



Major strategic choices ahead of TelCos: Reconfiguring for value

How digitalization will impact telecommunication operators' configuration

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Authors:



Bela Virag

Partner, Telecommunication
Information Technology, Media and
Electronics, Austria
virag.bela@adlittle.com



Karim Taga

Managing Partner and Global Head
Telecommunication, Information
Technology, Media and Electronics, Austria
taga.karim@adlittle.com



Glen Peres

Manager, Telecommunication
Information Technology, Media and
Electronics, Austria
peres.glen@adlittle.com



Ventsislav Dimitrov

Consultant, Telecommunication
Information Technology, Media and
Electronics, Austria
dimitrov.ventsislav@adlittle.com



Thomas Gaar

Consultant, Telecommunication
Information Technology, Media and
Electronics, Austria
gaar.thomas@adlittle.com

Executive summary

The telecom industry is not in a stable state. In fact, due to the increasingly large strategic and technical option space, we expect operators to become more diverse. Within the next five years, the structure of operators will likely have changed significantly. This makes evaluating them, and making strategic investment choices, much more difficult.

In this report, we highlight the most relevant driving forces and opportunities in the telecom industry. Below, we state a synopsis of our hypothesis of trends the coming years:

- 1) Europe: volume-driven growth in the core segments of the European telecom space.** Over the projected horizon, we forecast that telcos will win the 'price x volume' battle. In three out of five segments, telecom operators should be able to realize growth, which will nevertheless amount to only about a 1% CAGR over the next five years. And while opex cost-cutting initiatives cannot continue endlessly, demand for network capacity spanning various infrastructure does, indeed, seem to be without limits. Thus, new opportunities in the near-core are surfacing.
- 2) B2B2x is gaining importance.** A new segment – B2B2x – is developing to support the business opportunity of operating customers' digital solutions. B2B2x differs from the traditional B2C, B2B and wholesale segments in that services become part of the client's value chain. It differs from the Internet of Things (IoT) in that it does not include B2C, but it does include services delivered by humans. We expect this segment to reach USD 276bn in size – or 8% of global ICT spending – by 2020, and as such, it should be one of the fastest-growth fields for telcos to focus on. This segment is not necessarily new – it was originally created by IT companies. What is new is that telecom operators, leveraging their assets, can carve out a space in it and address a much larger share of the mega-trend 'digitization of the industry' than they have historically. Doing this requires a thorough understanding of what is needed to help companies digitize. We expect that some operators will actively address this new segment in an attempt to become part of their customers' value chains while others may choose not to participate.

In chapter 2 of this report, we outline how this new market works, what is needed for involvement, and how it is funded.

- 3) New production models begin to emerge.** Three factors are driving new production models:
 - an improved customer experience,
 - lower production costs, and
 - more innovation/faster time to market.

Eventually network resources will become elastic, transparent and accessible – moving far away from today's often slow, cumbersome and inefficient architectures. We will see web-like collaboration between companies emerge – even in the network and Operations Support

System / Business Support System (OSS/BSS) domain. And, we will also see web-like competition emerge. Cross-border service competition will arise and international expansion will be accelerated.

We expect groups with multinational footprints to be able to leverage group-wide scale effects and eventually achieve lower costs. Beyond this, we expect them to become suppliers to off-footprint operators.

In chapter 3, we outline the most important aspects of the transformational journeys operators have embarked on or are embarking on.

4) Operators will review how they manage their diverse portfolios of assets. Diverse asset groupings, such as data centers, towers and legacy networks, among others, require differing managerial approaches and strategic objectives. Operators will need to consider establishing dedicated approaches that suit each asset class. Certain assets, such as fiber and small cells, will likely work in asset-sharing models. As many copper-network owners embark on fiber-upgrade journeys, they will need to figure out how to balance the need for fiber sharing with their legacy roadmaps. This is in stark contrast to cable network operators, which, given their technical nature, can follow an 'upgrade with demand' strategy. Clearly, this will have a significant impact on balance sheets: a shift from depreciation to opex makes EBITDA levels less comparable. However, the most dramatic impact will stem from the vastly different types of operators that spring into existence: we will have traditional players competing with asset-light players following a rigorous cost-cutting approach while operating on a simple, customer-centric model. Beyond that, we will see international operators expanding their footprints on the basis of equally available infrastructure assets – all feeding into and off of the trends described in chapters 2 & 3.

In chapter 4 of this report we provide an outline of asset classes and the underlying logic of each of the asset classes.

5) Finally, bringing all of the above implications together, we expect the markets to recognize that these vastly different types of operators offer very different risk profiles and very different abilities to scale. Operators can differentiate their plays by: becoming truly global players; partnering-capable players fully embracing the new segments and customer needs; remaining strong and highly efficient in their domestic markets; becoming asset-heavy or light operators; or pure asset-holding and operating players. All of these possible paths have one thing in common: they anticipate the arrival of the next wave of efficiency increases – this time on a much more global scale.

This drives our final conclusion: We expect to see an increase in the importance of non-tangible assets in the sense of capabilities: e.g., the 'degree of openness' of an operator to third parties, the 'market-oriented approach to assets', and the ability to 'take design responsibility for the software that runs their factories' will gain weight when assessing operators.

In chapter 5, we evaluate the impact of the prior three chapters on corporate valuation and the impact of non-tangible assets on this.

1. Volume-driven growth in core European telcos on the horizon

Population growth and stabilization of fixed-voice telephony through bundling drive adjustments to our forecasts post 2015

The telco market in Western and Southern Europe has performed in line with our expectations, with the rate of change shrinking from -3.0% to nearly 0% by the end of 2015. This shift occurred earlier than we had expected: our previous forecast projected that this stabilization would take place in 2016.

The performance was driven for the most part by a decline in the fixed telephony market not being as significant as originally anticipated. Bundling of services (fixed voice with fixed/mobile broadband and even TV) has had a stabilizing effect on the decline in subscriber numbers for fixed-line voice services. While ARPU continues to fall in the majority of cases, driven mostly by a decline in call volume originating from fixed connections, in a few countries – e.g., Germany, Spain and the UK – fixed-voice connections remain resilient.

On one hand, convergence of telecom services is a driver for this, and on the other hand, there is a ‘minimum’ threshold for fixed-voice services (e.g., government or regulated industry lines, businesses and other segments that simply will not change their services), and this could result in a steady leveling off of the fixed-voice market, but with the rate of decline decreasing over time.

This factor is coupled with higher-than-expected population growth in the specified region (roughly 1% more households than originally forecast), which should drive a rise in telecom markets. Taking these developments into consideration, we have updated our projections for the 2016-21 period. Thus, our current 2020 growth forecast is higher than what we had originally estimated in 2015, and our revised 2016–21 (five-year) CAGR is now 1.2%¹.

Figure 1: Table for Belgium, France, Germany, Italy, the Netherlands, Portugal, Spain and the United Kingdom

EUR Billions	2011	2012	2013	2014	2015	2016e	2017e	2018e	2019e	2020e	2021e	CAGR 16/21e
Mobile data	19.9	22.5	24.5	25.9	28.4	32.0	36.4	40.7	45.3	49.8	54.2	11.1%
Mobile voice & messaging	91.1	81.7	69.7	63.1	58.6	54.9	51.9	49.0	46.3	43.8	41.4	-5.5%
Fixed broadband	44.0	45.1	45.2	46.4	48.1	49.5	50.7	51.8	52.8	53.8	54.8	2.0%
Fixed telephony	42.3	39.6	36.8	34.0	32.2	30.8	29.3	27.9	26.8	25.8	24.9	-4.1%
Pay-TV	24.0	24.8	25.7	26.5	27.2	28.2	29.2	30.1	30.9	31.4	31.9	2.5%
Total	221.2	213.7	202.0	195.9	194.5	195.4	197.4	199.6	202.1	204.6	207.2	1.2%

Source: Arthur D. Little

Market development is characterized by a struggle between ARPU decline and volume growth

The ‘ARPU x volume’ equation remains a key characteristic of the telecom services market. Declines in ARPU are anticipated across nearly all segments, coupled with volume increases. However, net growth is not expected to be realized on a consistent basis.

1. Mobile and fixed broadband remain the key sector growth drivers

Mobile and fixed broadband services represent the key components of growth over the forecast period².

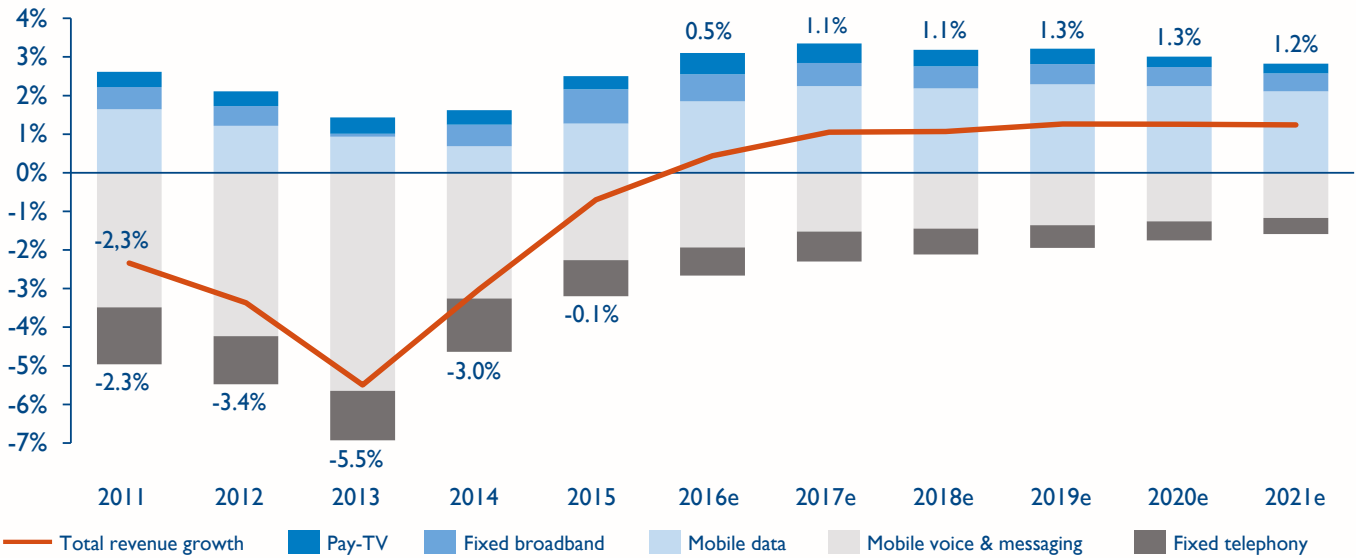
In 2015, mobile data traffic only represented 14.5% of all telecom and Pay-TV revenue; however, based on a projection of an 11% five-year CAGR between 2016 and 2021, it could exceed one-quarter of the total market by the end of that period.

If this were the case, focusing on the equation of ‘ARPU x volume’ pays off, as increasing demand for mobile data traffic (excluding SMS) is driven by growth in subscriber volume, connected devices and data consumption. While this results in a net increase in both ARPU and absolute revenue, the underlying data traffic associated with the ARPU is, however, growing at a disproportionately faster rate. Calculating the price per GB of

¹ Our 2015 estimate for the five-year CAGR between 2015 and 2020 was previously 0.6%

² We show fixed voice as a separate line item with a certain value contribution, even though it is often included in bundles

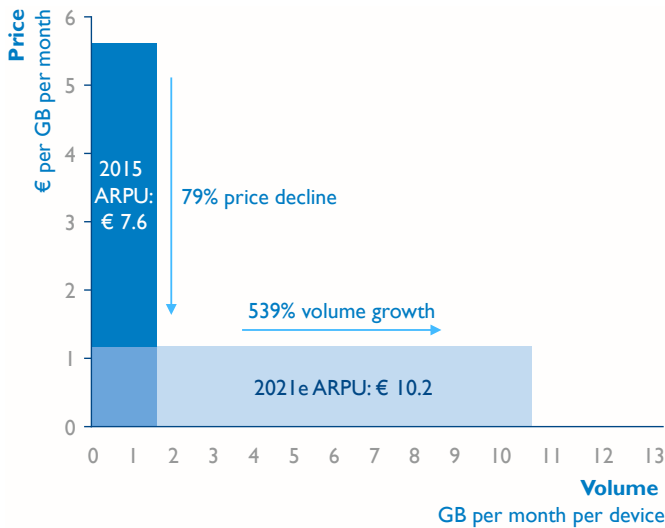
Figure 2: Contribution to growth – weighted by segment, 2011-21



Source: Arthur D. Little

data traffic shows the stark differences in development of price and volume in the mobile data segment, as shown in the figure below.

Figure 3: Mobile data revenue drivers – growth of mobile data by price and volume, 2015 & 2021



Source: Arthur D. Little

In the meantime, the need for access to at least “super-fast broadband”³ capacity continues to drive a return to fixed-line

data in the market. Fixed-line broadband ARPUs are expected to continue to grow. However, this growth isn’t indicative of future growth in the sector, as growth in ARPUs for both normal and super-fast broadband overall is either stable or is declining slowly. The growth in revenue is driven by the rising penetration of super-fast broadband (expected to reach a nearly 40% rate by 2021). This, coupled with the stable 20% premium on ARPU, is driving overall growth in the market.

The effect of these factors is likely to be that fixed-broadband revenue becomes much more influenced by the super-fast segment. By 2021, it is forecast to exceed 40% of the total fixed-line data revenue.

2. Voice continues to decline as use of VoIP and other OTT⁴ offerings continues to grow

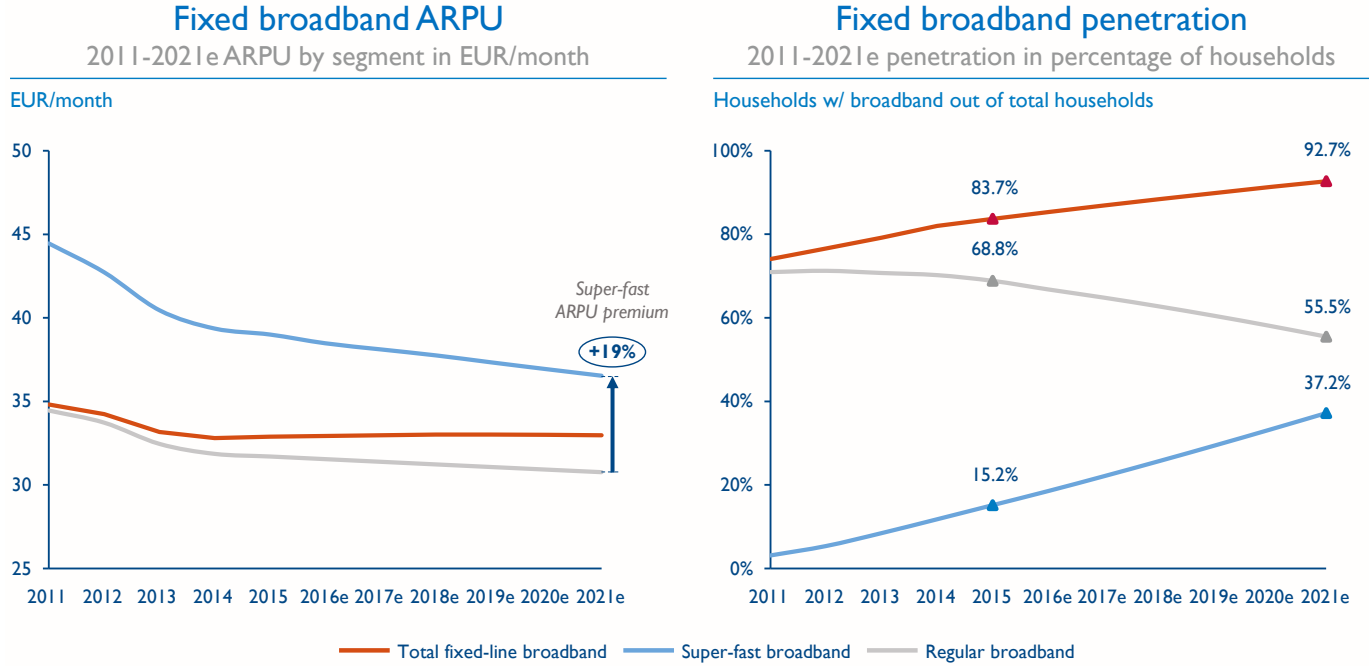
Revenue from the traditional core services of voice (fixed and mobile) and text messaging continues to shrink as they become part of data bundles (frequently, unlimited voice and messaging, along with a limited mobile data offering), and are substituted with equivalent services delivered over the internet.

Although subscriber numbers to mobile telephony are forecast to grow, in contrast to the case for mobile data, this growth will likely be insufficient to compensate for ARPU declines.

3 Broadband qualifies as super-fast when it offers download speed of at least 50Mbit/s, and has the potential for 100Mbit/s or more. Households are considered connected to super-fast broadband when they actually have access to 50Mbit/s of bandwidth. Consequently, such technologies include FTTH, DOCSIS3.0, FTTS/FTTB/FTTD with G.Fast and FTTC with VDSL

4 OTT refers to companies entertaining business models that are delivered “over the top” – e.g., over a telecom provider’s network. Often this happens without the service provider paying for it, and with the end customer having a service-undifferentiated rate

Figure 4: Fixed broadband ARPU and Fixed broadband penetration



In 2017, we expect the total revenue from voice and text messaging to be lower than the total for data services. This trend should continue throughout our forecast period. By 2021, the two markets, as well as mobile- and fixed-line data, are expected to converge in terms of value, reaching roughly 53% of the total market.

We are witnessing the transition of voice segments from being the main revenue driver for telecom companies to becoming a complementary service in converged bundles (i.e., triple- or quadruple-play). Voice markets will become less relevant as the revenue share of converged services grows stand-alone segments and revenue becomes too complex to be attributed

Figure 5: Fixed broadband revenue, by segment, 2011-21 (EUR bn)

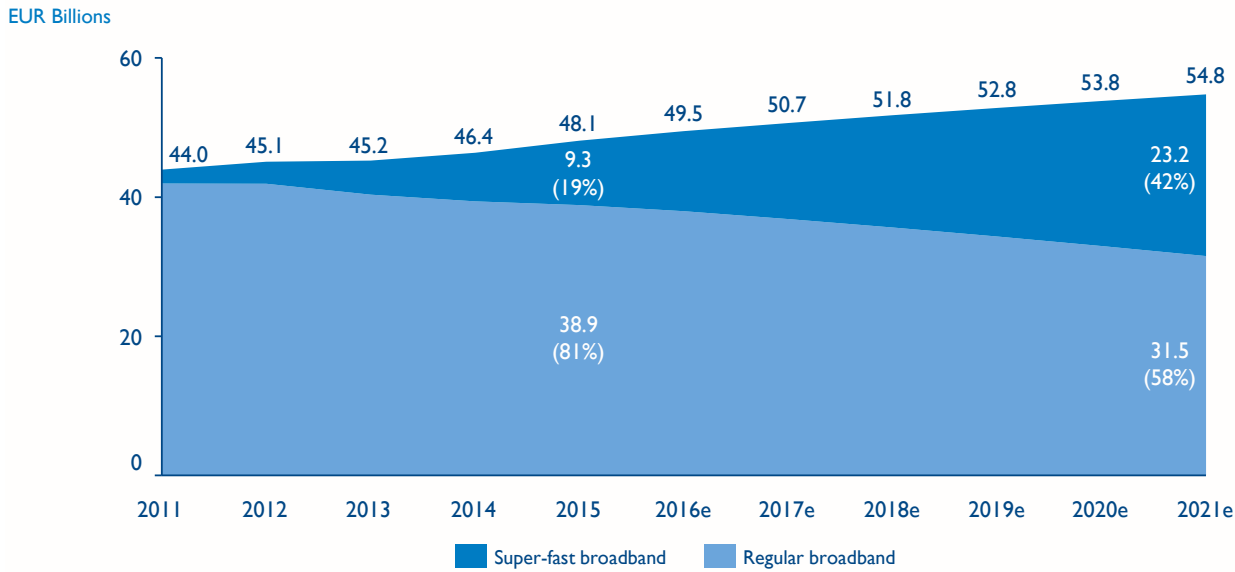
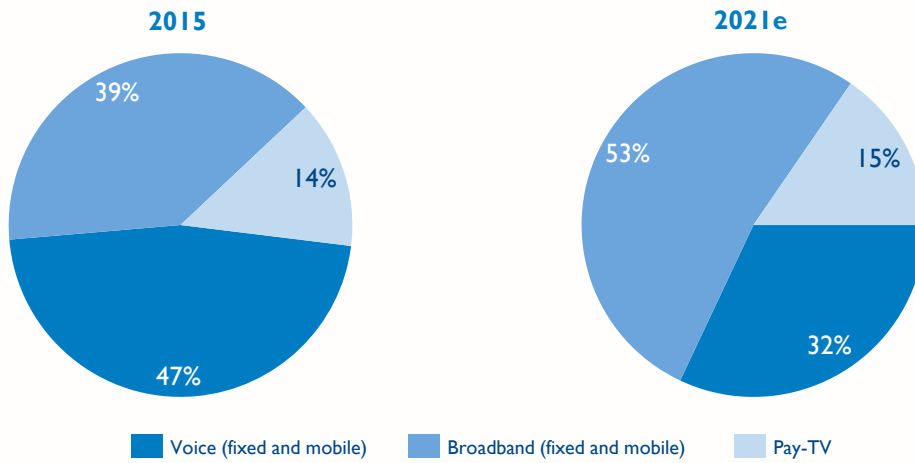


Figure 6: Telecom revenue, share of revenue, 2015 & 2021



Source: Arthur D. Little

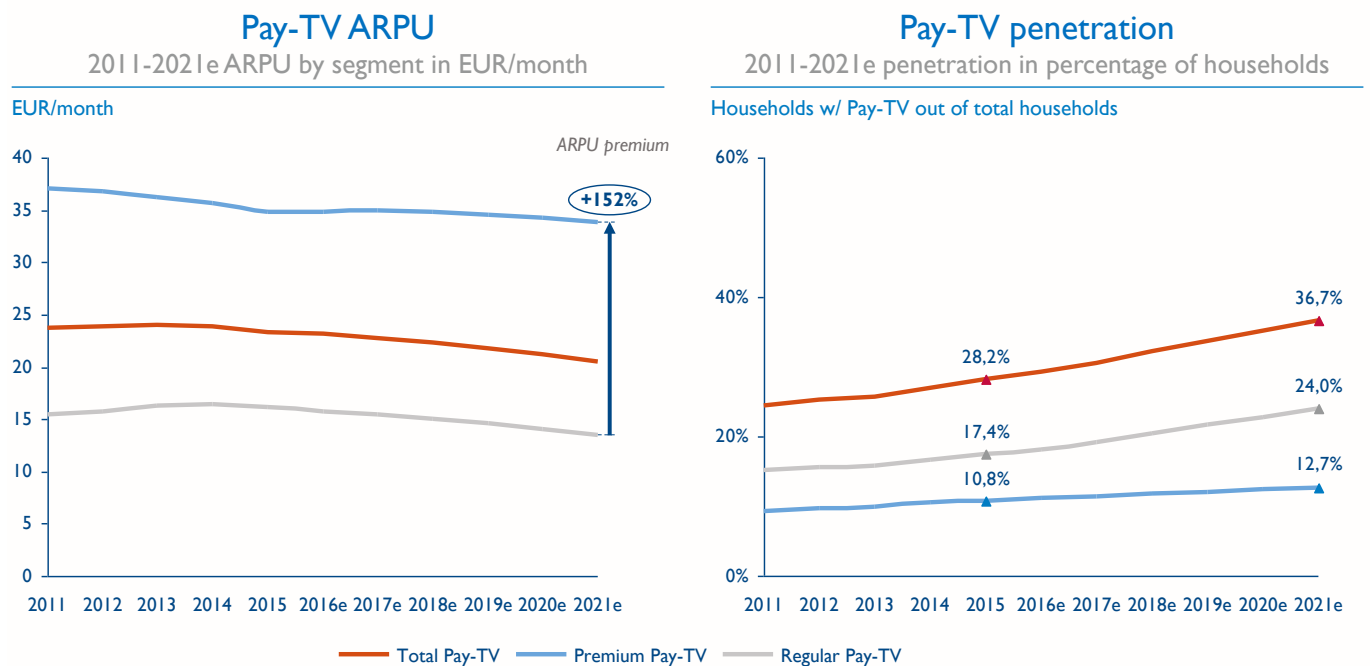
to the voice markets. Thus, telecom operators are less likely to consider these individually as drivers for growth.

