Germany (where two thirds of the lines will cover 100,000 businesses and 2,000 commercial and industrial parks by 2021). Vodafone has not yet announced a rollout in the United Kingdom where local and regional players such as Gigaclear, GTC and Hyperotic are already deploying FTTH. OpenReach, now legally separated from BT, has fixed a target of 10 million FTTH-connected homes by 2025.

Africa and Middle East: fiber becomes a reality

At the end of 2016, the Middle East had about 5.5 million FTTH/B lines, 80% of them concentrated in three countries: Turkey is well in the lead with 1.9 million, followed by United Arab Emirates with 1.5 million. In the small state of Qatar 98% of fixed-line access was via FTTH.

In comparison at this same date, Africa was lagging behind with networks in 20 countries but a total of only 800,000 lines due to the poor quality of national infrastructures, the relatively small middle classes and the high investment costs leading to expensive access offers. On the other hand, the effective penetration rate is rather high, since operators tend to give priority to business parks and the most affluent residential areas.

South Africa alone accounts for 80% of the African subscriber base, thanks to open-access private initiatives by local players (Vumatel, etc.) and national players (MTN, Vodacom) who have leveraged the higher data rates to improve their content offers. While most deployments are in "wealthy" districts, the regional operator Vumatel plans to launch an FTTH pilot offer in a Johannesburg slum district in November 2017, using aerial lines to limit the costs. It will be priced at 89 ZAR/month (€5.5) for 100 Mbps shareable between several homes and without volume restrictions. Safaricom’s approach in Kenya is similar: it has made an agreement with a local electricity supplier, Kenya Power International, to exploit its electrical network in order to reduce deployment costs.

Conclusion

Wireline VHSB deployment programs are highly dependent on the structure of the existing network, the competitive environment, the CAPEX available for infrastructure investment, the population’s geographic distribution, and government incentives. Generally, a choice must be made initially between VHSB technologies, or more precisely between wireline VHSB and wireless VHSB. Whenever the context is favorable for FTTH, this is the obvious choice in view of its advantages over its rivals FTTN / VDSL. It is more costly to deploy, but it has proven advantages and performance over the long term.
342 MILLION FTTH/B LINES WORLDWIDE (DEC. 2016) – 80% OF THEM IN ASIA

Caption:
FTTH/B lines (December 2016)
(FTTH/B: effective penetration = homes connected / homes passed)
Evolution 2016 vs. 2015

All figures are for the end of the period. Sources: FTTH Council, IDATE, Sofrecom (August 2017)
**Regulatory framework for fiber-optic broadband**

Since high-speed broadband impacts a country’s entire economic ecosystem, a well-defined regulatory framework plays a determinant role. It must encourage optical fiber deployment and wireless networks while serving the objectives of telecoms regulation. In practice, this means creating “appropriate” competition conditions that allows infrastructure investments to be amortized.

**Spur investment by guaranteeing the neutrality of technological choices**

To encourage competition, the regulator must allow operators to consult each other on the architectures to deploy and to remain as neutral as possible in their techno-economic choices. Indeed, this kind of approach speeds investment and innovation, and incites operators to invest in several different technologies (fiber, 4G, LTE, etc.), all of which helps to achieve nationwide coverage. In theory, free market conditions lead to use of the most efficient technologies as operators opt in a rational manner for technically or economically optimal solutions. Market regulation should obviously not obstruct this free selection, and it should acknowledge the reality that fast broadband access today can be wireline or wireless.

**Maintain a faire level of competition**

Nevertheless, today it is widely accepted that in some countries “open” competition at all levels of the network is not a good idea; the notion of “fair” competition is increasingly applied, particularly in the wholesale market. Unbundling is viable only in zones of high landline density, and the multiplicity of transport networks in many countries is tending to disappear in favor of a single network managed on the basis of network/services separation.

**Define realistic deployment ambitions**

In a free-competition market, VHSB networks must be capable of carrying digital services within a reasonable timeframe and according to predefined criteria (technologies, coverage, competition,…). The challenge is to meet the service expectations of citizens and businesses while guaranteeing that operators will get a return on their investments.

The regulator must therefore define realistic deployment goals in three areas:

- **Technologies**: the objective, which must take into account the exploding demand for bandwidth, is formulated in the most neutral way, for instance stating a minimum data rate for all subscribers. Farther downstream, it defines symmetry levels enabling the transition to fourth-generation telecoms services.

- **Coverage**: which parts of the territory are to be covered? The goal must also state a coverage target such that all homes and businesses in a served zone are ultimately connected to a network and able to enjoy very high speed services.

**Calendar**: networks are intended to attenuate the “digital divide” perceived by populations in zones where they arrive late. Yet the deployment plan must take account of operators’ budgetary and economic constraints, which is why it is usual to define a nationwide “minimum capacity per user” which of course may be exceeded in the more quickly profitable districts.

**Private operators must respect their commitments**

Since fiber is costly, operators may hesitate to deploy it outside densely populated zones, and even in fiber-equipped districts they do not always find it useful to connect all dwellings and enterprises. There is a high risk that operators will cream off the most profitable parts of their service areas and that some people will never get connectivity, except perhaps at prohibitive prices when additional network construction proves necessary. In short, operators will not spontaneously cover the entire territory, even if they are sharing a network, unless the regulatory framework gives them reasons to do so or if they receive public financial aid.

The regulator will therefore oblige private operators to confirm their deployment commitments and make contracts clearly stating the rollout schedule and annual investments.

**Build a legitimate framework for public intervention**

In the absence of contractualization, the regulator must create a framework that provides for the combined intervention of local authorities (when they are concerned) and the State to ensure that the principle of universal telecommunications service is respected even in sparsely populated areas. For this purpose:

- The State and the regulator must closely monitor progress and homogeneity in all zones preempted by operators.
- Public Initiative Networks (PIN) should be used when necessary, with government financial support.

As the World Bank has underlined, superfast broadband impacts the entire economic ecosystem, so its implications are broader than those of information and communication technologies alone. A number of strong trends are emerging, in particular the organization of wholesale. For the rest – technological choices, investment types, and network governance and regulation – each country is adapting its regulations to its own context.
Network financing through public-private partnerships

Public-private partnership (PPP) agreements enable central and local government to attenuate more rapidly the "digital divide" in sparsely populated and unprofitable zones. They can take various forms according to the method of financing and the level of risk accepted by the private partner. Care must be taken to avoid unfair competition with the operators.

By definition, a PPP designates any form of partnership between a public authority and a private sector entity whose purpose is to finance, construct (or renovate), operate or maintain public infrastructures or to deliver a public service. This definition covers both technical assistance services and concessions.

A PPP offers several advantages for the public authority. First, it ensures good quality of service for citizens at optimal cost. It brings to public services and infrastructures the benefits of private sector methods, know-how and reactivity while avoiding pressure on public budgets, tax increases and borrowing.

**EXAMPLES OF PPP NETWORKS WORLDWIDE**

**In France**, Public Initiative Networks (PIN) require PPP agreements to finance FTTH (see page 15).

**In Africa**, a government entity in each country hosting a landing (cable termination) point of the ACE (African Coast to Europe) submarine communications cable - Equatorial Guinea, Mauritania, Gambia, Benin, Sao Tome and Principe, Gabon, and others - has negotiated a PPP contract with operators, in many cases an "operator of operators". In order to access international submarine cable capacity, a company has to be created to run the landing station. The PPPs used are varied though similar in their general principles; each country defines operating rules compatible with its national laws. Partners have usage rights that depend on their investment, but they must pay for their reserved capacity (cable usage and station operation). Cable usage is "open" in the sense that any licensed operator has the right to exploit the available capacity.

**In Indonesia**, a PPP has been made to construct and maintain sections of the national backbone that will serve the remaining unconnected parts of this very extensive archipelago of islands where communication routes are often poor. Remoteness and access difficulties considerably inflate connection expenses. The private partner is in charge of building and maintaining the backbone. The public partner, (the Universal Services Obligation fund), leases the network at a fixed price if the contractual monthly availability is attained and then sells the available capacity to operators.

**PPP strengths and weaknesses**

A variety of PPP structures are possible, depending on the private partner's investment and tolerance of risks:

- **Financing**
  - Build, Operate and Transfer (BOT)
  - Delegated profit-sharing agreement (performance)
  - Management contract (costs + fees)

- **Risk**
  - Concession
  - Farming (revenue leasing)
  - Technical assistance (fees)
Optimized risk sharing

With PPP partnerships it is possible to transfer to each partner the risks that he is best able to control. To optimize the sharing of these risks, the partner’s abilities in four main areas must be assessed:

- **Finance:** finance the project at the best rates; borrow the project budget; manage the financing plan.
- **Design and execution:** study the requirements, specify the network, find the best contractors and supervise their work to be sure that the network meets the expressed needs.
- **Operation:** handle the network technical operation and assure the quality level imposed by the PPP.
- **Sales:** define and commercialize service offers, bill them and collect payments.