3. Premium pay-TV has an edge over OTT and should continue to grow

Access to higher-definition visual media (films, shows, videos) pushes up the consumption of broad-band on both mobile and fixed platforms. While consumption of some pay-TV services

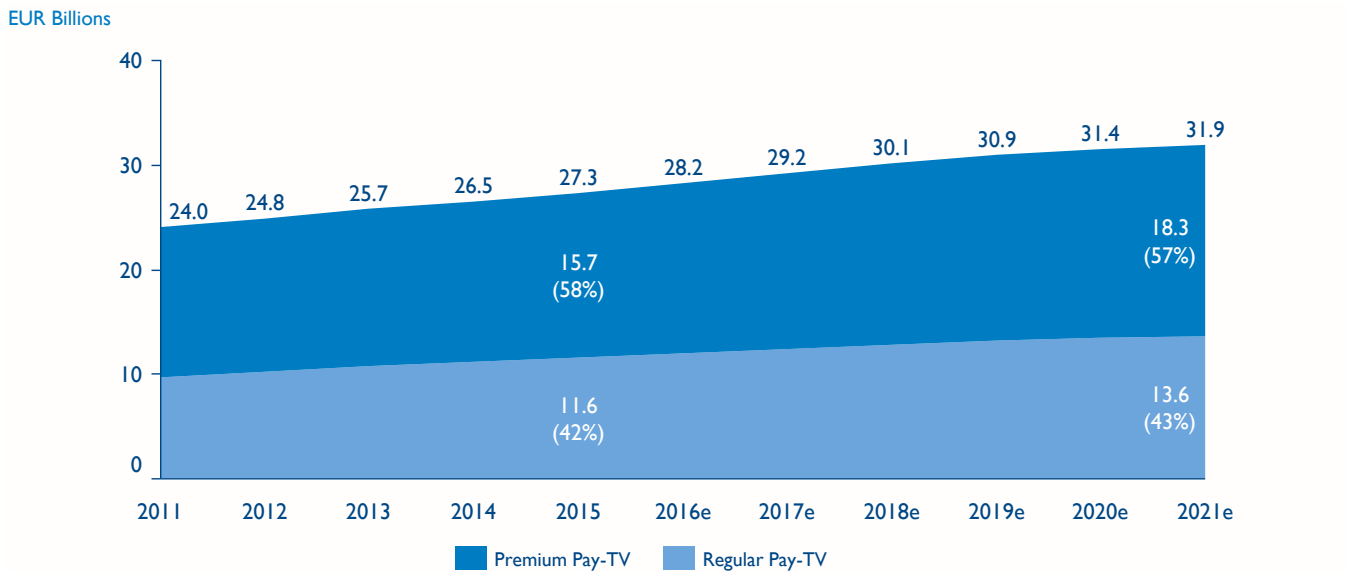
will decline vs use of OTT services streaming over an internet connection, premium TV will likely continue to have an edge due to exclusive content and thus will prove less substitutable to OTT. It should retain stable ARPU, coupled with growing penetration, due to increasing convergence of TV and other telecom services and delivery of television over the internet (IPTV).

Figure 7: Pay-TV ARPU and pay-TV penetration



Source: Arthur D. Little

Figure 8: Pay-TV revenue, by segment, 2011-21 (EUR bn)



Source: Arthur D. Little

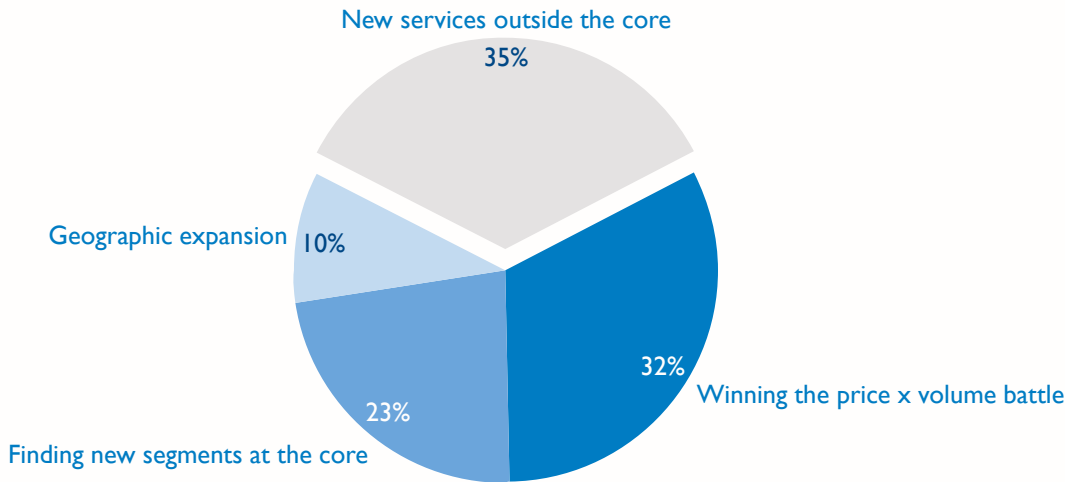
Similar to the fixed broadband market, the pay-TV segment is also experiencing a decline in ARPU, which is, however, compensated for by growing penetration rates. This is occurring in both the regular and premium segments. However, the difference in ARPU between these two segments is much more pronounced, resulting in a very high market share and growth contribution from premium pay-TV services.

Along with data revenue, premium pay-TV remains the only other growth opportunity for telecom operators in their core markets.

4. Telcos need to look beyond the core offer for sustainable growth

In three out of five segments, telecom operators should be able to realize growth, which will nevertheless amount to only about 1% CAGR over the next five years, on our estimates. This growth will be fueled by an increased volume of users and consumption of telecom services, which implies a corresponding increase in both capital and operating expenditure.

Figure 9: Anticipated growth drivers



Source: Arthur D. Little survey

Telcos are investing heavily in the rollout of superfast broadband and 4G as a means to facilitate the growing demand for traffic in terms of quantity and quality. At the same time, opex will grow, as the increased volume will require more spending on sales and customer service. Initially, telcos may be able to balance out the rises in their opex with cost-cutting initiatives, but this can't go on indefinitely, and demand for data traffic will continue to grow along with increases in population and economic growth.

We received mixed responses from our interview partners regarding their growth expectations. While the majority still rely on conventional growth (net gains from 'price x volume', new

segments such as B2B services and wholesale, geographic expansion), more than one-third of respondents believe growth will come from non-core segments, including offering new services in industries such as banking, utilities and smart cities.

Currently, over the projected period, telcos expected to win the "price x volume" battle. However, we expect some operators to focus on new market opportunities outside the core segments and to reconfigure to address the increased pressure on various financial margins.

2. B2B2x: Will operators finally take advantage of the digitization of the industry?

Telecom operators face a major issue with regard to differentiation, as high-speed broadband and ubiquitous connectivity are becoming less of an advantage and more of a “me-too” factor. At the same time, companies are shifting away from procuring telecom and IT as services and more towards seeking assistance in moving towards digitization.

We label this opportunity B2B2x. It has been created by IT players over the last decade or so, and it is poised for double-digit growth going forward, on our estimates. The issue is how can telecom operators best take advantage of the changing dynamics?

So far, we have seen operators engage in IoT, M2M and smart-city initiatives. What we are suggesting with B2B2x expands beyond connectivity and platforms into operating services (such as call centers and maintenance) and does not include consumer applications, as IoT does, but focuses on helping businesses to digitize. We estimate that the B2B2x market could reach a value of USD 276bn globally by 2020. In addition, we consider telecom operators to be favorably positioned to engage in this area, due to their existing capabilities in operating technological assets, their vast local service abilities and offering a customer interface.

Needed value propositions and engagement models, and the necessary capabilities and assets of B2B2x are not fully compatible with those of existing segments. However, without a pertinent transformation, executed in a timely manner, telecom operators risk becoming heavily entrenched in their roles of pipelines for connectivity (be it voice or data), which would restrict their chances for generating superior value.

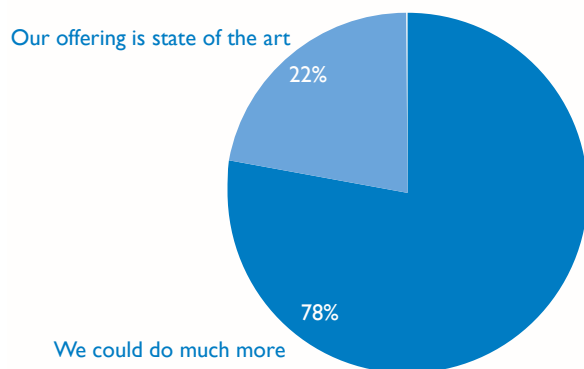
Overcoming the barriers currently preventing the significant monetization of B2B2x involves telecom operators gaining a better understanding of the industries in which their customers operate, reconfiguring their businesses and operating models in that direction, and generally achieving more agility and openness in their processes.

1. Does the impending digitization of industries amount to a new wave of OTT-like exploitation of telecom infrastructure?

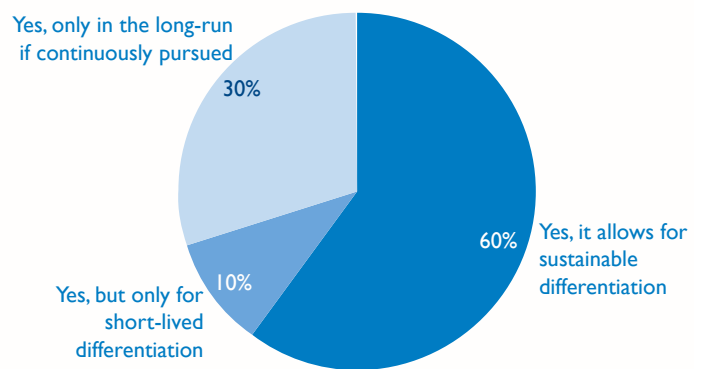
Companies are continuously increasing digitization as a means of market differentiation

One trend continues to drive change in many industries around the world: digitization of business models. Examples include smart agriculture, smart cities, smart toys, fin-tech, connected cars and public transport, smart homes, and so on. The rise of these segments illustrates how previously non-digital industries

Figure 10: Do you believe digital enrichment can act as a differentiator?



Q: How good is your present digital experience in your own perception?



Q: Do you believe digital enrichment of products and services can serve as a differentiator beyond customer experience?

Source: Arthur D. Little survey

are now heavily relying on inputs enabled by information and telecommunication technology.

Companies see digitization as providing potential for either higher productivity (efficiency) or market differentiation.

Digitization allows for higher volumes of information to be processed at higher speeds, and automates a wide array of processes once they are moved into the virtual space.

Companies not only seek productivity gains from digitization, but also differentiation.

This includes functions such as shipping and distribution, sales and customer service, production, accounting and human resources. All of these can all be viewed as efficiency benefits. Efficiency gains do not – at least directly – enrich the value proposition for the customer. But, they do indeed add value.

In addition to becoming more efficient, companies aim to leverage digitization to differentiate. Digital enrichment of products is reflected in the value that is derived from the consumer purchasing them.

Clearly, a car isn't necessarily a better car just because it is connected. And no light switch is a better light switch just because sensor and actor are separated and app controlled. Further, trucks don't function better just because they are now tracked with a dot on a map. However, the enhanced versions of the products offer clear functionality benefits that go well beyond the actual product. Companies in a broad range of industries are widely identifying the use of digitization for the purpose of differentiation.

Businesses benefit from these digital enhancements in three ways beyond productivity and efficiency:

- 1. Differentiation at the core:** Businesses use technological enhancement as key differentiators in otherwise non-differentiated products, through changed means of customer interaction and degree of knowledge. Examples include smart lawn mowers and light bulbs and connected toys, among others.
- 2. Servicication:** Vendors of products can now “manage and service” their products instead of just selling them, increasing the overall utilization and productivity of assets for themselves and their customers – and essentially widening relationships. There are many examples of this in the consumer space (smartphones, smart TVs, etc.) and in the business space (infrastructure-as-a-service).

- 3. Platform play:** Producers may enhance their products via platforms. An example of this is an app-store which combines entertainment content, payment and consumption into a single solution. The principle of a platform linked to an underlying product is the adding of value to the end customer, therefore allowing for product differentiation.

Initially, IT players have made significant impacts on industries with their ability to digitize: this includes the various music-streaming services, ride-hailing services, room-sharing platforms and the like.

We have seen what digitization can do, when thinking of Uber, Airbnb and the many others. B2B2x is about supporting companies in their ambitions towards digitization

Other types of IT players have supported their customers on their journeys towards digitization, such as Accenture, IBM, Tata and HPE. Clearly, these players and their customers alike leverage on the globally scaled enablement platforms provided by Amazon Web Services, Microsoft, Google and similar companies.

What is changing now, as companies are beginning to find their way into digitization, is the recognition that services need to be operated on a continuous basis and not end when the product leaves the ramp. This means companies require support in 'operating services'. This is also one of the differences from established M2M/IoT models: B2B2x goes well beyond connectivity and platform services and addresses deeper integration into customers' value chains.

To operate a service means to respond to customers' inquiries, invoicing on an event-driven basis (and having an agreement which covers that), monitoring delivery, installation and service performance, and managing licensing and configurations: many activities that are not yet available to, say, car makers or manufacturers of building automation systems. Yet, these are activities at which telecom companies excel. While in the past, operators may have performed these activities purely regarding their own services, many have begun to partner with third parties and operate and support foreign services as well, including TV, music subscriptions, etc. In the past, these were often bundled with a subscription model that related to the underlying connectivity, essentially turning 'bit-pipes for consumers' into 'sales-pipes for OTTs'. However, this doesn't have to be the case: why should an operator not sell enablement and operating services to the media and advertising industry⁵?

⁵ We reference this example not because it is particularly attractive – it is actually a smaller/less attractive B2B2x sub-segment – but because it illustrates how operators' current partnerships could be made to evolve further.

We believe that while global IT players will continue to disrupt established industries, support companies on technological evolution, and provide enablement platforms, telecom operators have a better starting position to operate digital assets in local markets. This is because they have existing assets and capabilities in place, so costs to test, integrate, deploy, manage and invoice for, say, smart devices, represents a minimal incremental outlay for them. Also, operators have established methods and capabilities to efficiently support their customers' customers throughout the service cycle.

Products and services will continue to be digitally enhanced and consumers, businesses and public institutions

Operators have the opportunity to figure out how to monetize digitization of the industry.

will continue to buy and use digitally enhanced products and services. Such digitally enhanced solutions will leverage available ICT infrastructure to the benefit of their vendors. This means, in a sense, there could be more OTT-like players out there than we may think – and the number may be growing each day. However, so far, many telecom operators have not figured out how to monetize this opportunity.

2. Delineating and sizing the opportunity

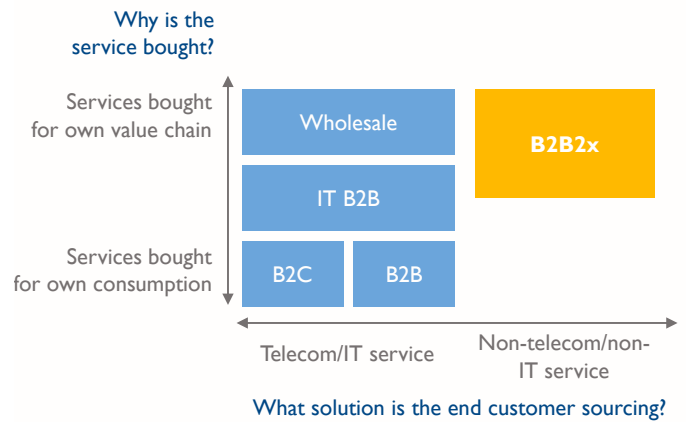
A new segment – B2B2x – is needed to describe the business opportunity of operating customers' digital solutions

The opportunity to support businesses in their digitization journeys not only regarding efficiency, but also on the redesigns their business models and the differentiation of their services, is one in which end customers are not buying telecom or IT services. Rather, they are buying non-ICT goods and services from providers outside the telecom and IT industries. These goods and services are, nevertheless, enhanced by means of telecom and IT services. In turn, the telecom operator's customer does not source telecom/IT services for internal consumption, but as a means to achieve differentiation of the value proposition in the market.

This brings us to two defining elements:

1. Which market the end customer is in – e.g., what product or service is actually bought; and
2. for what purpose the market procures telecom/IT services – e.g., for internal consumption or as value-adding input to the value chain.

Figure 11: Service value chain



Source: Arthur D. Little

What we are expressing here sounds simple: digitization puts telecom and IT services into other companies' products and thus into their value chains and other products, with the resulting revenue gain. What we argue, though, is that operators should evaluate whether this will actually represent a sizable, addressable and differentiated-enough opportunity to define a segment in and of itself: B2B2x.

While not every operator will recognize this opportunity as meaningful, we see sufficient evidence that it needs to be addressed distinct from the current go-to market and delivery approach. And, perhaps, it is the absence of exactly that train of thought which got in the way of monetizing the above-described client need for differentiation via ICT services.

B2B2x holds growth potential beyond the existing segments of telecom operators

To quantify the opportunity arising in B2B2x, we have reviewed a broad suite of digitization developments across various markets. We have assessed the following underlying markets each of which is undergoing digitization.

Each of these markets is projected to grow significantly over the next five years at rates depending on how each market is affected by mega-trends unfolding in technology (e.g., M2M communication, Big Data, cloud and edge computing) and business-model innovation (e.g., servicification and industry convergence). A complementary trend is the increasing virtualization of financial transactions, which allows for more remote and mobile payments, enabling the necessary mechanisms to monetize these possibilities. Industries more

heavily influenced by these trends offer greater opportunities for telecom operators to provide value-adding solutions through B2B2x models.

We have analyzed the value chain for each segment to better understand value distribution and evolution, and gauge the size of the opportunity for telecom operators.