If the chosen model provides for sharing of the main risks, this must be stated.

When is a PPP appropriate to finance an FTTH network?

A PPP must not create unfair competition for operators, so the profitability of each deployment zone must be analyzed prior to signing the agreement. There are three possible situations:

- **FTTx zone with a break-even duration of no more than 10 years:**
  - The PPP is not the right choice here.
  - The zone is profitable, so it is reserved for operators.
  - Infrastructure sharing should be encouraged under the regulator’s control.

- **FTTx zone with a break-even duration of 10 to 15 (or even 20) years:**
  - The PPP makes sense in these conditions.
  - The government specifies the project (infrastructures, services, commercialization, etc.).
  - Public financing is necessary.
  - The private partner must assume the commercial risks.

- **Unprofitable zone:**
  - The PPP is an option.
  - The public partner is obliged to assume the commercial risks.
  - Subsidies are predominant.
Zoom on the French model

The "France Très Haut Débit" program, intends to bring superfast Internet access to the entire population of France by the year 2022. The regulator ARCEP identifies two types of coverage zone:

- **Very Dense Zones:** about 150 French cities and large towns (Paris, Lyon, Marseille, etc.) in which all four private licensed operators Orange, SFR, Bouygues and Free will invest massively, rolling out their networks at the same time to take advantage of dense population and to counter competitors.

- **Moderately Dense Zones:** these are more disparate, ranging from dynamic town centers to extremely rural areas. In such zones a single operator deploys a network and then proposes a regulated wholesale offer to Internet service providers (ISP). For a so-called "government-regulated" part of these zones, the government published an AMII (Appel à Manifestation d’Intention d’Investissement: Call for Expression of Interest to Invest). Two private operators, Orange and SFR-NC responded and are now committed with the State and the local authorities concerned to roll out FTTH in 3,600 municipalities. Outside this government-regulated zone, the territorial authorities themselves may deploy a "Public Initiative Network" (PIN).

New players emerging

Many players bid for PIN projects: well-known telcos (Orange, SFR-NC), less visible operators (Axione, Altitude, Covage,...) and new entrants such as ozone, kiwi, k-net or Vitis challenging the big four national ISPs. Competition is intensifying both on networks and on end-users, which is a positive indicator that the race to fiber deployment (some of it co-financed) is well underway.

The PIN as a lever for employment and territorial attractiveness

The PIN business model remedies lack of private initiative at a time when operators are extremely busy on several fronts: mobile license renewal, 5G mobile, VHSB rollout in very dense and government-regulated zones, co-financing, equipment, new digital usages...

The PIN is also a means of creating jobs in moderately dense zones. The "Observatoire 2017" survey of companies involved in PINs (http://observatoiredesrip.fr/) reports that in 2016 PINs created 8,100 full-time jobs, 35% more than in 2015. It also notes that entrepreneurial activity tends to be higher and unemployment lower in PIN areas than in zones without fiber.

VHSB technologies (FTTH, satellite, 4G Home) used in a PIN undeniably help to attenuate the digital divide and open up remote areas. They create value across the entire country, which explains the very rapid success of this very French model. Companies active on PINs appear confident: more than half of them expect to capitalize on their PIN experience by selling their savoir faire notably in Europe and Africa.
2. Keys to optimal deployment

INTERVIEW with Nicolas Venne – Orange France – Forecasting and Geomarketing Manager

Orange France: a geomarketing approach to support superfast broadband

In a context of accelerating fiber deployment, Orange France is taking an innovative geomarketing approach in order to provide strategic support for Orange France's Fiber Projects Division and operational support for fiber and marketing teams working in the group's regional directorates. Let's take a look at the people behind this approach, their methods, tools and levers for success.

What are the goals of your geomarketing approach?

We aim to exploit our detailed knowledge of the different fiber deployment zones to support our Fiber Projects Division, fiber teams throughout France and the people choosing sales strategies for fiber offers. We can help them identify the most attractive segments for fiber and prioritize their investments; we can provide factual data to structure and plan rollout programs.