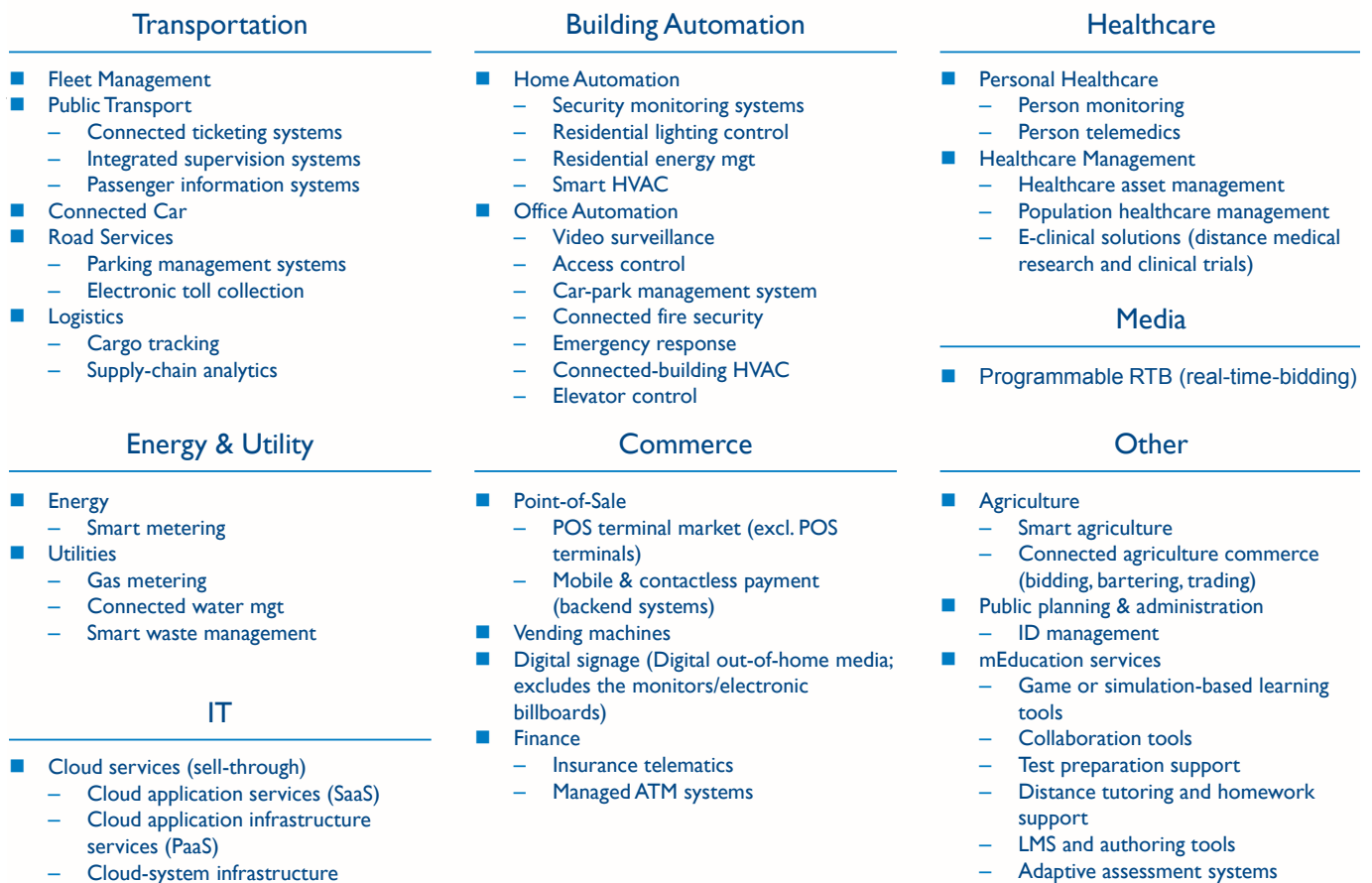
We estimate the total market size to be in a range of USD 248bn-303bn by 2020 on a global basis. From this point onward, we will assume the arithmetic mean of this range: USD 276bn.

Telecom operators are currently addressing this growing segment by contributing connectivity and some computer infrastructure services. In our view, these services

represent roughly 20% of the market volume we are discussing. The remaining 80% stems from supporting businesses in their aspirations to digitize their products and services.

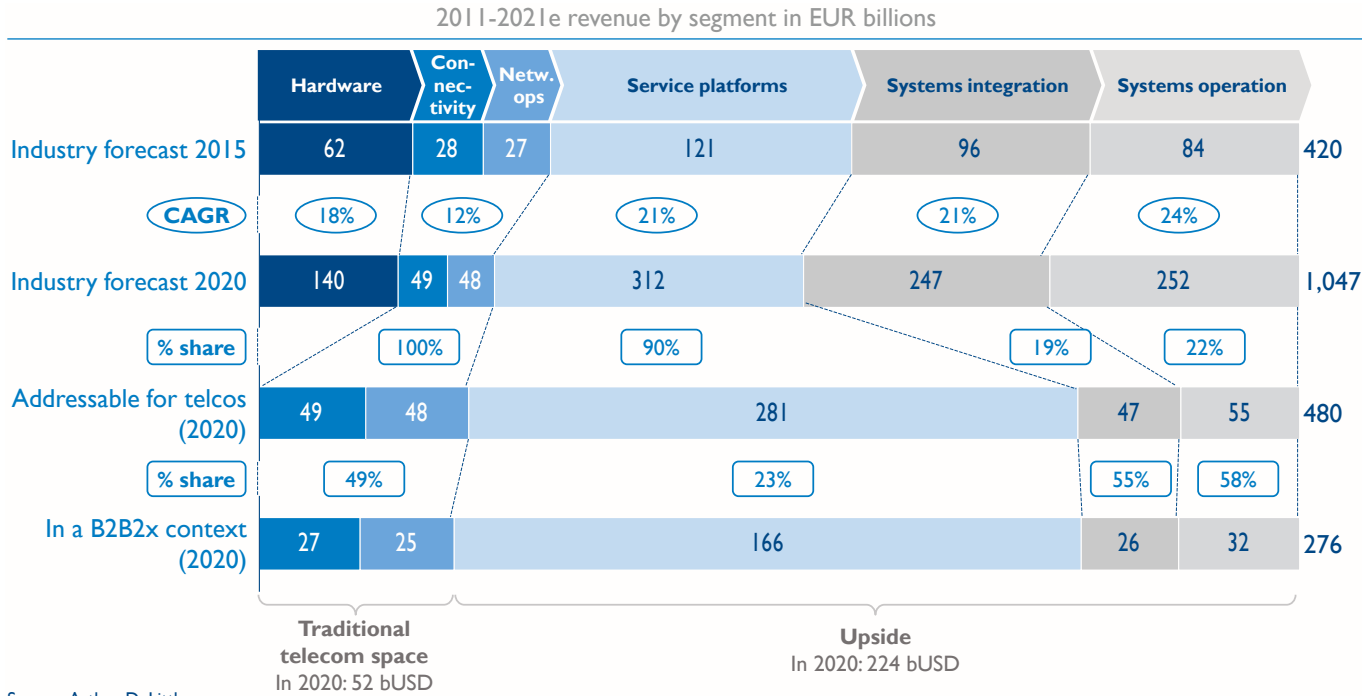
The global B2B2x opportunity is estimated to represent USD 276bn by 2020, with >80% of this is outside the traditional telecom space.

Figure 12: Potential B2B2x markets



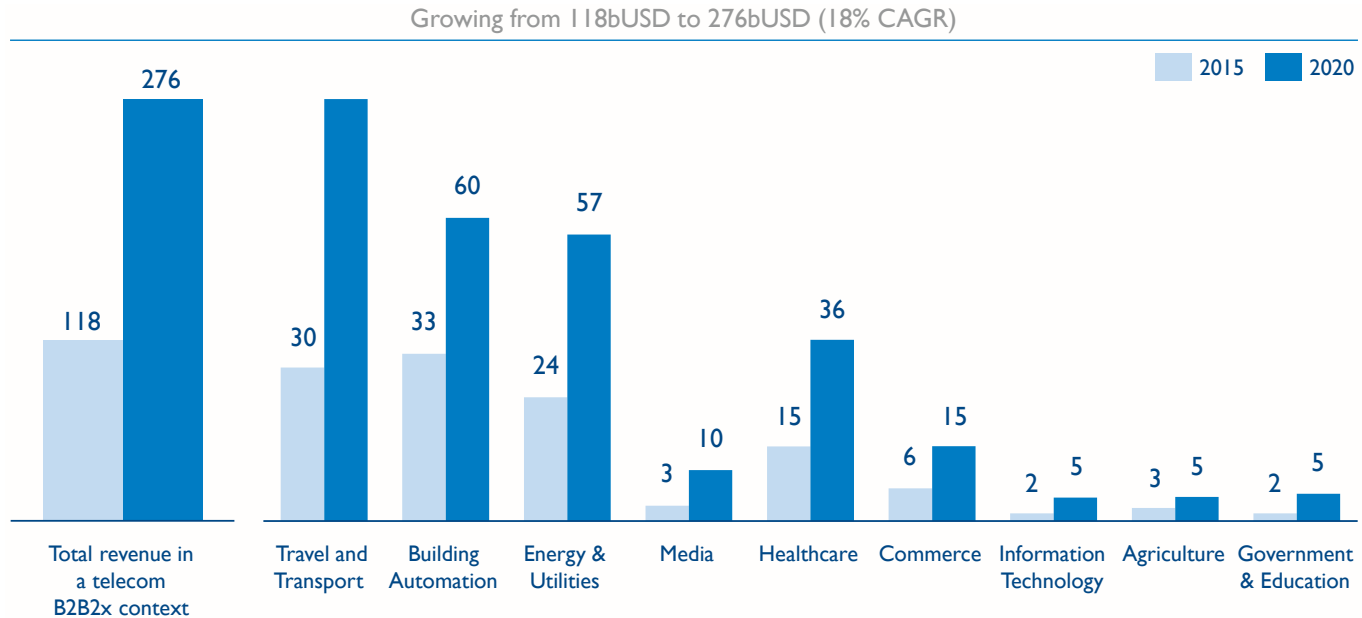
NOTE: We excluded the connected consumer electronics market and the video-streaming market, as projections on these markets would lead to substantial fluctuations in our forecasts, and the value available to telecommunication operators in the B2B2x model may substantially overlap with other markets or approaches, as well.

Figure 13: Global digitization opportunity (USD bn)



Source: Arthur D. Little

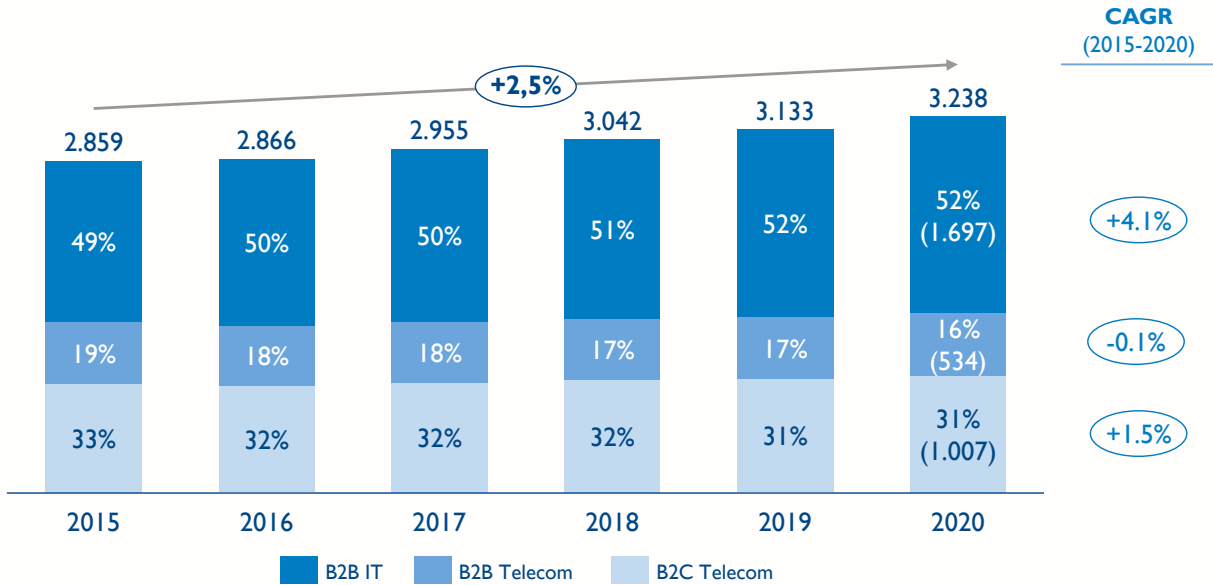
Figure 14: Global B2B2x opportunity by industry (USD bn)⁶



Source: Arthur D. Little

⁶ "Others" includes government services (some government services are spread across various industries), agriculture, education and solutions within the ICT industry.

Figure 15: Global ICT market, 2015-20 (in USDbn)

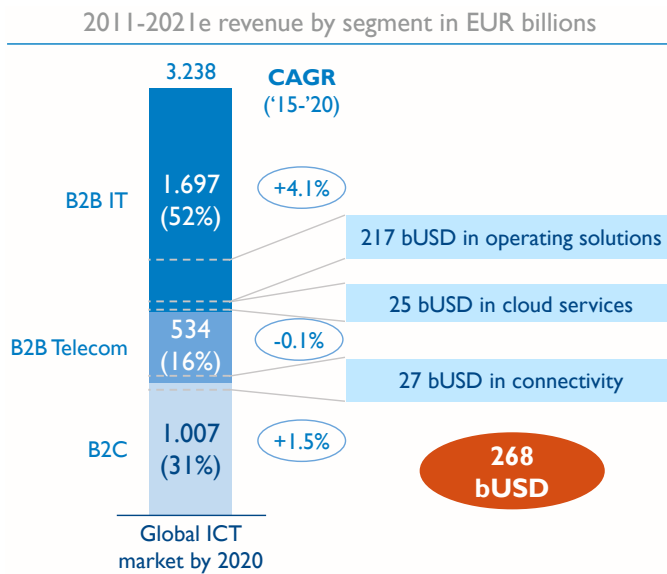


Source: Arthur D. Little & Gartner

Positioning the segment within the global ICT market gives perspective to its importance

At a size of USD 3tn, the global ICT market represents about 4% of global GDP. Overall, it is also growing at a similar rate to global GDP, at c.2.5% pa. The ICT market can be broken down into the following segments.

Figure 16: Global digitization opportunity



Source: Arthur D. Little & Gartner

An estimate of the full size of the B2B2x opportunity, connectivity and cloud included, equals USD 276bn globally in 2020, or 8% of the total ICT market. See the figure below for our estimates regarding the size of the global ICT market.

Given the above data, which segments will benefit most from this opportunity, and which companies currently serve the market? While many operators may wish to benefit more from the digitization of the industry, many lack the business or operating models⁷ to do so.

Existing segmentation – B2C, B2B and wholesale – does not sufficiently describe the features of B2B2x

Telecom network operators, due to their local capabilities and experience in operating infrastructure, are well-suited to operating technological assets and managing the customer interface. However, a) B2B2x services require deeper customer or industry insight and engagement, and b) operators need to acquire some of the capabilities of systems integrators to develop individual client solutions – even if they are being produced in standardized production environments.

Selling B2B2x services requires both depth and breadth in solution providing competencies. If a client is interested in, for example, a global container-tracking system, today's B2B sales approaches and steering mechanisms will very quickly prove unprofitable and too constrained to provide an appropriate support

⁷ We refer to the term "operating model" as consisting of processes, governance and an organizational structure; we refer to the term "business model" as the description of value creation that occurs in the process of buying assets and supplies and transforming them into products or services to sell, as well as the risks a company takes along the way.

mechanism. This is due to a number of factors, including the inability to design industry-relevant solutions, to deliver cross-border services, to provide adequate pricing models (e.g., solutions, not network, oriented), and to include customer support services, among others. More targeted approaches need to be developed, assembled and committed for delivery. Thus, the customer-facing approach requires reassessment, better technical interaction, and more commercial freedom to source and supply.

- a) IoT includes solutions targeted directly at the consumer segment.
- b) IoT typically does not include customer interaction services.
- c) IoT focuses on platform-play while B2B2x focuses on value creation for the client.
- d) B2B2x requires more intimate knowledge of industry-related value chains and ecosystem while most of today's IoT and M2M departments still focus on connectivity.

We have identified a significant discrepancy in the perceived value of a dedicated B2B2x segment between operators and their customers

We asked executives from both operators and non-operators whether they believed a dedicated segment focusing on B2B2x would be beneficial. The results showed that there is a significant discrepancy in views regarding the importance ICT players and their customers⁸ place on having a separate segment to handle the operation of digital features.

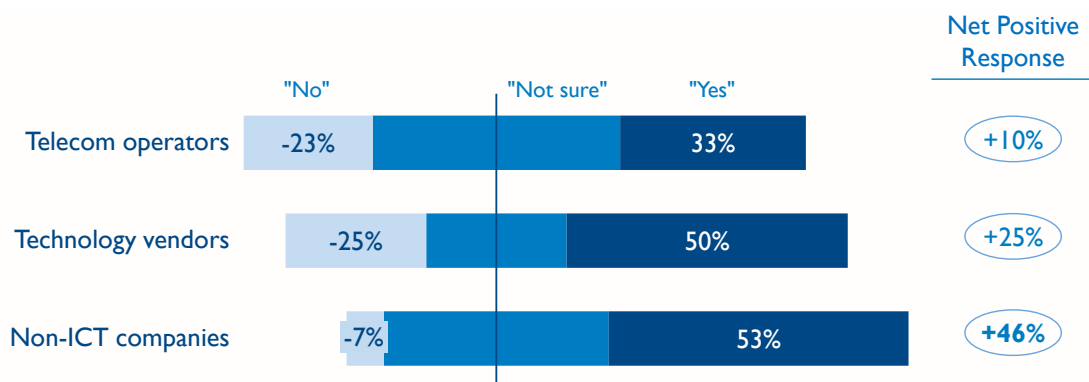
Despite the sizable portion (33%) of operators that see value in addressing B2B2x as a separate segment, there is a notable

discrepancy between the net positive responses regarding B2B2x from operators and the net positive responses of non-ICT companies to the same question.

Operators' are questioning three aspects of the B2B2x opportunity:

1. **Timeliness of the opportunity:** This is basically acknowledging that digitization is out there, and operators think they could help with its implementation, but are unsure how quickly the opportunity will materialize. We feel comfortable with our expectations regarding the opportunity, given that they are based not only on our research, but also on the research done for many underlying segments, as outlined above. However, this market is not currently dominated by telecom operators, but by IT companies. Operators choosing to get involved need to believe that providing IT services only does not suffice but that offering connectivity and low cost operations are also necessary.
2. **Ability to monetize the opportunity:** Given that the segment was created by IT companies, are they not much better situated to leverage on it? Our answer to this question is: maybe not, as few IT companies can credibly offer operating services and the related customer interface. IT companies may provide the technology, so they will capture a part of the opportunity. But, operating technology, e.g., IT, devices, services, customers and users, is an entirely different offering. Some IT companies may indeed create the demand and have been doing so, but many still struggle in this area.

Figure 17: Do you think the introduction of a B2B2x segment would be worthwhile activity?



Source: Arthur D. Little survey

⁸ Note that non-ICT companies were asked how worthwhile it would be for their ICT suppliers to introduce a B2B2x segment.

3. **Credibility in the go-to-market:** This is indeed a two-sided issue. Operators are often driven by EBITDA margins, while the B2B2x model may be more of an EBIT-oriented game than the traditional telecom network play. Levels of investment vary depending on individual operators' choices of how horizontal or vertical they wish to go. But above all, altering the go-to-market approach away from a product-sales orientation into a support/consultative approach is a major change for many operators. It is still far from clear how to mass-produce solutions. It is clear, though, that

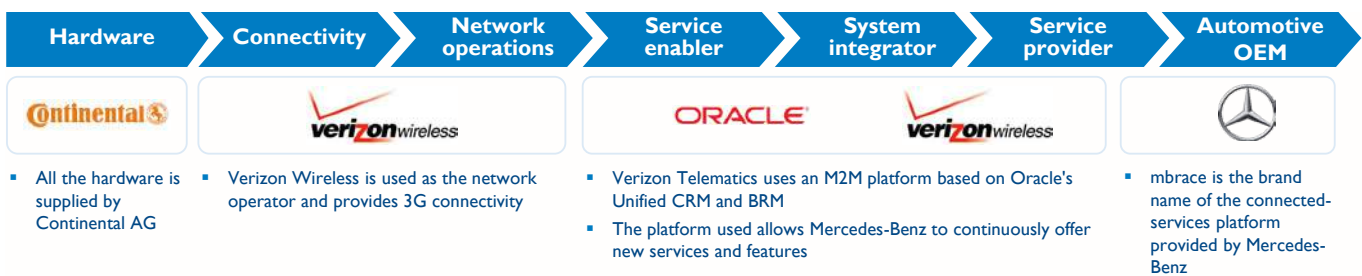
recent technological developments have made it possible for operators to address this issue.

53% of non-ICT customers, on the other hand, want to find an interface to operators which allows them to engage in a digitization discussion in a B2B2x context. The next sections describe in more detail what they seek.

3. Examples of B2B2x opportunities

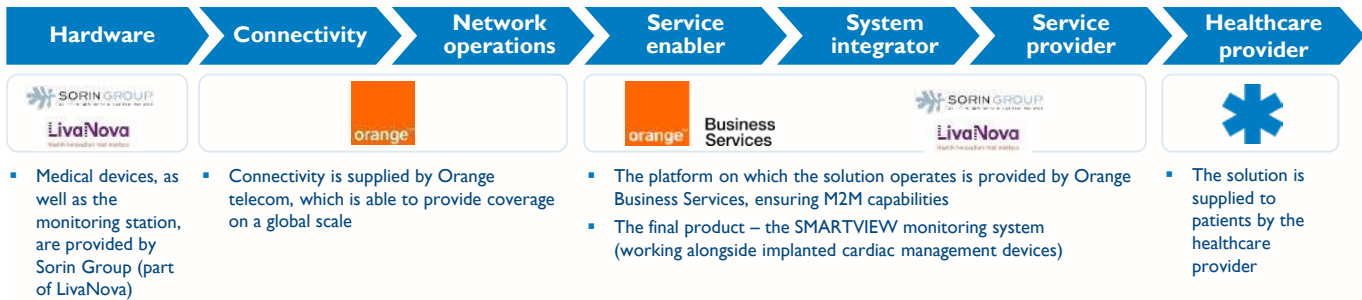
We have collected some examples of where operators are supporting their clients in their digitization efforts.

Figure 18: Example 1 - the mbrace telematics platform solution (transport & mobility)



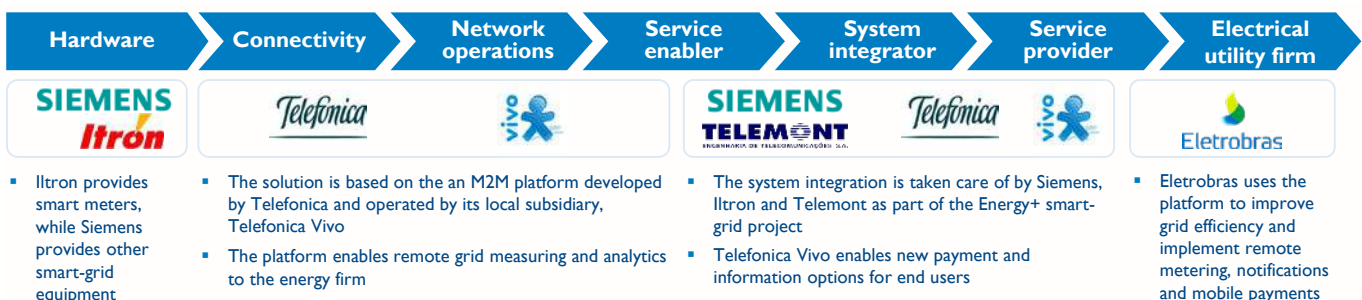
Verizon services the entire value chain, from connectivity to integration of vehicle telematics, on a single platform (marketed under the brand name "mbrace"), which has been integrated into Mercedes-Benz cars. mbrace is one of the USPs of these vehicles, which is enabling Verizon to address the needs and preferences of Mercedes' customers when designing the features enabled by its platform.

Figure 19: Example 2 - SMARTVIEW enables remote patient monitoring (Healthcare)



Orange Business Services co-developed a telemedicine solution (SMARTVIEW) with Sorin Group (a subsidiary of LivaNova), which is an internationally scalable monitoring and analytics platform for people with implanted cardiac management devices. The hardware is provided by Sorin Group, which also sells the devices to healthcare providers. Orange Business Services provides the M2M communication capabilities. Orange's network allows it to provide its partner, as well as the healthcare provider, with connectivity on a global scale.

Figure 20: Example 3 - Energy+ smart-grid project with Telefonica's M2M platform and integration (energy & utility)



Through its Brazilian subsidiary, Vivo, Telefonica has a role in developing a smart grid for the energy company Eletrobras. Via its M2M platform, Telefonica is not only a provider of device connectivity, but also an operator of many of the functionalities necessary for successful utilization of a smart grid. Telefonica further integrates solutions through other partners in the project – Siemens and Itron – making new payment methods and notification systems possible for the end consumer and energy provider. As such, the operator is not only providing technology, but building a full supply chain to support Eletrobras in benefiting from ICT.

Other industry examples

In agriculture, the connectivity of farming vehicles, irrigation systems, and new ways to survey and manage worked land have enabled AT&T to work with Monsanto on providing supply-chain solutions for farmers.

Even in heavily regulated industries, such as finance and healthcare, projects have taken place: e.g., Swisscom has put in place an extensive portfolio of white-label and back-end solutions for banks and financial institutions. Some work as B2B2x and some as pure B2B, while both benefit from the synergies of addressing similar customers and using the same technological capabilities in a context that is not focused on the telecom product, but on a specific client business case. Below we present a longer list of how operators can support industries.

While there are many use cases, so far, there seems to be little “breakthrough growth”

All of these examples sound “niche-y” and “small” – which they generally are. They do not yet offer breakthrough growth.

While current examples sound “niche-y”, they overall already account for good business. And, they help us to identify the fundamental functional benefits that need to be scaled up.

However, they show us what is needed to deliver on the opportunity. Abstracting from the above examples, the solutions really consist of a concise set of functional benefits: track and trace, customer experience customization, dynamic pricing, solution convergence, sharing economies/usage-based models, deployment and local installation/integration, remote control and monitoring, customer support and device management. We focus on these later in the report.

Revenue streams are composed of three elements: connectivity, platform services and operating services.

However, these functional benefits must be delivered for the purpose of integrating with operators’ customer’s value chains. Operators need to address clients’ requirements on availability, quality, manageability, configurability and integrability:

- Service quality must be consistent, uniform, predictable, transparent and accessible

Figure 21: How operators can support individual industries

Transport & Mobility	<ul style="list-style-type: none"> ▪ Fleet management for companies and public transportation ▪ Supply-chain optimization 	<ul style="list-style-type: none"> ▪ Parking management for cities ▪ Electronic toll collection and ticketing systems
Building Automation	<ul style="list-style-type: none"> ▪ HVAC controlling systems ▪ Access control, alarms systems and surveillance ▪ Connected elevator controlling 	<ul style="list-style-type: none"> ▪ Emergency-response systems ▪ Building garage and parking management
Energy & Utility	<ul style="list-style-type: none"> ▪ Smart metering ▪ Smart-grid M2M communication platforms 	<ul style="list-style-type: none"> ▪ Connected waste management for public and private entities ▪ Grid optimization analytics
Media	<ul style="list-style-type: none"> ▪ Digital outdoor media management ▪ Mobile advertisement platforms ▪ Advertisement-slot bidding systems 	<ul style="list-style-type: none"> ▪ Big data analytics for marketing-campaign optimization ▪ Content delivery
Commerce	<ul style="list-style-type: none"> ▪ Mobile and contactless payments ▪ e-Wallet ▪ Auto-insurance telematics 	<ul style="list-style-type: none"> ▪ Online-banking platforms ▪ Vending-machine management ▪ Augmented-reality shopper experience
Healthcare	<ul style="list-style-type: none"> ▪ Person/patient monitoring ▪ Telemedicine platforms to link patients and clinics 	<ul style="list-style-type: none"> ▪ Electronic clinical trials ▪ Hospital asset management
Others	<ul style="list-style-type: none"> ▪ Population healthcare management for governments ▪ Smart bidding platforms for agricultural produce 	<ul style="list-style-type: none"> ▪ Learning management systems and game-/simulation-based learning tools ▪ New service revenue streams for consumer electronics

Source: Arthur D. Little

- Services must be delivered just in time, activated on demand, and integrated with a company's own production approaches and/or platforms
- Services must be deployed flexibly, dynamically and configurably, allowing the support of multiple use-cases without manual administrative interaction with the supplier
- Services must be integrable into own production or delivery mechanisms, basically utilizing API exposures on the side of telecom/IT suppliers to fully integrate the final good or service

These are the steps telecom operators need to take in order to gain access to and successfully monetize the B2B2x opportunity, in our view.

4. Overcome obstacles in order to tap into the B2B2x opportunity

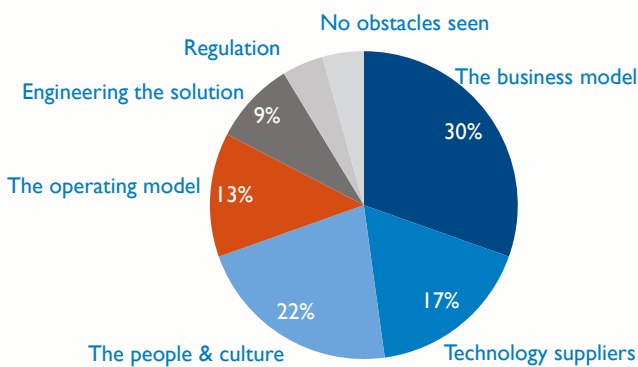
A major part of digitization hurdles can be alleviated by the telco

From the responses of non-ICT businesses, we can infer the perceived constraints as show below.

The good news is: engineering a solution is hardly ever the problem. Our interviewees also don't see regulatory constraints to be a limiting factor. The top-ranked issue is the customers' business models, technology delivery, people and culture (including skills) and operating model. While telecom operators aren't really in the business of solving people-and-culture issues, they can support customers on the other three top scorers – and

To drive B2B2x, operators need to know how their services create value for their customers and why they should buy them

Figure 22: Constraints as perceived by non-ICT businesses



Q: What obstacles do you see in digitally enhancing your products & services?

Source: Arthur D. Little survey

these already account for 63% of the problem. On a side note: what strikes us most is that technology supply is viewed as an obstacle. This could be indicative of a mis-match between the way solutions are designed and proposed and what customers need to successfully digitize their products and services. To overcome this issue, we would propose that telcos:

- Amend their go-to-market strategies based on dedicated verticalized expertise;
- Allow sales teams to engineer solutions based on their clients' context – liberated from internal constraints, with the focus on generating value for the customer; and
- Redesign their production environments to include third parties – both customers and partners.

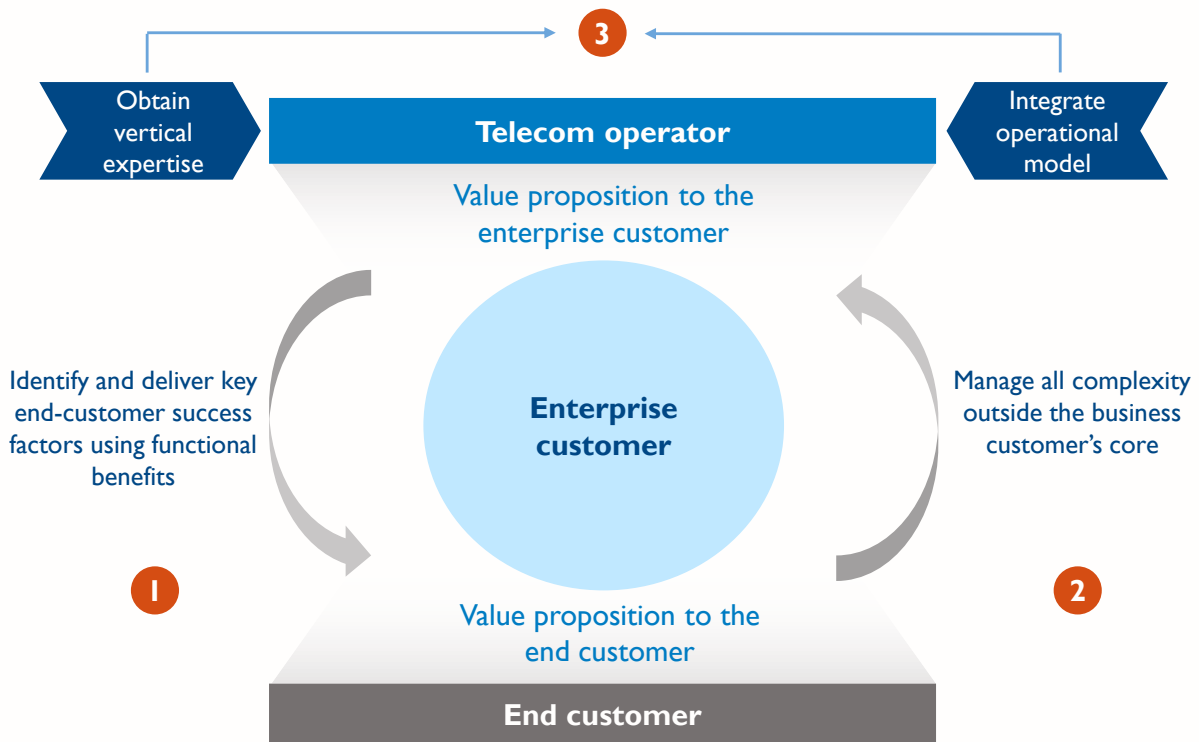
Introducing dedicated vertical expertise provides access to the largest portion of the B2B2x opportunity.

The typical approach for a telecom operator to extract value from the B2B2x opportunity is by starting small and scaling later. It is a two-step approach:

- Operators need to understand a business issue that may exist in a particular industry and provide a solution that delivers end-customer key-success factors. This will be the value created by augmenting the enterprise customer's value proposition. Often the related use cases are small. An example is wi-fi management of a stadium.
- Operators need to scale the opportunity by addressing more use cases within the same industry, offering the same solution for multiple other, related applications. Examples include parking-lot management, ticketing, live streaming, cell-phone coverage, security-situation awareness and video surveillance for that same stadium. Alternatively, there could be markets for wi-fi management at horse racetracks, cinemas, airports and on ships, among others. The idea is to build a community of application ideas.

Many companies are not technologically savvy enough to understand all that technology can do for them and how this can be done. Thus, operators need to remove all technical complexity associated with the delivered solution. The unique advantage telecom operators have over their IT competitors, such as IBM, HPE and others, is that they are able to operate infrastructure and services on a continuous basis, including customer interaction, and do so at relatively low cost (at least for those aspects that fit right in with their operation of a telecom network). What this entails are designing and operating ICT solutions for non-ICT-skilled customers, monetizing part of the benefit they create for their clients.

Figure 23: Tailoring the value proposition



Source: Arthur D. Little

1. Delivering functional benefits to meet customer’s key criteria for success

Telecom operators need to start the process by gaining a better understanding of what really counts as an “enhanced value proposition” in the context of the enterprise customer’s industry. For an elevator operator, it could be ‘service availability’, but also granularity of diagnostics. For a car manufacturer or distributor, it could be flexibility in delivering on-demand solutions over an on-board platform. Below, we have categorized the overarching functional benefits a telco could deliver to enhance the value proposition of a customer. It is up to the telco to understand how and where each one can be applied to really constitute a more attractive offer to the end customer.

Automated customization of customer experience: Lack of knowledge, limited employee time and lack of flexibility of assets make it difficult and costly to cater to individual customers. Telcos can leverage collected information to deliver dynamic digital content to their customers’ customers at the right place and the right time via pricing, special offers, information and advertisements tailored to the specific customer.

Dynamic pricing: Telcos can help customers with allocating capacity by enabling them to match demand with supply at impressive response rates. An example is parking systems.

Telcos can provide customers with information and advice on available parking options and, at the same time, use their knowledge of the demand side to allow parking facilities to adjust their prices based on incoming traffic, effectively creating a dynamic marketplace that is transferrable to a wide variety of products and services.

Managing the convergence of solutions: Industries do not become more connected only internally or with their customers, but also with their other partners and suppliers required for delivery a solution. Telcos can help customers manage the platforms that emerge out of this trend, consolidating various industry solutions into a value proposition for their customers. For example, in connected cars, the telematics service managed by the telco can become a marketplace for motor insurance, “infotainment” content, paying road taxes or even booking hotels or parking spots.

Enabling sharing economies, “as-a-service” and usage-based models: Superior capabilities in sensor technology, tracking and near-field communication support responsiveness and security in the management of mobile assets. All sorts of transportation vehicles – bikes, cars and boats – are already being rented on-the-go, using connectivity rather than physical contact points. Access to other items, such as construction tools, warehouse space and industrial machinery, and even

services, is now being based on this model. Telcos can handle the arising complexity of asset management becoming a critical point in many markets through their ability to accurately allocate usage or capacity, which allows the asset owner to maximize utilization.

Deployment and local installation/integration: Many applications require deployment of software and hardware, possibly at a local site or via integration into an existing platform. Given that many operators (especially fixed-network operators) have field-service forces, or have the capabilities to manage such teams, local deployment support becomes very possible. Many fixed operators have expanded on their communication services by offering home alarm systems. Installing these is typically not a problem. Similarly, some operators have already demonstrated their abilities to successfully engage in the smart-home market by installing and operating related services. Nothing is hindering the further expansion of these offerings to business buildings, warehouses and vehicles, among other areas.

Remote control and monitoring: Switching on the air conditioning in your car or house on a hot day before you enter certainly sounds appealing. But the features telcos can enable for products through remote control and monitoring do not end there. In healthcare, for example, these concepts can be used for monitoring patients away from medical facilities and even administering drugs when necessary. This area offers potential for gains in terms of effectiveness, e.g., better control over a situation, as well as higher productivity (in the form of fewer physical resources required). For companies with global operations, this could immensely increase the amount of “shared services” that can be centralized or even managed by a third party.

Customer support and device management: Services in this category span a wide range of activities: client interaction via chat, mail, phone call, social media and others, as well as monitoring and maintaining client devices and configurations, ensuring security, managing the transitioning into the solution and the next solution, etc.

The understanding of vertical key success factors in order to deliver the correct functional benefit does not happen without internal changes to an operational model (to facilitate delivery) and changes in innovation sourcing and available competencies (to facilitate understanding).

In the past, many operators’ innovation efforts revolved around tariff offerings, technology adoption as presented by technology vendors, and various forms of competitive intelligence. Today’s

sources of innovation have expanded into customer applications – things technology can do. No company needs any technology for the sake of that technology, but all demand what it enables: speed, reliability, manageability, lower costs, higher productivity, and better differentiation. The same perspective can be applied in B2B2x: a customer would not benefit purely from innovation in telecommunications or IT, but rather from the application in the context of their industry. With the increased importance of understanding the value chain of the customer, so too comes a necessity for a broader scope for finding innovation, venturing beyond what is available in the ICT segment.

2. Managing complexity by integrating business and operating models

The second step of gearing the company towards engaging a customer’s value chain involves pivoting their value proposition around the problem it addresses rather than the underlying technology. The inability of a customer to architect various telecom/IT tools and technologies into a marketable solution is what the telco should seek to mend.

Mechanisms for governance and managing processes and information need to be coordinated to allow the seamless integration of operator services into the structure of a client company. Systems for activation, delivery and operation need to be synchronized. This requires that organizations open up by developing technical, organizational and process interfaces.

The business model of the telecom operator should extend further efforts into augmenting the other sections of a customer’s business model into their capacity for delivering and/or maintaining this solution. The core of the value proposition in B2B2x is not limited to the functional benefit delivered, but heavily built on managing all related processes beyond the customer’s expertise. The opportunity is open to those companies that overcome this hurdle and make technology accessible business-wise.

More flexibility, compatibility and adaptability are needed from assets and capabilities, including production models and solution development

Telcos already have established network and IT assets, which gives them a head-start in providing ICT-related services to a broad and diverse customer base. However, these assets are often embedded in quite monolithic IT stacks. It seems that expanding these stacks to cover additional asset classes (such as customer-oriented assets) is as difficult as breaking the stack into layers to enable more configurability. The abstraction of

network operations through SDN⁹ and NFV¹⁰, on the one hand, and the reworking of the OSS/BSS¹¹ approaches, on the other, may address these requirements, allowing faster time to market and better collaborative capacity with third parties. However, this will only be successful if done from a perspective of enhancing customer experience or interoperability.

Operators will need more flexible, adaptable capabilities to manage a more diverse set of requirements efficiently, especially if they are to venture into some vertical segments. At the same time, they should avoid entertaining client-individual or even business model-individual platforms. The diversity of solutions required makes investing in a platform on a one-to-one basis less attractive. Instead, managing platforms across organizational boundaries of clients and partners alike may be sufficient.

Aside from delivering on the functional benefits described above, having functional breadth spanning communication, computing and operational services becomes necessary.

Lastly, regional or even global uniformity of services and approaches gains importance. Otherwise, any enterprise entertaining a cross-border business will face difficulties and inefficiencies when engaging with nationally bound operator models. This makes multinational or global uniformity a desirable characteristic.

Achieving customer focus is key

The key value driver of B2B2x is to regain focus for creating value for the customer. Delivering value to clients requires operators to think in terms of “share of wallet” rather than “market share”. Operators need to develop a sense of the value they are able to create for their clients through the application of technology, and package that value in such a way that customers are able to purchase services and based on that achieve greater success on the market. And, they need to do this in a more industrialized, replicable manner than we have seen so far. This may require new organizational setups. But, it definitely requires a change in the mindset of the customer-facing units to re-focus on customer benefit.

⁹ SDN = Software-defined networks, e.g., the orchestration of network elements' configurations and behaviors through software.

¹⁰ NFV = Network-function virtualization, e.g., the abstraction of individual network functions into a virtual layer, thereby separating the needed hardware and software.

¹¹ OSS = Operating support systems, e.g., all network-facing systems (element managers, configuration tools, resource management tools, capacity management, incident and problem management, documentation, etc.). BSS = Business support systems, e.g., all commercial-facing systems (customer management, sales support, channel management, self-care, product and service management, financial management, mediation, billing, rating, logistics, customer-care systems, etc.).

3. Changing production models: why and how?

Meeting customers' evolving needs

Operators have struggled to monetize the growth of data traffic. More importantly, though, many operators have recognized that they need to redesign their production models to meet the continued demand for bandwidth, agility, accessibility and efficiency increases.

Having asked more than 100 telecommunication executives about their approaches to transformation, we received answers that could not be more diverse. There are many initiatives to redesign the production model – mostly focused on IT, but some also on the various networks.