So the Geomarketing Department intervenes upstream of the deployments?

Yes, that right. Our job is to reassure the Orange France Fiber Projects Division in its deployment choices which can be considered to be strategic in view of the cost of this new network. And later on we support the deployment and marketing teams in order to confirm or question their important assumptions, taking into account regulatory, technical and commercial factors.

What skills do you need?

We depend on our geomarketing specialists most of whom have postgrad degrees. They have technical and communication skills and are experts in geomarketing software. They know how to process voluminous data and diverse information. They are capable speakers able to present our analyses, adapting their discourse to their audience. We centralize these skills and capitalize as much experience as possible.

What are your intervention modes?

We present ourselves as consultants addressing all Orange’s needs. We collaborate closely with these internal customers and then propose orientations and recommendations. To ensure intimate knowledge and fine analysis of the specificities of each region, we appoint a specific contact for each Orange department to provide a kind of “one-stop shop". Once a year, we make a Tour de France to meet all the operations managers and their intervention and network supervision units. This strengthens our cooperation and helps us find the best ways of working together.

Which tools do you use?

We use geographic information systems to aggregate external databases, customer data, network quality data and even customer experience information. Our consultants are free to choose between three geomarketing systems reputed to be the best: ESRI, GEOCONCEPT and MapInfo. In our studies we use Google satellite and street images to get an impression of districts that are fiber candidates. These allow us to see building characteristics in more detail and the presence or absence of aerial cables. We also exploit information about future property developments which helps us target new buildings for fiber pre-installation. Finally, we have developed internal and external digital tools. For example, our in-house geographic web service "My Fiber", provides information such as indicators updated with cartographic data showing fiber-equipped zones and the presence of our customers and our competitors. “GeoLife” provides socio-demographic data (tell me where you live and I will tell you who you are!), appetency data (address-by-address information that highlights potential value-generating addresses), shops in which fiber could be commercialized.

Geomarketing has also developed a digital map to allow customers and prospects to check the eligibility of their address — and even subscribe immediately or register their interest. That’s a world premier!

With all these tools we can give our operations managers hyper-fine knowledge and a vision of potential deployment zones and their occupants. Our preliminary statistical analyses help our internal customers to...
prioritize and plan their deployments.

What are the key factors for success?

In the case of fiber, the rollout must be oriented by geomarketing criteria which need to be regularly refined and enriched by a comprehensive technical vision.

We operate in a continuous improvement loop that helps us to:

• Work very closely with the regions and exploit local knowledge to adapt to specificities of terrains and markets.

• Maintain a continuous market intelligence activity to monitor software and skills and thereby improve and evolve our own methods.

• Work on forecasts, while analyzing feedback in order to question our methods and enrich our analysis and prioritization criteria.

• Capitalize on field experience and translate it into recommendations that our fiber project managers can easily put into practice.

What will be the next steps?

To give our customers even finer information, we recently developed an “address appetency” rating system that can guide deployments during the connection phase, with objective business criteria. We will soon explain the utility of these new metrics to Orange entities and integrate them in the information system. Another stimulating challenge for us!

INTERVIEW with Jean-Benoît Leclercq – Orange West Division - Fiber Program Manager

How to make a success of fiber deployment

The acceleration of fiber deployment requires the creation of a reliable ecosystem to federate external players and operators. Over the region covered by the Orange West Division, based in Rennes, there are few participants and they are not easily interchangeable. Openness, complementarity and partnership are the conditions necessary for success.

Who is actually involved in an FTTH deployment project?

There are four types of player:

• Local authorities and central government who see fiber as a driver of economic and social development and a way of making territories more attractive. Elected representatives are increasingly impatient to create large-scale, homogeneous networks.

• Electricity companies who share their nationwide networks with us.

• Subcontractors are essential to execute different tasks.

• More than 200 Orange staff in the West Division: production teams, contract managers, supervisors, subcontracting managers, operating personnel, data quality managers, and all the associated technical services.

What is the biggest challenge in a fiber project?

Fiber projects take two years, so we always have to deal with the impatience of public officials and the investing companies – and future end-users as well! Building a solid, reliable ecosystem takes time and we always have to manage this pressure throughout the project.

It’s important to anticipate needs in order to ensure reasonable work stability for subcontractors. In parallel, we verify the availability of material and human resources and manage shortages.

What kind of shortages? Financial or material?