But, we also found commonalities: operators' transformation initiatives follow three drivers, which we discuss in more detail in this chapter:

1. Improving customer experience by offering and exposing functionality that influences the behavior of the network, and by allowing real-time self-order, real-time provision and self-service;
2. Lowering production cost by reinventing IT and the network and fully utilizing cloud-related efficiency and scale benefits, as well as utilizing sharing of assets where sensible;

3. Allowing for more and faster innovations to hit the market through partnering as well as internally.

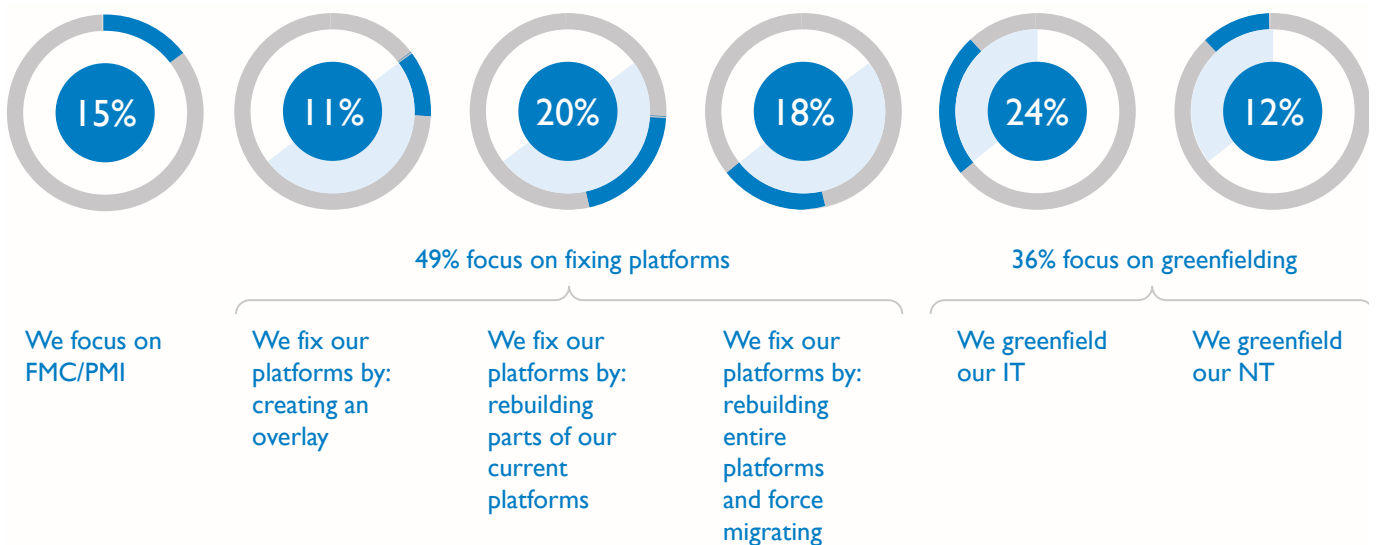
1. Improving customer experience

Customer use of broadband connectivity is evolving rapidly. The increase in non-linear video consumption, combined with an increase in 4K, early virtual reality applications and devices, an increase in fiber access, edge and cloud computing for businesses, etc. are all pointing in the same direction: more bandwidth and better QoS¹². Of course, this growth is fueled by an increase in services following carrier, OTT, IoT and B2B2x business models.

In addition to the increase in traffic, we will also see the number of transactions rise. It will thus be-come imperative to automate network management, activation and provisioning and provide differentiated services to the suppliers of network-related services. All this translates into the need for more elastic, configurable connectivity services.

There are operators offering many of these features already; however, the method of configuring and producing them is often manual or only semi-automated, limiting the benefits to a few customers or use cases and inviting a rise in errors and delay.

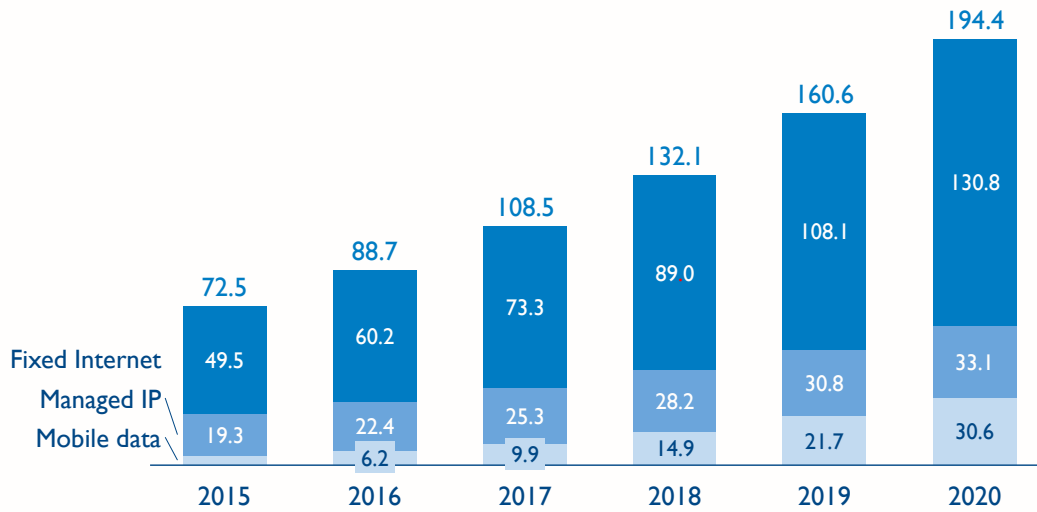
Figure 24: What transformation approach are you focusing on?



Source: Arthur D. Little

¹² QoS = Quality of service. We refer to the fact that other than throughput, other technical parameters are gaining importance in customer experience.

Figure 25: Global IP traffic (ZB)



Source: Cisco White Paper "The Zettabyte Era - Trends and Analysis" Jun 2016

Examples of requirements	Description
Bandwidth on demand	<ul style="list-style-type: none"> Adjustable bandwidth Guaranteed, constant stream bandwidth (e.g., for streaming or surveillance applications) Capacity reservations in aggregation and core (e.g., to ensure that in case of failover, capacity is available without performance degradation) Bit-level, error-free failover between main and secondary routes (e.g., for media applications) End-to-end bandwidth management functionality (e.g., to ensure that all network segments support the agreed services)
Traffic prioritization	<ul style="list-style-type: none"> Traffic is prioritized throughout the network depending on the criticality of the traffic Application-aware traffic management and policing for in- and outbound traffic Capacity management on a service-by-service level (e.g., to manage public internet traffic separately from other applications, despite using identical routes) Mission-critical environments are supported and related evidence is generated
Latency-aware routing and rerouting based on traffic volumes – respecting service guarantees	<ul style="list-style-type: none"> Traffic types requiring latency management are routed to ensure target-level latency Examples may include remote control applications in traffic management, etc.
Security – generally and especially during configuration changes	<ul style="list-style-type: none"> Manage network-level security for typical network attack-scenarios Offer automated interfaces for security applications to request device isolation (in case a device is recognized as compromised) Support other security applications to leverage packet inspection methods
Quick and easy deployment	<ul style="list-style-type: none"> Automated service deployment following a best-connected approach with service-level restriction management
Client-transparent routing – including fallback routes	<ul style="list-style-type: none"> Interface with client applications regarding the active traffic routing by traffic type Expose routing decisions made
Service monitoring and orchestration	<ul style="list-style-type: none"> Expose service-monitoring results (e.g., performance, packet-loss, etc.)
WAN optimization in all shapes or forms	<ul style="list-style-type: none"> Traffic is being cached, compressed, re-packaged, etc., based on type, service level and destination
And many other features required to support consumer, business and government demands	

Source: Arthur D. Little

Beyond this, present best-effort IP network architectures limit performance-management abilities.

Automating and exposing these functions via APIs to clients, other operators and product partners enable use cases that would not be possible otherwise. Easy examples include the dynamic increase in bandwidth to support the accelerated daily push of SAP data into a data warehouse; the ad hoc caching of media content at the edge; or the bit-error-free-in-sync rerouting of the live video feed of a soccer game in 4K from the stadium to the studio in case the primary route has too much delay. Beyond elasticity of singular services, combining them creates even more value. An example may be found in the security space: the spontaneous restriction of a compromised device from accessing the other, still secured servers, until the device is secured again.

Beyond enabling real-time self-order, real-time provision, and self-service, it is about avoiding costs spiraling out of control in light of elastic demands that stem from managing multiple types of services, each with its own QoS requirement on a single IP network.

Operators able to create elastic, efficient and transparent service platforms supporting functionalities as described above will be able to leverage opportunities for innovation, whether alone or in collaboration with third parties. Those continuing to operate in monolithic stacks will be closed out of these fields of play.

Clearly, existing services will be reinvented on the new platforms, be they voice, messaging, unified communications, cloud networking, data networking or managed services. But, they will be built to be positioned in new fields of play or value pools ranging from the IoT, Big Data, smart cities/homes/etc. or B2B2X models of service provision.

Lastly, the ability to scale out services gains importance. Some operators, such as Telstra, transform their production models to reach beyond their network footprints. We anticipate dynamics to occur in three ways:

1. Operators managing other carriers' networks in non-competing territories
2. Operators integrating with others' networks to address the needs of multinational customers beyond the own network footprint
3. Operators allowing other carriers to use their own networks with less manual intervention in the process

We can envision a world in which operators compete in markets well beyond their own network assets and reach, but still utilize their OSS and BSS platforms. Consider Gigsky offering broadband services for travelers in 90 countries; or cubic-telecom, which offers services in 200 countries based

on a cloud-like production platform. Essentially, the network operator's competitive environment changes: web-like collaboration possibilities will drive competition on a more global scale and, as such, may drive further consolidation. We expect to see:

- a. Increased pressure to structurally separate assets from service entities – to liberate operators to play for scale as they compete across boundaries, and for the supply side to gain incremental benefits from the wholesale market
- b. Continued price-based competition with more services or volumes bundled in
- c. Better and more attractive services, as networks as well as services will compete
- d. Matching up of global or multiregional B2B2x demands, with suppliers being able to deliver across borders

Clearly, those operators trapped on the receiving end of globalization will face a shrinking addressable market. While there will be winners and losers among operators, customers will win in all cases: industrial digitization will advance, globalization will continue, and consumers will benefit from ever more agile and open-service experiences across all three domains: home and entertainment, work and public services.

2. Lowering production cost

Lowering production cost is always an important topic. Some operators have taken more radical approaches to lowering their production costs than others, and many methods are being covered in numerous reports. In this report, we do not want to iterate the full range of commercial, operational and technical levers; rather, we want to highlight the most effective options operators – big and small, privately and publicly held, fixed and mobile – used to reinvent their production platforms for the purpose of lowering costs.

Reinventing IT

Do it yourself (using open source)

In some advanced European markets, we have seen mobile operators (mostly private equity-owned challengers) turn away from major-vendor BSS/OSS environments and instead turn to open-source or even self-made applications. The obvious initial reaction will be that this will bring limitations in functionality, lack of differentiation ability, lack of roadmap and stability issues. However, thoroughly validating the outcome shows that these downsides do not actually appear. The reviewed operators are highly agile and operate at much lower costs while fully meeting customer needs at the POS, online or via apps. At the same time, issues do not spiral out of control, fixes and changes

are being applied swiftly, and there are no major system faults occurring. However, we have not (yet?) seen any larger operator engage in such an approach. It seems that many larger operators prefer to go with the big-name companies, such as Amdocs, Oracle and others.

We can't generally say that do-it-yourself solutions actually beat big brands' solutions, but we can say that some smaller operators have chosen a DIY strategy and were proven to be well served. It seems that big-brand suites have grown into heavy-weight expert systems with such vast functionality that may be inapplicable for many smaller operators. Thus, it would be unfair to say that DIY does not work and should be discarded at the beginning.

Given the market dynamics resulting in an increased need to partner, the technological evolution into virtualization and the resulting engineering requirements regaining some DIY attitude may be healthy, even for bigger players. It puts design responsibility back into the operator's hands, avoids the complexities of managing external vendors, and significantly lowers cost while increasing agility. And, finally, it may be that for some operators, IT is becoming more of a strategic asset they should own and design.

On the other hand, larger operators that have to or want to cater to higher complexity may feel forced into using big-brand systems. We argue that we have seen big OSS/BSS transformation programs fail to deliver on expectations. Thus, investigating an alternative approach may yield new perspectives on the underlying reasons for failure, as well as the underlying economics of a DIY approach. There is no evidence yet that the root cause of failure of many of the major transformation programs is due to big-brand solutions. But, it is likely that hinging an operators' transformation ambitions on a ready-made solution does not make an operator more agile than a DIY/open-source approach would: simply due to the sheer size of the undertaking that comes in large, pre-fabricated chunks with the need to be digested in bigger bites. So, going DIY may actually do two things (assuming DIY includes reworking the processes):

- a. It fosters operators' own agility and design responsibility.
- b. It allows for differentiation ahead of the curve (e.g., the big brand's roadmaps).

Thus, DIY is indeed worth investigating and can no longer easily be dismissed.

Building an overlay

Instead of rebuilding entire IT stacks or platforms, there is the option of maintaining the legacy underneath and building an overlay. While this approach carries obvious mid- and long-term

risks, at first sight, in the near term, it seems like a less risky strategy.

The advantages of the approach may be clear:

- Building an overlay is often considered to be cheaper capex-wise.
- It can be done incrementally, allowing space for prioritizing investments as time passes.
- Building an overlay, especially if done incrementally, is easier to shoulder during go-live.
- It doesn't change the running systems – it just makes them simpler/more versatile to use.

However, there are also clear disadvantages to building an overlay:

- The underlying legacy requires maintenance, too, and is cumulative to operating the overlay.
- Any incremental approach means multiple iterations of integration and testing (all variants of testing: functional, integration, performance, error handling, stress, etc.), directly increasing efforts.
- Maintaining an underlay is probably difficult to do without interrupting the overlay.
- Rebuilding entire system stacks can provide architecturally cleaner solutions.
- Overlays do not solve the problem of poorly documented interfaces.
- The remaining underlay may reach end-of-life shortly after the overlay is finished (including delays).
- New functionality is often impossible to integrate into the old world, essentially leaving the operator exposed with a limited feature set.

To make this more visual, if you have an old, rusty car that leaks oil and is fuel inefficient, putting in a new exterior and interior and new driver interfaces will not make it a new car, but as you add part by part you can still use it to drive your kids to school while you add the above-mentioned enhancements to it. This approach may seem like a bad idea, but sometimes it is still the best option under given constraints.

Many respondents to our study have stated that they prefer this approach over replacing entire stacks or even "greenfielding". Taking a more mid-term view, we suggest preparing for an ever more dynamic market which may eventually force such "overlayed" IT stacks to behave similarly to an entirely new stack, only with increased costs and complexity.

Reinvent the network

1. “Cloudifying” the network

With the term “cloudifying the network,” we mean the deployment of network services on an elastic, dynamic, real-time basis, accessible to other applications, such as self-care portals, BSS systems and customer applications. Carriers such as AT&T, SKT, DT and NTT are both legitimizing and leading the change towards the future through formal network transformation programs and targets.

Core network architecture is being changed on two levels: the transport network is automated and dramatically simplified, whereas the control plane is virtualized and extended in scope to allow end-to-end control of the network. Simplification of the transport network enables adoption of new network topologies and close integration of IP and optical layers. This allows operators to reduce congestion from video internet traffic and manage network resources more effectively. Control-plane applications unhooked from their proprietary hardware and OS environments are pooled into a common carrier-grade cloudified or virtualized infrastructure.

Siloed service-delivery platforms, too, will be decoupled from proprietary platforms and operated in the same pool as network applications. To reduce latency and/or optimize traffic transport (e.g., tactile web or massive high-quality video on demand), telecom operators are exploring locating service delivery platforms closer to the customer. Carriers such as AT&T and SKT are working on the (M-)CORD (Mobile-/Central Office Re-architected as a Datacenter) concept to build out data-center resources at the edge of the network.

All of this makes sense if the platform functionalities can be exposed to the customer, which means channeled through existing or future customer-premise equipment (CPEs). Whether the approach is CPE bypass or redeployment of virtualized boxes, carriers expect large returns from being able to monetize network functionalities, allowing users to self-administer the complexities of new service configurations.

Despite efforts, a one-size-fits-all design has not yet emerged. Operators such as DT seem to be using these technologies to drive mass cost-reduction through centralization. By contrast, AT&T and NTT are looking to meld cloud, network infrastructure and security into a single, coherent platform, whereas Telstra virtualizes its network for the purpose of customer experience and footprint expansion.

Let us investigate each of these angles:

We can see two main drivers lowering network production costs by cloudifying the network:

1a) Automation

Often operators still need to manually intervene to support many network-related activities: configuration, policy setting, prioritization, routing, switching (when deploying leased lines or bringing new nodes into service), capacity planning and the recognition of shortages, ensuring security, etc. Network operations such as maintenance, problem solving and incident resolution, and even simple performance monitoring and reporting, require significant manual analysis due to the many network sections/layers that are being managed in today's multi-platform, multi-vendor network domains – often with very vendor-specific or even product line-specific environments. Debugging an end-to-end service across multiple network domains, servers and network elements while ensuring the desired levels of end-user performance becomes a daunting task. This multiplies with issues such as when documentation is not up to date and capacity reservation is not managed in real time. Having done multiple audits, we can confirm that even some of the big-brand operators are suffering significantly from that problem.

An operator should be able to achieve savings from automating network provisioning, configuration management, resource management, service management, analytics, incident and problem management, and many other functions. Our joint study with Bell Labs¹³ yielded that about 15–25% of opex could be saved by automating the network and making it programmable. Related savings materialize across all network segments, but most notably in the “on-premise” networks, access and aggregation, followed by service platforms, core, transmission and network management.

1b) Centralization

Beyond automation, SDN enables centralization.

While many examples are widely known, the one most publicly quantified is DT's ambitious Pan-Net of the EU segment, reducing ca. 850 platforms to ca. 50, and thereby saving ca. EUR 1.2bn, equating to almost 10 ppts in EBITDA, from that segment. However, Vodafone's Ocean, Orange and AT&T's ECOMP, Verizon's EEO, Telefonica's OSM and others' initiatives point in similar directions: automating network orchestration across their footprints for the purpose of reducing cost.

No deployment has been successfully completed as yet. But, if they do succeed, group synergies and scale effects are back on the table, as there is no logical reason for multiple entities within a single group to source, integrate, deploy and operate functionally identical technology.

¹³ http://www.adlittle.com/downloads/tx_adlreports/ADL_BellLabs_2015_Reshapingthefuture.pdf

And what's more, once the network is centralized, it becomes easier to centralize core platforms as well (e.g., internet gateways, subscriber registry, gateway switches, messaging servers). Finally, service platforms, such as voice-box systems, IMSs¹⁴, content platforms and CDNs¹⁵, may go the same way. Once the network can be centralized, all net-work-related applications (many of which are IT platforms anyway) will follow.

Who benefits most?

We believe the larger an operator group, the higher the benefit from the centralization opportunity. Forty-six major groups own just over 500 operative entities, or half of all operators globally, 70% of which are mobile operators. While the average group has about 12 operators, the largest groups have more than 30, or even 40 participants. This could yield massive centralization benefits.

The other half of all main operators are standalone operators and groups with only two operative entities. Seventy percent of these are fixed operators. As groups will leverage scale benefits to their competitive advantage, we expect standalone operators or small groups to become subject to consolidation strategies – whether on an equity or technological level. Also, we expect to see more centralization initiatives within groups that own mobile operators.

2. Asset sharing:

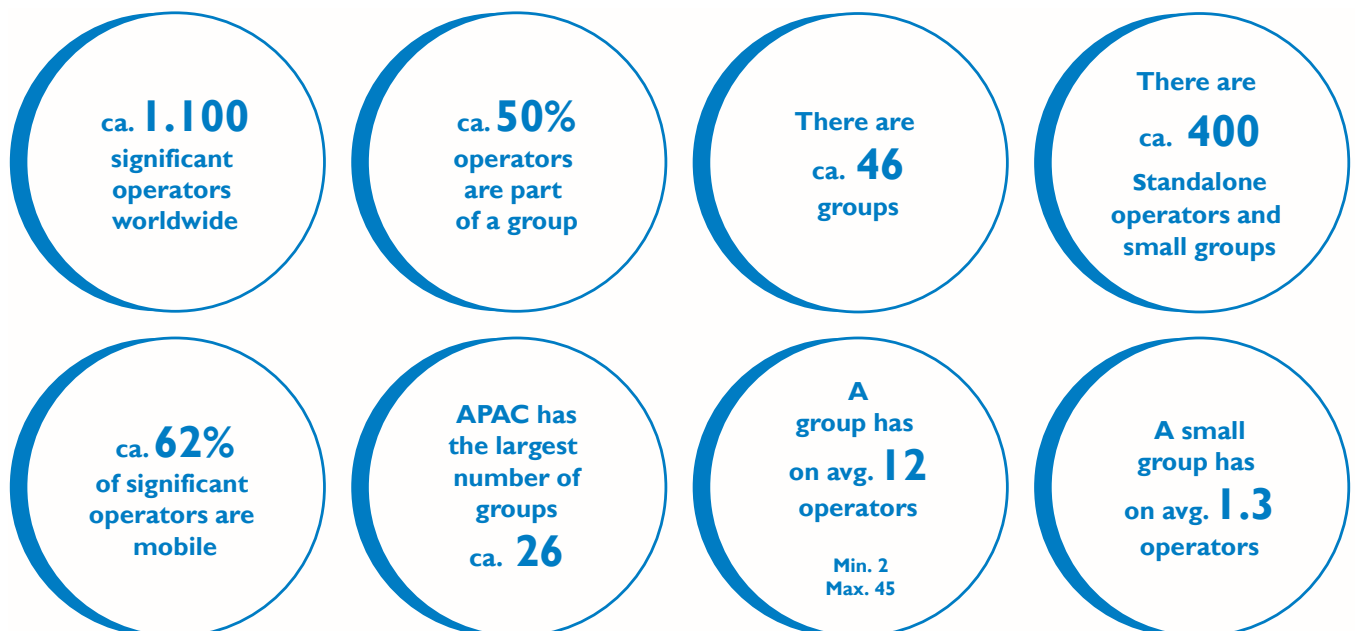
Any asset represents long-lived sunk costs that often demand opex over time. The economic logic of asset sharing is two-fold: monetize the asset through a successful go-to-market and increase asset utilization to lower unit costs. In our view, operators should leverage all reasonable options when it comes to increasing asset utilization, as long as it doesn't cannibalize monetization interests. Sadly, we often see rather loose links in operators' governance between market-oriented managers and asset-oriented managers. Consequently, assets may be less utilized than they would be if that link were closer, which could potentially leave monetization options on the table.

Structurally, though, relying only on own abilities to succeed in the market is sometimes suboptimal in terms of asset utilization, as it leaves out many other players' ability to load the asset. So, let's look more closely at asset sharing.

Optimizing asset utilization by means of sharing requires three steps:

1. Delineating assets and the related capability requirements
2. Defining potential sharing models
3. Assessing the up- and downsides of sharing

Figure 26: Operator landscape



Source: Arthur D. Little Due to constraints in data availability and continuous change in ownership structures, the analysis does not have a definitive date, but is based on 2014-2016 data. Only significant operators were considered, leaving many smaller operators out (fixed line, etc.). MVNOs and ISPs were not considered. Due to the vast amount of telecom operators and the fact that there is only limited information available about a considerable number of them, the authors have decided to narrow the field of research to retain practical relevance. Therefore, in this study the authors have only considered telecom operators that have at least 3% of the respective country's population as customers. Furthermore, due to the small quantity and insignificant size of small groups, it is not differentiated between small groups and standalone operators. We define a "large group" as a group with more than 2 operators and a small group with 2 or less operators.

14 IMS = IP Multimedia Subsystem, used to access various services provided from other networks,
15 CDN = content distribution networks, used to store content closer to the consumers to improve user experience.

Delineating assets and the related required capabilities

Identifying assets suitable for sharing depends on the operator's strategy: it may be its towers, RAN, ducts, IT, call centers, data centers, fiber links, microwave links, ducts, shops, etc. – i.e., any asset or capability an operator may have on its books. If an asset cannot reasonably be linked to positive market impact or competitive advantage, the asset is likely non-differentiating and should be up for review. It might achieve higher returns if shared. By definition, sharing non-differentiating assets cannot harm business success.

So, these are simple ones. Even those assets with links to market impact may be reviewed: if the return from sharing outweighs the disadvantages incurred by losing exclusivity to a strategic asset or capability, plus the related transaction costs, it may be shared as well. Drivers for this may be that own-brand strength may be lower than asset strength: in this case, the operator may prevail in the long term (assuming no one else catches up), but others could perform at a faster rate.

This is clearly not the case if the leveraged asset provides the ability to grow market share. Thus, the analysis for cable companies most likely yields that their networks should not be shared, while the outcome of the analysis for smaller fiber, such as in local utility companies, may yield different results.

Defining the sharing model

Sharing assets generally happens in one of two forms: within the operator's hierarchy or in a separate vehicle outside of the operator's hierarchy. Regulatory concerns, shareholder requirements, and many other strategic considerations play a role here. Operators may not even consider sharing a RAN if they don't also have an equity stake in the entity that owns it. This may be prohibited by regulation. In this case, the decision is easy.

In all other cases, the return from outplacing an asset must be higher than the related transaction costs, and returns must be superior to the scenario of sharing it while keeping it on the books.

In all cases, we believe any shared asset should have a dedicated management structure focused on optimizing asset utilization and thus maintaining asset attractiveness to as many parties, and for as many use cases, as possible.

Assessing the up- and downsides

The upsides seem relatively clear: if the network technology demands a "build-it-and-they-will-come" approach, an increase in asset utilization will result in a higher return. This may be different for "build-as-you-grow" models, such as cable

infrastructures. However, there are also less-visible benefits: financial engineering, managerial focus, sharing of future re-investment requirements, asset maintenance or development that is no longer in conflict with own go-to-market priorities, etc.

But, there is one more aspect: making an asset accessible to the market may make a market accessible to the operator. An example is turning a carrier's data center into a carrier-neutral location. This would address new segments that otherwise would not consider the operator's asset.

The costs of any such transaction are fairly well understood: other than transaction costs from the activity, there is the potential if having to operate the asset at arm's length and the risks relating to finding, contracting and interacting with a sharing partner. All of these factors need to be carefully assessed to understand the value drivers and risks incurred.

But, there are also behavioral costs when sharing an asset, as we show in the figure below.

Conclusion

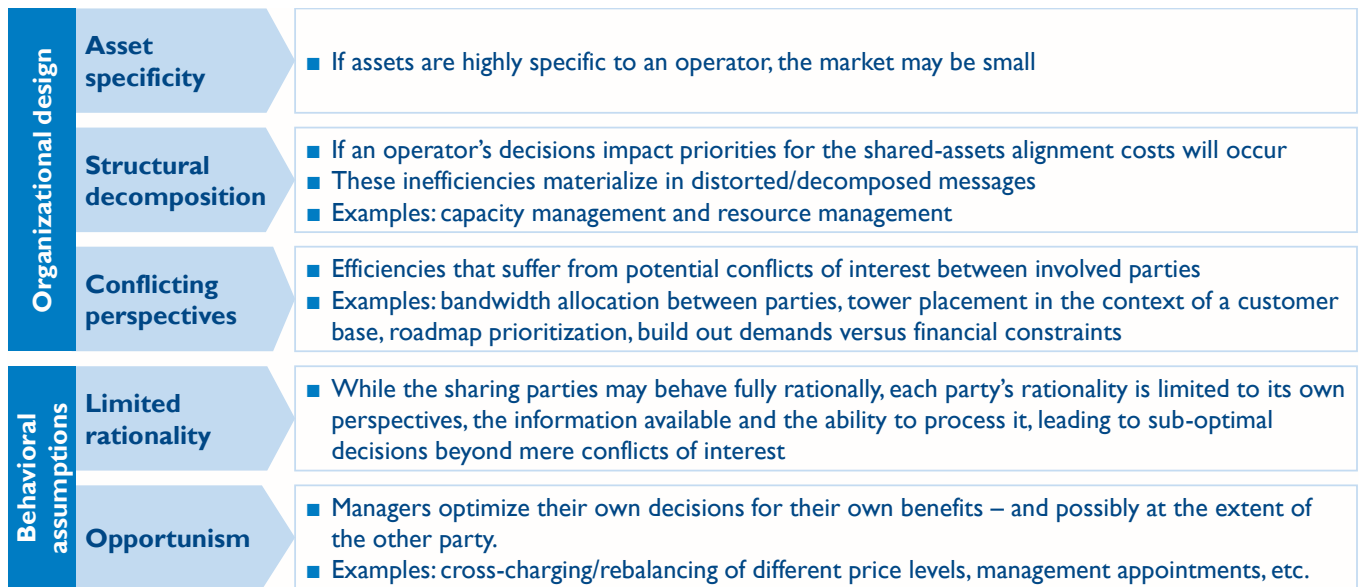
The future production model will seldom be a custom solution stitched together with proprietary hardware – instead, it is, as far as possible, 'commodity software' running on 'highly standardized infrastructure'. It will emulate web-scale designs, where practical, to benefit from economies of scale in software and hardware.

Operators will engage much more closely in the many design questions that start to emerge from the evolution of technology and business models. Questions operators should ask themselves include:

- Which parts should I self-develop?
- Which parts do I buy from vendors, and who else could supply solutions?
- How can I leverage scale benefits of groups? What impact does that have on my operating and my business model?
- How can I best utilize my assets? What do I still want to own and solely use, and what am I okay with sharing?

There is not yet consensus on the target model. There is not even consensus on which path to take or where to start. Only two things are clear. First, present modes of production are not sufficient to satisfy stakeholder demands: customers, other carriers, regulatory and public interests and, of course, shareholders are demanding better service, more accessible services and lower costs. Second, it is clear that addressing any of the aforementioned topics requires deep-rooted changes across network and IT domains from network core, service-

Figure 27: Behavioral costs of asset sharing



Source: After Oliver E. Williamson’s “Transaction Cost Economics”

delivery platforms, CPE, service exposure and BSS/OSS to deliver. As such, we expect many operators to be busy with massive transformation programs – journeys with a yet unclear outcome.

3. Driving innovation

Operators have witnessed how OTTs, web-scale¹⁶ and public cloud players have created eco-systems around their offerings. These ecosystems are built upon self-service platforms and vast communities of users. Based on actual usage patterns, elements of a platform are being evolved to make the services more relevant, adding functionality and more granular control, and even changing business models if necessary. This user-driven evolutionary approach forms the basis of the digital revolution.

Sometimes operators choose strategies of acquiring OTTs – like Verizon did with AOL or AT&T did with Quickplay, DirecTV and TimeWarner. But what we want to understand is how transforming the production model can lead to more innovation. It is clear that OTTs such as Facebook and Google monitor the performance of their services very closely. They know of network congestion simultaneously with the operator – possibly even faster – as the user experience in consuming video services deteriorates. It is companies like these that have a

vested interest in improving their users’ experience – companies that rely on their users “enjoying” interaction with their services. Operators, on the contrary, are not as invested in the experience of an individual user who has bought a “monthly-charge, best-effort, flat-rate broadband service on a shared medium”. They care more about the overall network performance perception – which is important, but often really a question of marketing.

Operators interested in driving innovation can take two non-exclusive approaches:

- a) Partner ...
 - with companies taking an active interest in their customers’ experience. We believe players that bank on an optimal customer experience are most interested in engaging with:
 - Network-oriented players such as CloudGenix, Viptela, Aryaka and Akamai;
 - Cloud-infrastructure and platform service-oriented players such as AWS, Google, Microsoft, Adobe, Oracle and SAP; or
 - Service-providing players such as Google, Facebook and Netflix, but also more local sites such as news portals.

Companies outside the ICT realm also have an interest in managing their customer experience (please see Chapter 1 on B2B2x).

¹⁶ We refer to web-scale players as companies that provide web-based services on a globally available infrastructure which they themselves have built, and now design and operate. Examples include Google, Facebook, Dropbox and Microsoft

Clearly, there are so many use cases out there that no operator alone can even begin to anticipate or prioritize them. And we believe they shouldn't. We think the approach is a much more platform-oriented one, in which operators expose their network and IT APIs to allow the world of innovation to interact with them in a hugely efficient manner – and, in turn, provide the better service and possibly collect some profits along the way

b) Do it internally ...

there is not some universal law prohibiting operators from innovating. But, operators have a legacy constraint that outside companies often don't suffer from: the production environment, namely the often-monolithic IT and network structures and their asset-heavy business models that constrain operators from innovating in potentially less EBITDA-rich service areas.

This impacts their ability to innovate in at least two relevant dimensions:

1. They cannot afford to "fail fast", since implementing anything requires large investments and long times.
2. As a result, whatever they do bet on needs to be big. However, there is no method of safely predicting "the next big thing."

Innovating services internally is difficult to do. Still, many operators achieve some form of innovation – be it in retail

services for consumers, business services for particular industries or applications, value-added services or wholesale services. Some have used corp-up models¹⁷, corporate venture funding and other vehicles in which operators engage with innovative players on an equity level, while refraining from making a 'bear-hug'¹⁸.

However, having a programmable platform, being open to developers and suppliers, may liberate operators from their main innovation constraint. Being able to try out services or build services for specific pilots adds to their toolboxes to innovate and help utilize own assets. Thus, we believe those operators reinventing their production models by making them programmable and accessible as described above in order to allow innovation to happen more swiftly and with lower cost have better chances of differentiating and beating competition than those that don't.

In order for telecom operators to win in the traditional and highly competitive B2C and B2B, and especially the newly emerging B2B2x, segments, they need to have access to technologically relevant, high-quality infrastructure. However, telecom operators need not necessarily own infrastructure in order to deliver their products to consumers and businesses. Controlling them may suffice.

¹⁷ "corp-up" refers to the idea of corporates and startups working together with the objective of creating top- or bottom-line business impact.

¹⁸ We use the term 'bear hug' to describe the effect that happens during the post-merger-integration processes after a small company has been acquired by a larger organization: the acquired company gets overburdened with processes, procedures and systems that may be required for the larger organization to work, but that stop the smaller company from functioning

4. A new art: configuring an operator's asset portfolio

In this chapter, we do not refer to any financial engineering-driven thinking. We believe designing an operator's asset portfolio to fit strategic purposes creates value in its own right. While each asset class has its own logic, there is one underlying theme: operators should manage assets – preferably to their customers' benefits. And, they should do so to efficiently increase asset utilization. This does not, per se, require operators to own the assets. It may even be that conflicts of interest arise between market-oriented activities and those related to asset optimization. This is especially true in new, differentiated growth areas such as B2B2x: if operators think more about what they can deliver based on existing assets, rather than how to create value for clients as they advance on their digitization journeys, they will fail to optimally address the segment. Counting SIM cards and circuits, MBs and minutes, and the like gets in the way of increasing share of wallet in an increasingly digital economy.

While these benefits may appear 'far out' for operators, let us dissect the issue a bit more to see what operators actually need from their assets in order to supply services:

- **Accessibility** to relevant and high-quality infrastructure – whether fixed network, mobile network, data center

capacity or small cell networks, including the next technology on a non-discriminatory basis.

- Ability to **configure** infrastructure to deliver services – for example, provisioning of fixed services remotely for a new customer and pushing subsequent service and application updates remotely to the set-top box.
- **Transparency of interfaces** between the infrastructure provider and the telco, with clearly defined demarcation points. Individual customer information should be aggregated at the level of the infrastructure provider, and all network analysis/optimization should be done with aggregated customer information by the infrastructure operator.
- **Stability of prices** – so that the telco can, in turn, provide stable and predictable pricing of its own services to its customers. This is especially true for B2B and B2B2x services with two- and three-year contracts, and stability of pricing is a key requirement. While this can sometimes be enforced via the regulator, occasionally it also requires equity ownership.

Figure 28: Example of infrastructure map to customers

Crown Castle – Infrastructure map



Crown Castle fiber infrastructure map (USA 2016)



Crown Castle towers map (USA 2016)



The more transparent the infrastructure map, the better the InfraCo is able to sell infrastructure services to potential telcos

Source: Arthur D. Little, www.crowncastle.com

- Knowledge of **infrastructure map** – the best utilization of infrastructure is made when the infrastructure supplier provides maximum information on the location of its infrastructure and the telco is able to use as much of the infrastructure as it needs to deliver its services. An example of an infrastructure map is Crown Castle (a tower/fiber/infrastructure provider based in the US) which provides a detailed map of its towers and fiber sites to telcos.

1. Why decompose and reconfigure?

Traditionally, telcos owned and operated their own infrastructure for both fixed and mobile telecommunication services. Telcos obtained a unique strategic advantage by owning infrastructure that was wider in geographical reach and better in technology compared to competitors. The strategic advantage of owning infrastructure is being recalibrated in importance compared to the past. In segments in which infrastructure coverage is important, especially in fixed broadband, open-access regulation is increasingly common, even for new investments such as fiber, thus improving its access to third-party customers. While there are markets in which access regulation is still 'light', e.g., in mobile or cable, the current and future proliferation of assets makes it difficult for operators to achieve optimal utilization: these include datacenters, TV platforms, fiber, small cells and the like.

- Telcos have to cover large **non-cash depreciation cost**, which is a strain on the focus of the telco executives: due to large infrastructure investments in the past, many telcos continue to carry big fixed costs on their balance sheets. Hence, CEOs of telcos are obliged to obtain returns that fully cover the costs of these past investments – i.e., they have to obtain high-enough revenue/EBITDA to cover the cost of the large non-cash depreciation of past investments. Therefore, CEOs of telcos may be reluctant to launch attractive services with potentially lower EBITDA margins and thereby access new segments of the market. Any transformation of the service portfolio leading to similar EBIT, but lower EBITDA, becomes problematic, as it dilutes the EBITDA margin.
- **There is the issue of underutilized infrastructure**, due to the favoring of own retail revenue vs third-party wholesale revenue: when a telco uses its infrastructure only to deliver its own retail products and services, it usually results in lower utilization of the infrastructure. The strain between the retail and wholesale business units of telcos prevents them from optimally exploiting wholesale opportunities in favor of maintaining their retail revenue. The telco thus loses out on opportunities to fully monetize its large infrastructure base.
- **Open access** is a contentious topic. Some markets have open-access even on new fiber investments, while other markets have low open-access regulation. Regulated infrastructure is more expensive to own than non-regulated infrastructure. In addition to many existing regulated assets, even new infrastructure, such as fiber investments, is increasingly under obligation to provide open access in some markets, while the threat of open access for fiber is there in many other markets. The same is true for new asset classes, such as small cells: we expect that small-cell deployments will be economically quite unfeasible or comparatively inefficient if multiple parties deploy non-open-access networks in dense geographies.
- **Mismatch between the expected returns** of the shareholders of a telco and the returns a telecom asset can deliver – telecom shareholders typically expect payback periods of up to five years, with return on investment of around 10–15%. However, some asset classes, such as fiber deployments and data centers, require large quanta of investment with payback periods of 10 years or more. However, such assets also promise longer economic life of 30 years or more. This is a clear mismatch between the risk and return expectations of telco shareholders and some of the infrastructure of a telecom business, which can result in reluctance or even inability of telco shareholders to invest in such infrastructure.
- Regarding **faster time to market**, in addition to benefits that come with managing assets independently, there are benefits for customer-facing entities, as they will then also be managed independently. This 'division of labor' brings increased focus and more transparent interfaces between the entities. One example of this is Spark in New Zealand, which, after its separation, set up Spark Digital Ventures (an incubation-focused entity) and Spark Digital First (its own product house). Liberation from the previous focus on what its standards-based infrastructure could do allowed Spark's entities to operate on a variable-cost basis, leveraging third-party infrastructure if needed. This is driving innovation faster and closer to the customer, resulting in very promising market share development at increasing EBITDA levels.
- **Higher valuations** and clean ownership structure – when infrastructure is spun off from a telco, the new InfraCo usually can command a higher valuation multiple than its parent telco – is leading to a higher overall valuation for the shareholders of these entities. This is due to the fact that the infrastructure managed by an InfraCo usually is better utilized, better managed and better financed. The best example of this effect is O2 Czech Republic, whose valuation more than doubled, as illustrated in the chart below. The overall increase in valuation of O2 Czech Republic is mostly driven by the increase in valuation of the commercial entity (O2), but CETIN's valuation increased, too. The combined

increase in value creation goes beyond what can be explained with mere financial engineering.

- Regarding **shared investments**, if dilution of equity follows the spin-off of infrastructure, it results in the new investor sharing part of all future capex. This will relieve the telco of a part of its capex-funding cash requirements.

In Spain, Telefónica, after the sale & lease back of 3.715 mobile telecommunications towers to Cellnex in the 2012-2015 period, in 2016 decided to set up its own Infrastructure assets' Spin-off, Telxius, which brings together 10.741 of Telefónica's telecom towers in Spain (plus 5.190 in other countries) as well Telefónica's international network of 31,000km of submarine fiber optic cable.

The key drivers were, first, to file an IPO (initial public offering) to sell a 40% stake of Telxius in the stock market to raise capital, and second, to enable the management of the Telefónica Group's infrastructure on a global scale with a more specialized and focused approach, with the aim of increasing the services provided to other operators.

Telefónica had to cancel its IPO ambitions in September 2016 after demand from investors proved inadequate. Currently Telefónica is looking into new alternatives to attract investors.