Financing is no longer a major issue, because we have been able to demonstrate that fiber becomes profitability much more quickly than we initially thought.

The main difficulties are mainly due to the accelerating schedule, with production increasing by 30 to 40% every year. This leads to shortages of manpower and materials across the country. Strong demand for fiber connectivity has changed our relations with subcontractors who have become very choosy: they no longer see us as a client but as a partner. They make us wait until we can guarantee a certain volume of work over several years and gradual growth of demand to enable
them to procure the personnel and equipment they will need.

How do you manage this shortage?

We develop skills. Externally, we make partnerships with schools to train and then hire fiber technicians and fiber contract managers. And we train Orange personnel in-house to support this transformation of our activity.

We prioritize our deployment to be sure we have the necessary equipment and we propose plans that aim to reconcile the region’s political ambitions with Orange’s commercial challenges. To guarantee the profitability of a project, it is important to carefully manage the investments over time and to rapidly generate revenues in order to reassure our financial backers. Our revenues come mainly from customer subscriptions and capacity sold to other ISPs. To maximize our chances of good revenues, we seek zones where appetency for fiber appears highest. Our prioritization is based on fine analysis of INSEE socioeconomic data for France and our own knowledge of prospects and customers. We share these analyses with Local Authorities and other stakeholders so they can understand why we give priority to specific zones. Finally, the commercialization of our offers is supported by geomarketing tools developed specially by Orange and employed taking into account our operational realities.

Do deployment projects succeed better in certain zones?

Projects tend to move faster when we succeed in building trust-based relations with our subcontractors, local authorities and the operator. Conflictual situations are rare because fiber tends to federate elected officials of all political colors who agree on its benefits.

Difficulties that sometimes arise are generally due to technical or communication errors. Citizen may create associations that delay the project when the public authorities have not made the effort to dialog with them and explain the logic of the investments. An operator may make a poor technical choice or the authorities may fail to manage the civil engineering work properly.

Do public/private complementarities exist in fiber projects in your region?

Six Public Initiative Networks (PIN) are now operating in the region. Orange West is a customer of four of them as an Internet service provider, and we act as a rollout subcontractor for three of them.

How do you coordinate all the stakeholders?

For this purpose we have created several continuous animation structures. At meetings of local PIN management committees, information and schedules are shared and everyone is kept up to date on the progress.

A Strategic Subcontracting Committee chooses common subcontractors for each contract and closely supervises their workload, being careful to respect their intervention zones and the competition rules. PIN equipment inventories and compliance with legal obligations are checked at weekly meetings. Finally, an Orange engineering team regularly discusses future architectures and technician visits to customers’ homes. This coordination appears so vital for PINs that Orange takes charge of network operation and maintenance in order to guarantee quality of service for customers.

To summarize, what are the structuring factors that make for a successful fiber program?

I would list four key levers:

• Build a stable, agile ecosystem jointly with all the stakeholders.

• Anticipate shortages of materials and above all of human resources.

• Properly manage the dual, complementary roles of PIN operator and Internet service provider.

• Supervise the commercialization of fiber offers to generate a return on investment and attain the political goals.
REPORT from Fayssal Soulaymani – Orange Morocco – Fixed-Line Business Unit Manager

From wireless to wireline: how Orange Morocco is organizing fiber deployment

To compensate falling mobile revenues and to accompany Morocco's digital transformation, Orange Morocco made a decision to attack the landline market by leveraging optical fiber. The operator's FTTH rollout is backed by a targeted, differentiated and personalized marketing strategy.

Challenge was to consolidate our credibility as a fixed-line operator with property developers who have traditionally chosen Maroc Telecom's copper-based services. To do this, we developed a sales approach that draws attention to the value of our additional services delivered over superfast optical fiber to users - at no extra cost! And our ability to meet consumers' expectations and future needs. We follow up with lobbying actions and made partnerships with professional organizations including the Engineering Design Federation and the Property Developers Federation. On three occasions we organized "Optical Fiber and Smart Buildings" symposia at which we presented the latest technological progress, evolutions in the regulatory framework, and experience in real projects. We have published Orange's guidelines for optical fiber installation in buildings. All these efforts have proved worthwhile, notably with companies positioned on prestigious developments. For example, Bouygues Immobilier Maroc and Palmeraie now systematically install Orange fiber in preference to copper.