2. Key infrastructure blocks

In order to evaluate the right ownership structure of telecom infrastructure, we evaluate the infrastructure along six key infrastructure blocks:

- Legacy infrastructure (referring to copper-based fixed networks)**¹⁹: We refer to copper-based networks and the related assets: local exchanges including the active equipment there, ducts, cabinets, man-holes, in-house wiring, copper-oriented customer premise equipment, etc. It is typically regulated and has large fixed opex and depreciation costs, but provides relatively stable long-term revenue.
- Next-generation fiber infrastructure**, comprised of dark and lit fiber and passive and active components up to the fiber-related customer premise end-point: Typically, fiber deployments still requires large future capex investments and has a long payback period with uncertain long-term revenue.
- Data centers** refer to the real-estate business: This is a business of costs and scale, with low margins and high volumes.
- Mobile towers** refer to the passive part of a mobile network, including towers and the housing infrastructure on

Figure 29: After a series of Sale & Lease Back operations, Telefónica set up its own asset Spin-Off, Telxius, to capture

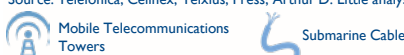
Case study – Telefónica Spain



Telefónica	Year	Asset	Transaction	Counterparty	Value	Description
Telefónica Spain's Telecom Infrastructure Investments	2012		Sale & Lease-Back		90€M	■ Sale of 1.000 rural Towers
	2013 - 2014		Sale & Lease-Back		70€M	■ Sale of 2.415 Towers (Project Volta) ■ Cellnex would manage a consolidation process with Yoigo's Towers
	2015		Sale & Lease-Back		44€M	■ Additional sale of 300 Towers (Project Volta Extended)
	2016	 	Asset Spin-off		c.5€Bn ¹	■ Telxius is an Infrastructure assets' Spin-off created by Telefónica which includes 10.741 telecom towers in Spain (plus 5.190 in other countries) as well Telefónica's international network of 31,000km of submarine fibre optic cable ■ Attempted IPO in Sep 2016, which was unsuccessful. Currently looking into alternatives

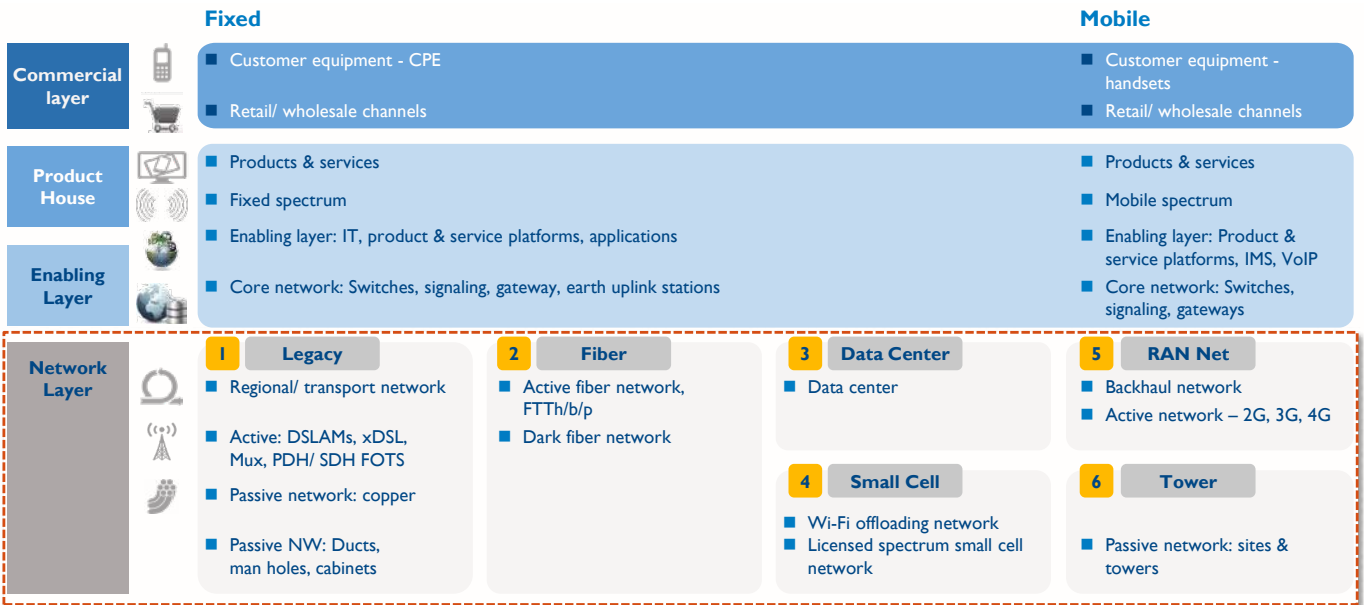
Source: Telefónica, Cellnex, Telxius, Press, Arthur D. Little analysis

Notes: (1) Based on Telefónica's valuation at the moment of Telxius' IPO



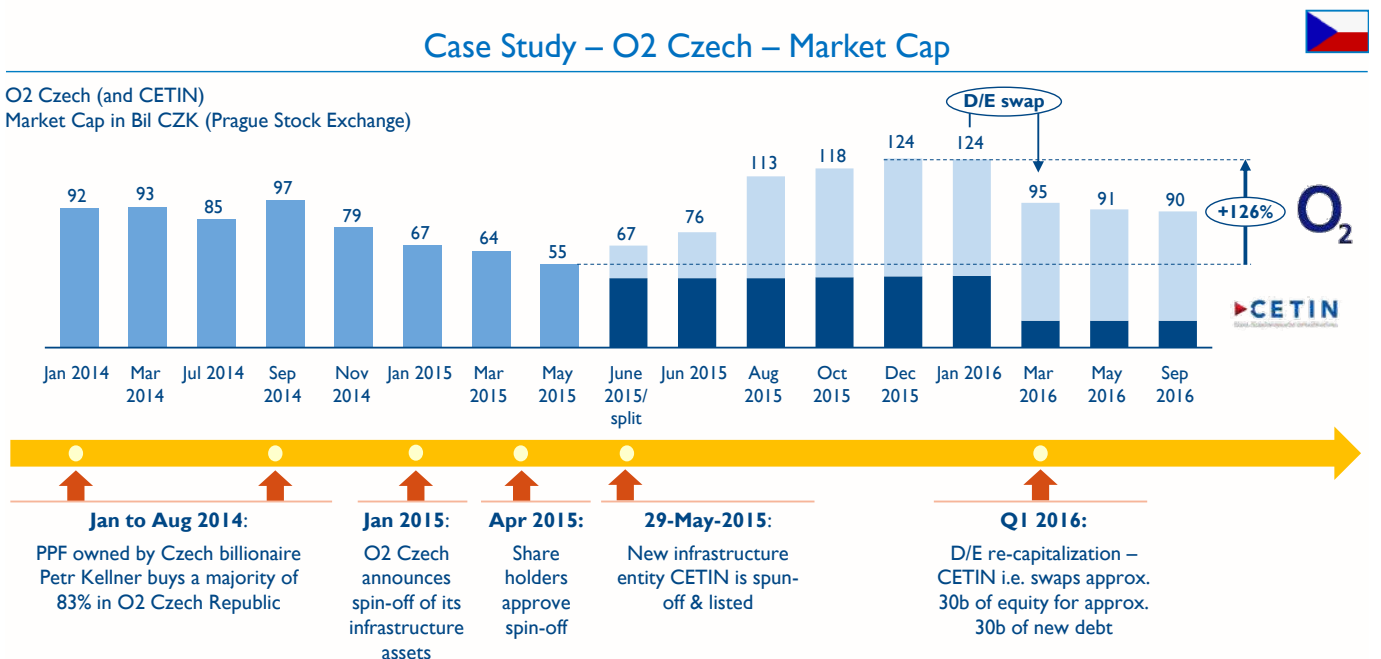
19 We are focusing on traditional telecommunication companies

Figure 30: 6 asset classes



Source: Arthur D. Little

Figure 31: Valuation of O2 Czech pre- and post-spin-off of its infrastructure into CETIN has increased in market value by 126%



Source: Arthur D. Little analysis, O2 Czech Republic (published information), Thomson One Banker Sep 2016
 Note: D/E re-capitalization assumed done in Q1 2016
 Eoy = End of Year

site as well as access to power supply, cooling, heating, etc.: It is more similar to real-estate portfolio management rather than telecommunications engineering.

- **Mobile RAN²⁰ networks** including backhaul and the active mobile network components for all network generations: These assets are more about smart technology and opex optimization than coverage exclusivity.
- **Small cells** include both WiFi offloading as well as licensed spectrum network technologies with very short ranges: These networks are a – yet – untested business model, and a higher-risk but strategic investment. However, it is likely that partnership models will emerge that secure efficient use of public space and backhaul, and avoid overbuild. As such, it is likely that small cells will be run via NetCo models.
- Owning and operating such a diverse set of infrastructure under a single telco is not only a strain on management focus, but also financially inefficient.

3. Leveraging legacy infrastructure

Typically, legacy fixed infrastructure, such as copper cables, central/local offices, ducts and manholes, are the earliest assets invested in by a telco. Although they are largely depreciated, they are still valuable since the telco, via these assets, still has access to locations on the ground and rights of way through key urban areas.

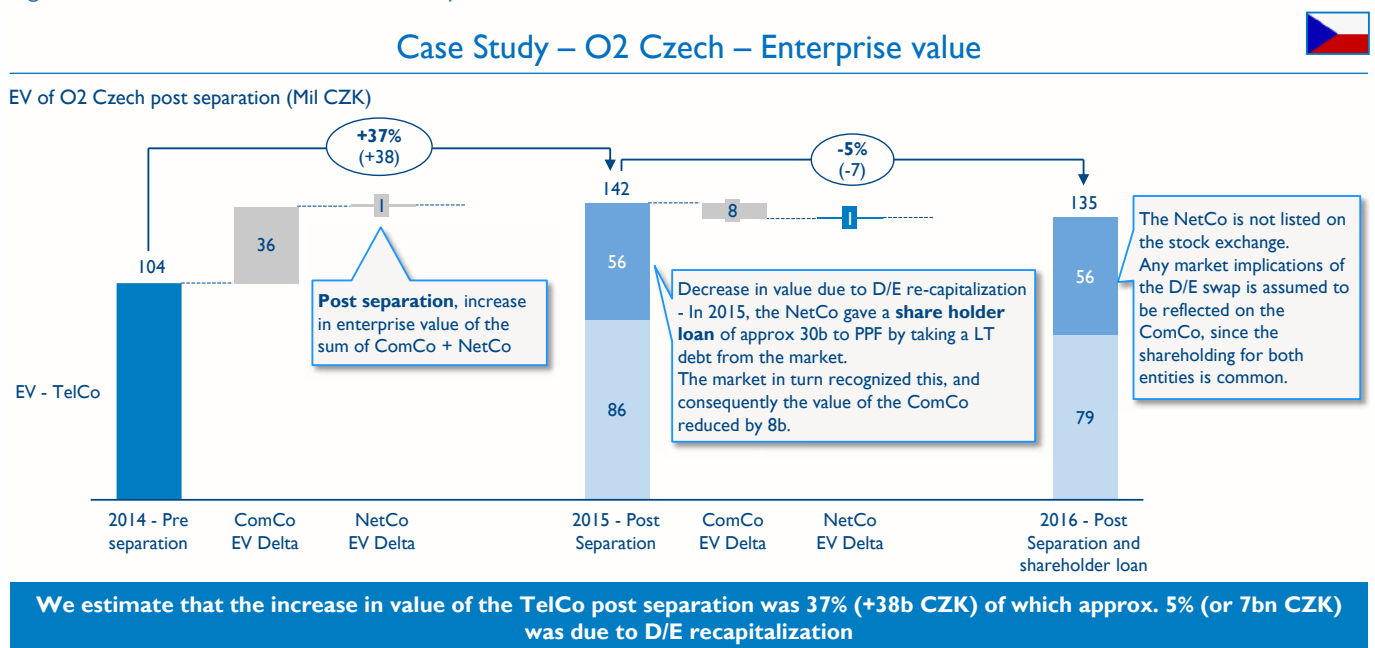
Determining whether to reorganize the asset portfolio (i.e., spin-offs or carve-outs, irrespective of a change in ownership) legacy assets is a two-part decision.

On the one hand, legacy assets form a valuable infrastructure base of strategic importance and provide stable sources of revenue and potentially wholesale income. They may even serve as a basis to roll out future fiber in a country. Sometimes there are even regulatory obligations to maintain legacy infrastructure on the books of telcos. Reorganizing the legacy asset portfolio would provide instant advantage to competing operators in the fixed market – maybe even benefiting competing mobile-only operators, if they were to start engaging in multi-play competition on equal playing grounds. And, there are probably many more arguments against such restructuring of assets.

However, on the other hand, legacy assets are highly regulated, and by separating them, the owning telcos are freed from regulatory constraints and can thus start bundling and pricing their retail products to better meet market needs, which enables them to better compete against other, lesser- or non-regulated operators.

We believe that some value can be unlocked if legacy assets are being restructured. Access infrastructure is often regulated both in price and scope, and thus by design, does not allow for infrastructure-based differentiation when it comes to connectivity services. All the while, many incumbents enjoy

Figure 32: Increase in EV of O2 Czech Republic



Note: In order to do this analysis we assume that there was no major shift in O2/ CETIN corporate strategy in 2016 that greatly impacted valuation, except the D/E recapitalization
 Source: Arthur D. Little analysis, O2 Czech Republic (published information), CETIN CZ website, Thomson One Banker Sep 2016. Arthur D. Little estimate of the debt of the TelCo, Comco and NetCo is used, based on their Balance Sheet. Estimate of equity of NetCo is from its Balance Sheet, and Market Cap of ComCo is from the Prague Stock Exchange

20 RAN = Remote Access Network

superior market shares. Separating copper-network operators into two independently managed entities should enable top management of the market-facing entity to better focus on market-oriented innovation without having to consider the double-edged sword of any requirements to enable equivalent offerings on the wholesale market. There is value creation in the commercial arm of the telco when freeing it from regulatory constraints, as well as in the new LegacyCo when using it as a base for future fiber/small-cell investments and improving utilization with higher third-party sales. The management of the legacy assets can focus on monetizing the existing infrastructure base and using it as a base for future NGN investments, such as fiber and small cells.

So far, however, there are not many commercial examples of spinning off legacy infrastructure. O2 Czech Republic is a recent success story of an incumbent telco that voluntarily spun off its infrastructure (both legacy fixed and mobile) into a separate InfraCo called CETIN in Q2 2014. There was no change in the main shareholder, so some may argue that the spin-off is virtual. But, this is the reason it allows us to assess the impact of a reorganized asset portfolio from the perspective of focusing management on its respective areas of responsibility. In the past years since the spin off, valuation of the rest of O2 Czech has more than doubled, while the valuation of CETIN has remained stable.

A note to highlight is that spinning off the legacy assets as such does not create any value. However, the ability of the telco to

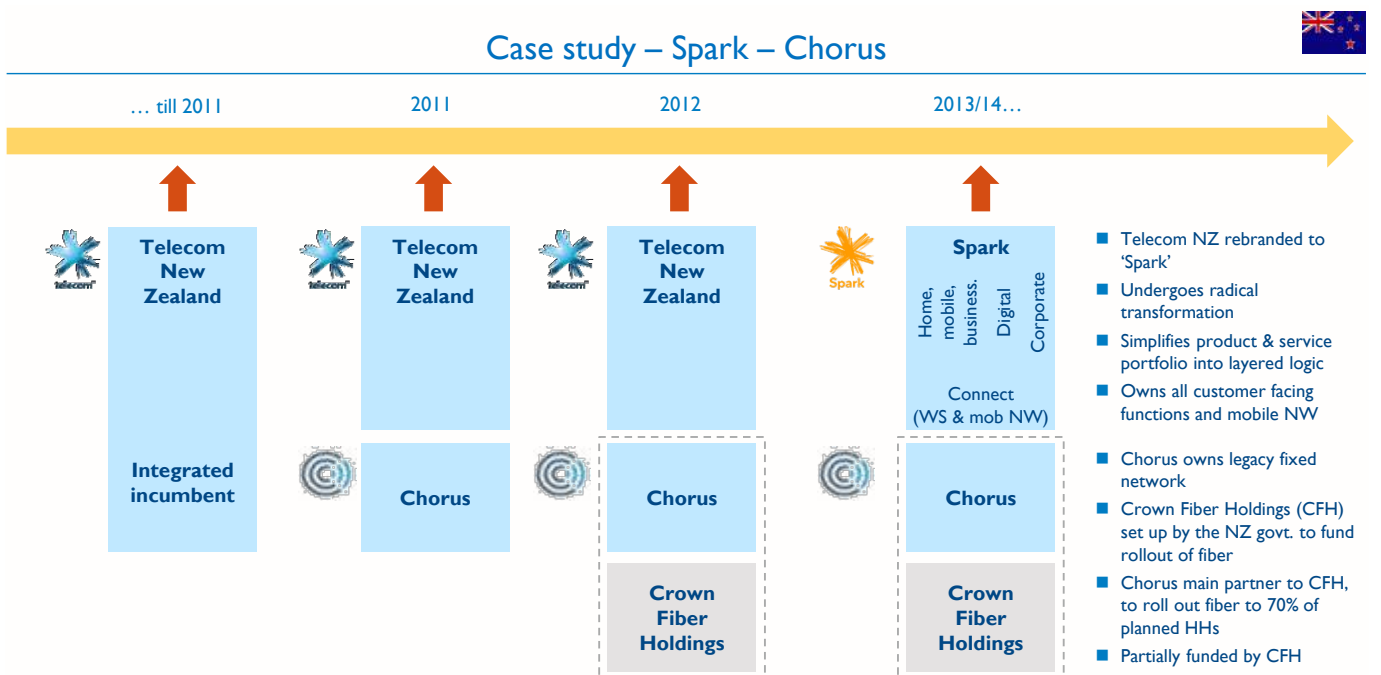
radically simplify itself after the separation, clean up its product portfolio, rationalize its pricing strategy and align its product bundles with market requirements as well as upgrade its path of legacy network assets, is what drives value recognition and creation. O2 Czech Republic is expected to have simplified its product portfolio from several hundred products to a few tens of products post spin-off.

In O2 Czech, the formerly integrated TelCo was split into a ComCo and NetCo. The EBITDA split between the ComCo and NetCo was roughly 50:50. In the first year post separation, 2015, the combined Enterprise Value of O2 + CETIN increased by 37% - We believe this is largely due to (approx. 32%) real value creation due to simplification of the structure of the ComCo, and better matching of assets with contracts in the NetCo. A smaller part of this value creation (approx. 5%) is due to D/E recapitalization, as CETIN took a loan of 32b CZK to pay back its shareholders (i.e. swapping Equity for new LT Debt).

4. Driving fiber investment

Nationwide fiber deployments are huge investments, often equal in size to the entire balance sheet of the performing operator (at least at depreciated values). Moreover, fiber investment offers a long-term payback period (more than 10 years), while typical shareholders of telcos look for returns with a five-year horizon. This mismatch in size of funding and expectation of payback – as well as regulatory uncertainty on

Figure 33: Telecom NZ spun off its fixed infrastructure into “Chorus” and the commercial arm rebranded as “Spark”



Source: Arthur D. Little, Spark/ Chorus public domain information

Figure 34: Chorus obtained government funding to roll out fiber to 70% of New Zealand

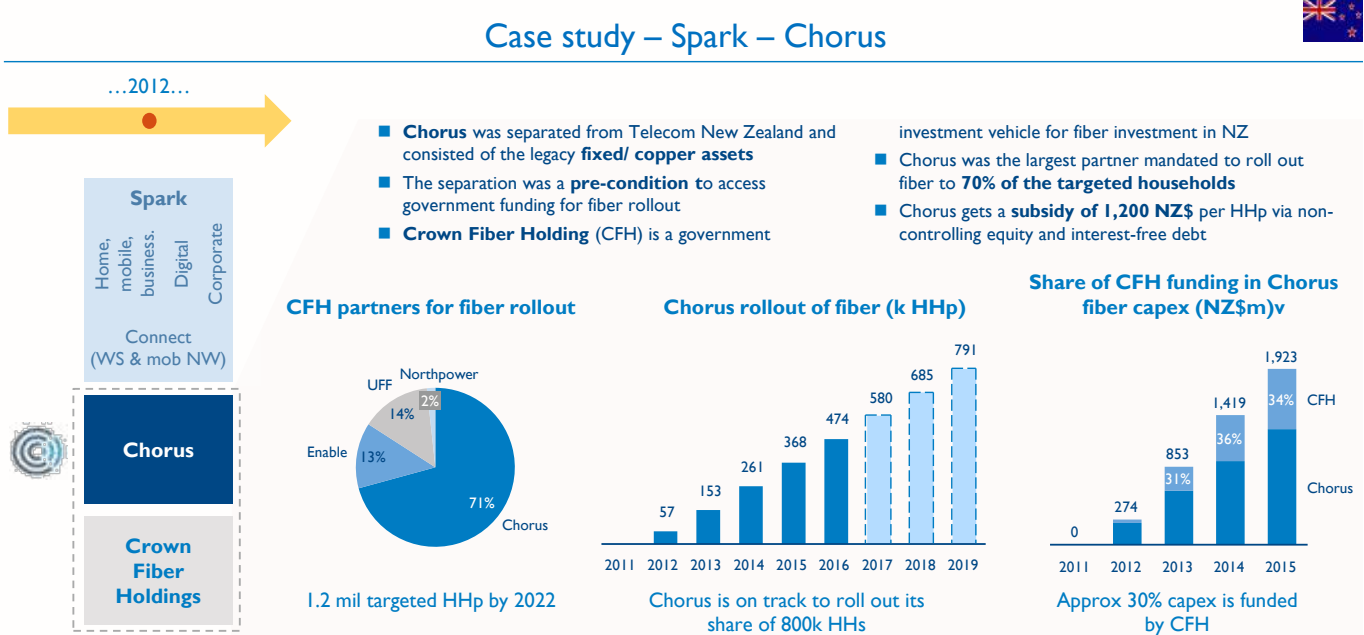


Figure 35: Spark has launched several innovative products with a simplified structure