Differentiated and personalized prospecting

Once our segments are defined, a sales team prospects door to door, explaining to people the unique experience that Orange fiber can bring. Our prospecting plan makes a distinction between new-users and subscribers of our rival operators; our salespeople adapt their sales pitch to the profile and needs of each contact. For our existing customers we have created a specific fast-broadband customer path.

Already thousands of fiber users

The product marketing strategy is naturally most successful when we promote our offers guaranteeing satisfactory quality of service at the same time as the technical FTTH rollout. At the moment we are deploying FTTH in Casablanca, Rabat, Tangier and Marrakech and we will add eight other towns by next year with offers that should appeal to the more affluent socio-professional groups, to families with children wanting big bandwidth, and to small and mid-size businesses.

Our intentions are to increase our investments, target new towns and regions, and develop content offers to build the loyalty of our installed base and introduce services to meet business needs. FTTH is a high-value market that will give Orange a new growth lever. We will boost our image by delivering an incomparable user experience and achieve our ambition of becoming the country's preferred operator.

Lobbying of property developers

The dynamic Moroccan property market that sees 200,000 new homes build every year presented a first development opportunity. The

Part of Orange Group since 2010, Méditel was renamed Orange Morocco on 8th December 2016. The country's second biggest mobile provider, Orange Morocco launching a 4G offer to overtake its two competitors, the incumbent telco Maroc Telecom and the third license holder Inwi. However, growth has slowed over the last two years due to a sharp drop in mobile tariffs (-15% in 2016 according to the ANRT) reflecting a high equipment rate and exacerbated competition.

Orange Morocco therefore decided to seek renewed growth on the landline segment. Coincidentally, at this time the Kingdom wanted to speed its digital transformation which will inevitably lead to a massive increase in data traffic. To transport this future traffic and guarantee the high-quality fast broadband service expected by end-users, the operator decided to roll out FTTH as an alternative to ADSL, adopting a very refined approach to its target users.

A geomarketing approach to existing housing

In order to prioritize our deployments in existing buildings, we segment the zones and identify our targets by analyzing socio-economic data: population density, socio-professional categories, condition of the landline network, and so on. This segmentation is done mainly in the biggest towns and in their less dense affluent suburbs where we perceive potential appetite for our offer.
INTERVIEW – Orange Ivory Coast – Customer Relationship Strategy Project Manager

Orange Ivory Coast’s VHSB offer provides a solid foundation for usage and content growth

Orange Ivory Coast exploits FTTH as a means of diversifying its innovative services and content offering. To differentiate from its rivals, it has matched its offers to residential and enterprise customer usages. Their commercial success is assured by advertising campaigns during launch, personnel training and close proximity to customers.

What are the challenges for Orange Ivory Coast?

We aim to diversify our cellular, fixed and mobile banking businesses through new content offers and services. Very High Speed Broadband (VHSB) will leverage this diversification and boost our revenues by enhancing enterprise and residential customer satisfaction.

FTTH is a means of consolidating the loyalty of enterprise customers by giving them better connectivity and services such as video monitoring, videoconference and cloud. On the residential market, FTTH is an opportunity to impress consumers and develop our business with innovative services and content such as IPTV, VoD and online gaming. I might say that FTTH deployment serves Orange’s goal of becoming the benchmark partner for digital transformation in Africa and of participating in the continent’s economic and social development.

Which market needs motivated your fiber launch?

Today 90% of Ivory Coast businesses are on ADSL, but this is subject to connectivity instability – often due to weather conditions – which disrupts business operations. Further, the use of copper is an invitation to theft. In this context, fiber brings the bandwidth and guaranteed stability that businesses need to use big data. It will also drive residential usages such as online games and video streaming by providing the totally fluid experience.

How did you organize the commercialization of VHSB offers?

Our approach was to propose offers based on usages rather than technologies. On the professional and SME segment, we launched two offers with differentiated services and speeds adapted to the customer’s need.

For the residential segment, we coincided the fiber roll-out with the launch of our triple and quadruple play offers in order to promote Orange services and content. As an example, a customer can buy (using Orange Money) on TV d’Orange a video that he can watch on his TV set or on a tablet or smartphone. Structuring our portfolio according to consumer expectations and needs was essential to differentiate us from other operators. We are the very first operator to propose these services.

To develop the offering, our marketing people worked closely with the technical experts to make the customer path as fluid as possible, from the act of purchase to delivery.

How did you target the launch zones?

We chose several zones simultaneously, mixing businesses and residential villas. Our priority targets are:

• Professional districts: Le Plateau, Biétry and some parts of Cocody, Abidjan. Professionals and SMEs are the prime targets for high-speed services which are invaluable for their activities.

• High-income residences. Although the entire population would like broadband, low purchasing power holds back subscriptions.

We aim to give users a dazzling first experience to satisfy their demand for innovation and to drive our profitability and growth.
How do you promote your new offers?

We systematically run advertising campaigns to inform customers and prospects of the arrival of fiber in their district. We exploit all available media to reach residential subscribers, something never seen before in Ivory Coast: outside advertising, weekend events and even door-to-door visits by salespeople.

We are also counting on two other very positive factors:

- **Proximity and pedagogy to inform customers.** We explain to them individually the advantages of fiber and we keep them informed at every stage from subscription contact signing to installation.

- **The skills and know-how of our technical and commercial staff who all receive special training to ensure they fully understand the features of the offer and its installation process.**

To continue to develop fiber and drive wider adoption, we need to roll out fiber in new districts and propose even more affordable equipment.
Experience of very high speed broadband in many countries reveals four constants:

• VHSB requires massive rollout of optical fiber networks, regardless of the technology chosen for the last part of the subscriber line: FTTH, FTTB, FTTN or cellular.

• VHSB deployment is expensive at €100 to €800 per linear meter, depending on technologies, territories, and existing infrastructures. Given the break-even duration, total nationwide coverage in any country requires a combination of private and public investment.

• For financial and operational reasons (availability of equipment and trained personnel), nationwide coverage requires a 10-year program, on average.

• VHSB deployment and the new services it engenders are strong vectors for job creation and economic growth.

Looking beyond this common baseline, the deployment model must be adapted to each country taking into account various factors:

• Consumer aspirations, allowing for real needs and the ability to pay (although a few African operators are testing low-cost fast broadband).

• The competitive and regulatory context, which must provide for investment sharing, openness and network neutrality.

• Preexisting networks and infrastructures. In countries using copper or cable, these are progressively replaced by fiber while re-using existing civil engineering works. In predominantly cellular markets, VHSB requires new infrastructures or at least cellular network upgrades to increase capacity.

• Finally, as is often said, "Where there's a will, there's a way". Political will is imperative. Experience shows that when a government commits to massive investments and global rollout programs "VHSB for everyone" is achieved much more quickly.

If high-speed broadband is to live up to its promise of quality of service, the quality of infrastructures and then operations must be supervised closely. Even when governments or public players assume a large slice of the investments, they must be accompanied by specialists capable of designing, constructing, running and commercializing these networks according to the highest industry standards.

Finally, we should never forget that the raison d'être of these networks is to provide a foundation for service digitization. All services – e-government, telemedicine, e-agriculture, e-education, smart cities, etc. – require universal access to high-quality networks. Fiber-optic broadband frequently proves to be less costly than other technologies in alleviating the desertification of territories and isolation of populations. It is the optimal solution for demolishing the digital divide.

Conclusion

Territorial attractiveness, economic development, innovation and new digital services are just some of the benefits that superfast broadband can bring to any country. However, the deployment approach remains highly dependent on the local context; there is no universal solution that can be duplicated everywhere. All markets are subject to a number of unavoidable realities.
About Sofrecom

Sofrecom, an Orange subsidiary, has developed over 50 years unique know-how about operator businesses, making it a world leading specialist in telecommunications consultancy and engineering. Its experience of mature and emerging markets, combined with its deep understanding of the structuring changes affecting the telecoms market, make it a valued partner for operators, governments and international investors.

In recent years, 200 major players in over 100 countries have entrusted strategic and operational projects to Sofrecom: transformation and optimization, technological modernization, innovation and development. Its privileged access to Orange Group’s vast resources and innovations enables Sofrecom to propose proven, avant-garde solutions.

Sofrecom is an international group whose strength lies partly in its diversity, with more than 2,000 consultants and experts of 30 nationalities working in 11 agencies around the world. Sofrecom is above all a network of men and women, a powerful network of know-how and expertise which ties its personnel to customers, to Orange experts and to industrial and local partners.

Sofrecom’s Know-How Network is also the guarantee of a transfer of know-how, skills and expertise for sustainable transformation based on internationally certified methodologies.

Sofrecom, The Know-How Network