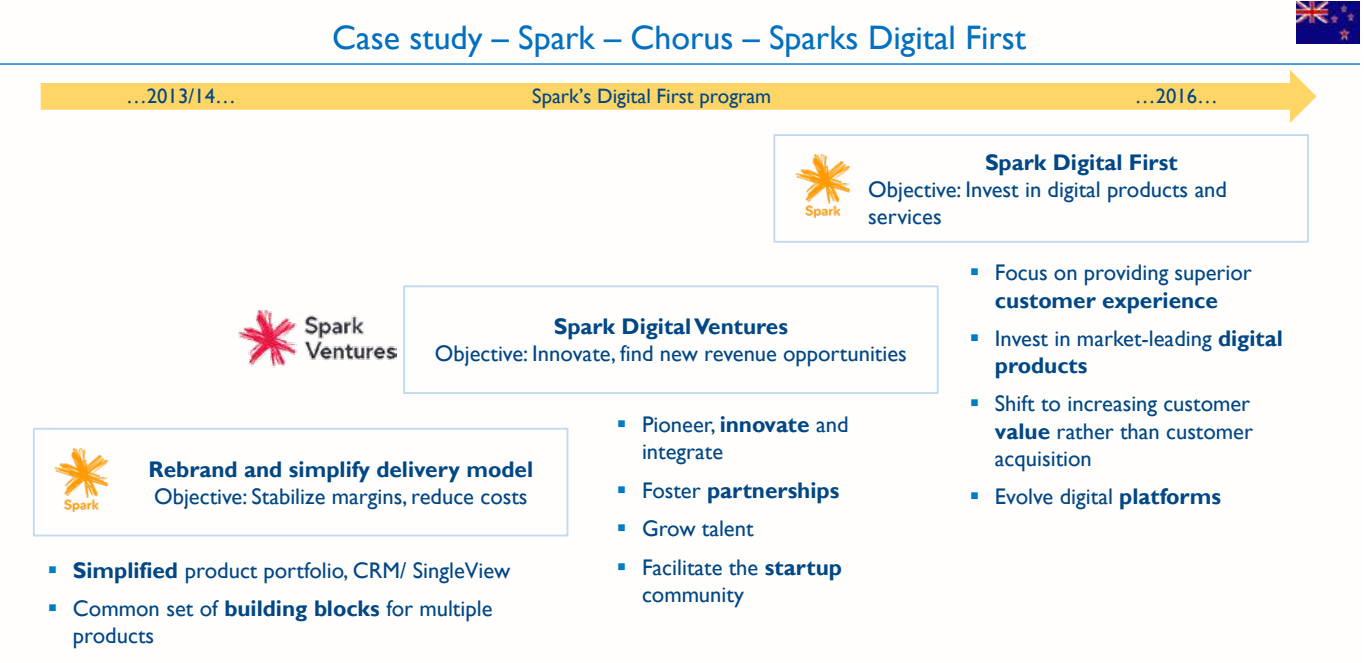
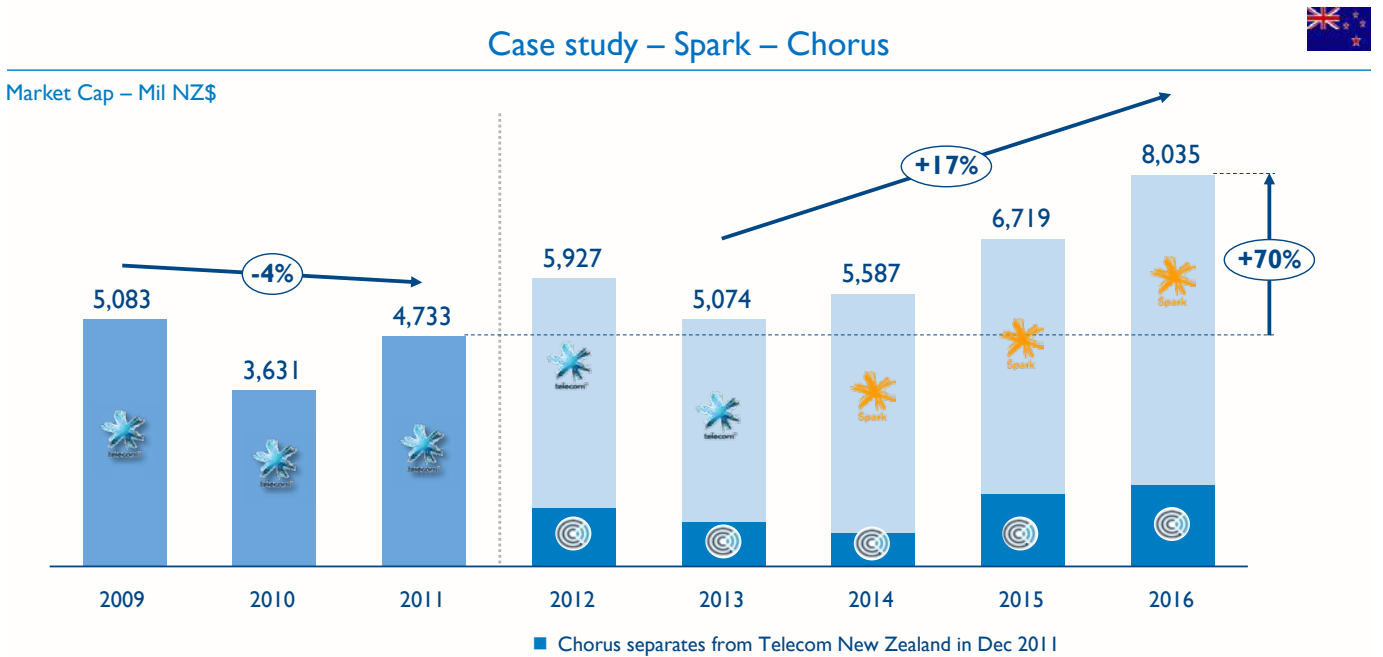
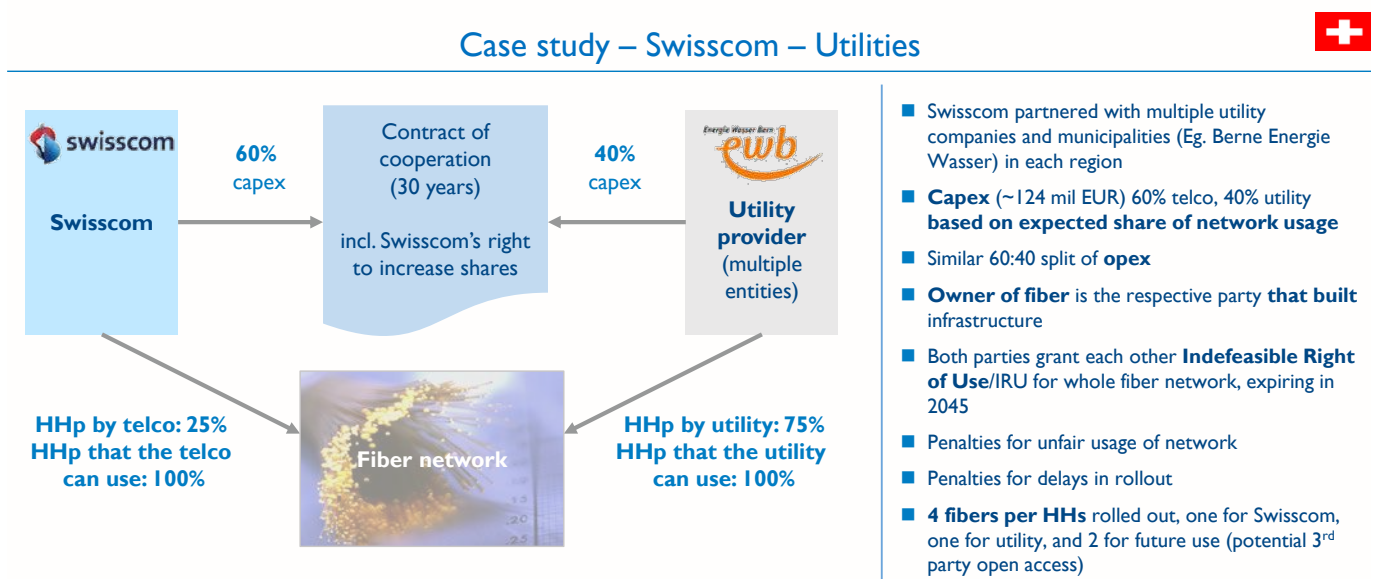


Figure 36: The combined valuation of Chorus and Spark increased by a 17% CAGR from 2013 to 2016



Note: Valuations are at end of financial year (end of June of the respective year) from the New Zealand Stock Exchange
 Source: Arthur D. Little, Spark/ Chorus public domain information

Figure 37: Swisscom partnered with more than 70 local utilities to roll out nationwide fiber in Switzerland

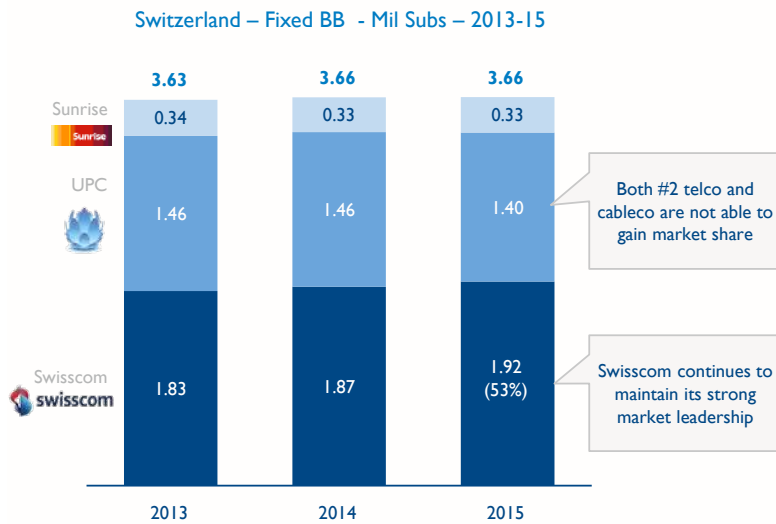


Partnering with local utilities is a smart way to roll out fiber in a shared effort utilizing the local utility's right of way and stable cash flows to fund fiber

Source: Arthur D. Little, Swisscom

Figure 38: Swisscom has so far maintained market leadership even after open access, due to superior products and customer experience

Case study – Swisscom – Utilities



Source: Arthur D. Little analysis, mirabaud.com, BMI, operator website

■ **Swisscom** was able to maintain leadership in product and customer experience compared to its rivals Sunrise and UPC in terms of brand name, network reach and services offered:

- **Convergence** - Expansion of LTE, fiber and IPTV services led to further upselling opportunities for Swisscom, challengers Sunrise and UPC looking to catch up (e.g. UPC launch of an MVNO)
- **Lower churn** - Convergence leads to lower churn, further benefiting Swisscom as its starts with a large customer-base advantage
- **Best-in-class networks and services** – Swisscom has better networks and offers premium services (e.g. greater LTE speeds, better and more content, unlimited data), leveraging that Swiss consumers are happy to pay a premium for high quality
- **Strength of brand name** - all other players must offer similar services to remain competitive in the market

Both #2 telco and cableco are not able to gain market share

Swisscom continues to maintain its strong market leadership

future competitive access – has led to difficulties for telcos in investing in fiber by themselves.

In order to overcome this, some telcos are looking for partnerships with governments or private infrastructure funds in order to invest in nationwide fiber. Typically, this is done either by spinning off legacy infrastructure into new entities and jointly investing in fiber with a third party, or forming a special-purpose vehicle (SPV) together with a third party for shared fiber investments.

The underlying logic is that 1) if fiber deployments do not fit into an operator’s balance sheet, the deployment must remain in a separate balance sheet; 2) if that separate balance sheet must not be consolidated (technically or from a rating perspective), the ownership structure must be adjusted accordingly and the customer base for fiber must be such that no dependency is created; 3) market conditions may still demand fiber deployment; and 4) government funding, on both national and local levels, can more easily be funneled if a standard model is provided (such as an SPV²¹).

Telecom New Zealand is a successful example of a telco spinning off its legacy assets into a new entity called “Chorus”, and then partnering with the government of New Zealand to

obtain a large amount of funding to roll out nationwide fiber. Chorus obtained 70% of the government funding ear-marked for fiber investment (NZD 1.9bn), and is expected to roll out fiber to 70% of New Zealand. While Chorus is successfully rolling out fiber, the rest of Telecom New Zealand has rebranded itself as “Spark”, and is transforming itself into an agile telco. Spark has launched several new ventures post legacy/fiber spin-off.²²

Another example of a fiber rollout is Swisscom, which partnered with more than 70 local utilities in Switzerland to roll out nationwide fiber. Even though this fiber is open access and Swisscom’s utility partners have access to half of the fiber, Swisscom has consistently maintained its market leadership through high-quality products delivered over this fiber with a superior customer experience. In Switzerland, fixed-mobile convergence-based competition is also high, giving Swisscom an edge, as it owns good fixed as well as mobile networks compared to the competition.

5. Data centers

Data centers, particularly the large central ones, and only to a lesser extent the distributed ‘edge computing-oriented’ ones, are typically a real estate-style business model: large capex,

21 SPV = special purpose vehicle. A company funded to arrange shareholding interests and investments according to the requirements of the participating parties.

22 Refer also to our report, *Race to Gigabit Fiber*, on http://www.adlittle.com/downloads/tx_adlreports/ADL_RacetoGigabitFiber.pdf

low margins. This is an efficiency and scale business, with key drivers being access to a convenient location, high-speed connectivity and low-cost power. The prime reason many telcos engage in this market is that they have themselves have organized their IT production in data centers. Coming from a 'we-need-to-own-it' mindset, they invested into their own data centers. Realizing that there was a market out there, they later opened up to third-party clients. Telcos also owned prime locations in urban centers, with high-speed connectivity and other resources – drivers for competing in the market.

Since the computing requirements of telcos are fairly stable (given that load increases are matched with computing-power increases), there is only a limited need for increases in space or quality of carrier data centers. Moreover, since the telco owns the data center, it is no longer 'carrier neutral', but affiliated with the other connectivity services offered by the telco. Telcos are often limited in their ability to scale up their data centers and maintain the highest efficiency and latest technology, as they suffer from an internal prioritization conflict between data-center updates for the purpose of running fully utilized and profitable data centers and more market-oriented IT projects or other demands. Also, with the prices of cloud services decreasing with the advent of Amazon Web Services, Microsoft and others, smaller businesses are moving to the cloud directly, instead of leasing data-center/server capacity in local data centers. Thus, local telco-hosted data centers are often less competitive than independently run data centers – except, possibly, in markets without competing data centers, in which, clearly, owning a data center still remains a strategic asset.

However, let's not forget that the value created is actually moving away from the data center itself to the products and services enabled by the data center. The best products and services are successful not because the firm producing them owns their own data centers, but because the product is innovative and can be scaled up easily. The ideal data-center operator should offer an easily scalable solution to its data-center subscribers (or cloud and hosting solutions) – preferably on a global basis. Owning more locally oriented data centers may even be a hindrance in this regard, as customers with multinational or even global business models will find it difficult to engage and seek matching capabilities.

In September 2016, KPN in the Netherlands announced the spin-off of six of its data centers in the country to NLDC, a new entity with an independent management. The new entity is expected to operate carrier- and cloud-neutral data centers and to focus on providing core data center services in a cost efficient and scalable manner.

For similar reasons, Verizon sold 24 data center facilities to Equinix. The Telco was looking to sell 50 sites, but Equinix cherry-picked only 24 in North and South America. For Verizon, this is another step in refocusing its business into a less asset-heavy, direction, namely video streaming and advertising. Examples of this journey include continued investment into go90, the AOL stack and the pending purchase of Yahoo! Inc.

6. Small cells

Investment in small cells is a future-oriented endeavor which will drive future 5G networks. There is no clear business model as yet, but what is clear is that it does not make sense for three to four operators to deploy a network 10 times denser than current networks and overlapping multiple times in a given geography. There is a potential market for small-cell-as-a-service; however, this is as yet untested (even though RAN-sharing concepts have been around for some time). Many operators are making investments in LTE or wifi-based small cells. But, so far, they have pursued small-cell investments for self-use without sharing.

Telcos are investing in small cells and micro-sites to fill in capacity gaps in their networks and relieve congestion spots. There has not yet been a strong push for a cohesive nationwide small-cell strategy. Today, telcos still think of their macro-mobile networks as the main infrastructure, while small cells are used to fill in the capacity hot spots. However, in the future, with 5G around the corner, small cells will play a significant role, as the requirements of 5G – gigabit speeds and millisecond latency to mobile devices – can only be effectively delivered by small cells.

Small cells are an opportunity for telcos to pursue a new business model based on shared infrastructure and providing small-cell-as-a-service solutions to other telcos and businesses. This is a new, potentially high-return, high-risk investment. We believe small-cell investments are going to be the next big wave of investments. Small cells bridge the gap between fixed and mobile telecom infrastructure. We see incumbent operators with dense fiber networks optimally positioned to roll out small cells.

7. RAN and other networks

In this report, we do not evaluate mobile RAN network sharing and spin-off of towers in detail, as this is a fairly common and successful model used by most mobile operators around the world²³. It is interesting to note that in Q3 2016, the Mexican government awarded a wholesale mobile network license to Altan to build and operate a mobile carrier-of-carrier network. It is yet to be seen how successful such a wholesale mobile

²³ Please refer also to our publication on http://www.adlittle.com/downloads/tx_adlreports/2013_TIME_Report_Network_Cooperation.pdf

network model will be. Meanwhile, it is an interesting case study to evaluate the success of a fully independent mobile active-network infrastructure model.

8. Conclusion

There is value in deconstructing and reconfiguring the way operators manage their assets. That value stems, to a lesser extent, from financial engineering and, to a larger extent, from an increase in asset utilization and more focused operations of the telecom infrastructure, better product quality, flexibility to respond to changing market situations and increased speed of delivery of the telco.

More important, however, is this should liberate customer-facing providers to service those customers and expand their markets.

They may even expand into other markets, where the service entity does not have assets using the same production model. This will drive customer centricity and production efficiency. On top of that, in case of isolating regulated assets, such a move may also isolate regulatory constraints.

The decision to spin off a particular infrastructure asset should be considered when:

- The asset is no longer strategically differentiating in the long term,
- The utilization can be improved by independent management and/or
- Value can be further increased by new investments, e.g., fiber investments built on legacy infrastructure.

5. Quantifying the impact

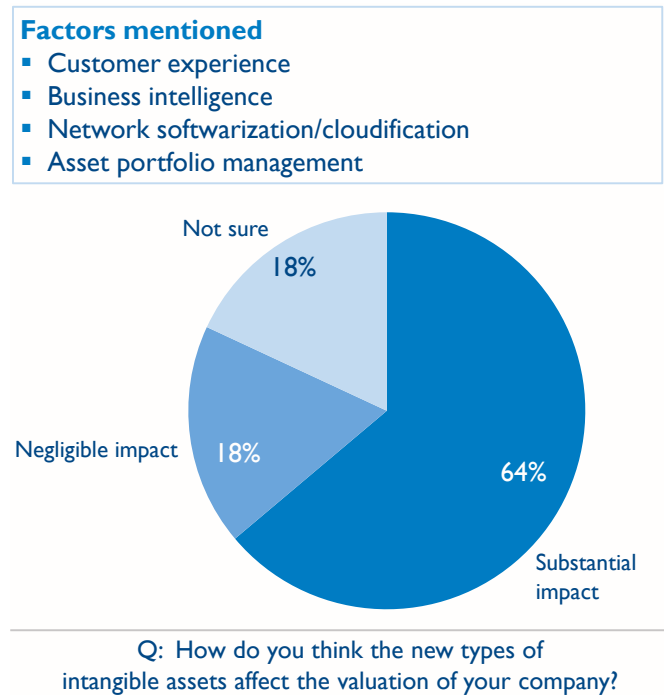
Identifying the drivers of change in the industry

Based on their current trajectory, telecom services are becoming less and less differentiated. Telcos now increasingly rely on their ability to engage business customers' needs for digital enrichment, using open and agile production models and reducing their rigidity based on heavy assets in order to accommodate change and innovation. Technological advancements in network operation and the digitization of numerous industries are changing the playing field, the production model and the infrastructural set-up of telecom operators – and, subsequently, the way they need to be evaluated from the perspective of the investor.

Many of these trends do not immediately manifest themselves into a change in tangible assets, but the importance of intangible assets is undeniable, as the majority of respondents in our study were already aware of the trends we discussed herein, as well as their potential impact.

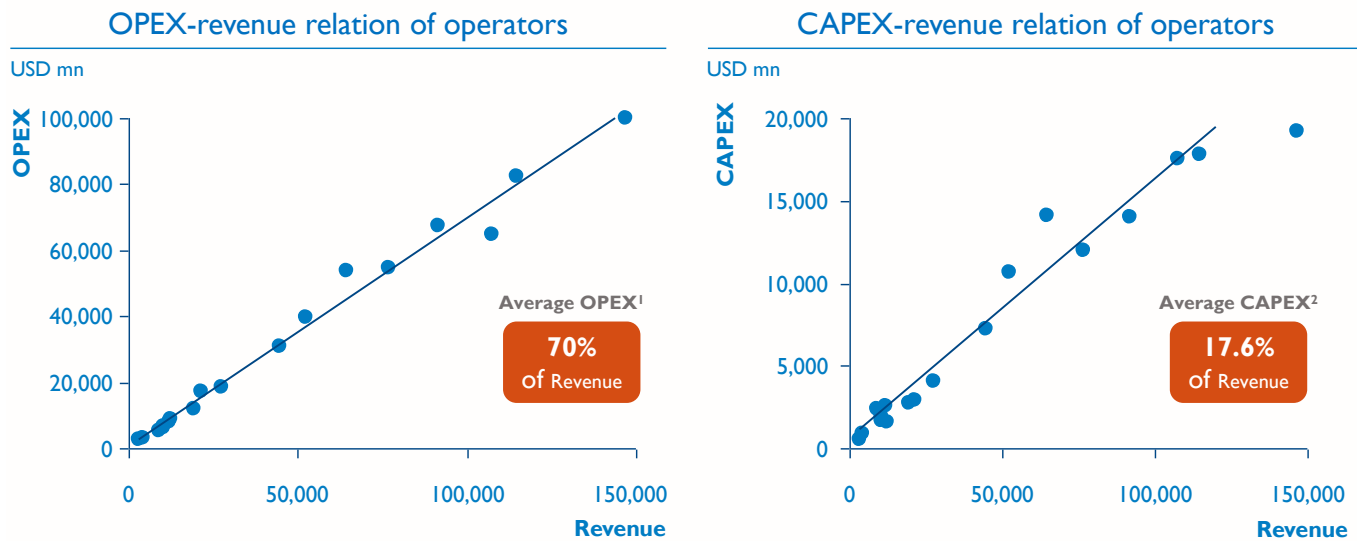
By 'intangible assets,' we refer to the ability to partner, reinvent the network and IT, and be open to partnering and other key differentiators, as described in the final pages of this report.

Figure 39: Changes to company valuation



Source: Arthur D. Little survey

Figure 40: Ratios of OPEX and CAPEX to revenues



¹ OPEX refers to the expenditures leading up to the EBITDA margin
² CAPEX excludes licensing fees

Source: Annual reports 2015 of 18 major telecom operators including AT&T, BTG, China Telecom, CK Hutchison, Deutsche Telekom, NTT, Ooredoo, Orange, Rogers, SingTel, Swisscom, Tele2, Telefonica, Telekom Austria, Telia, Telstra, Verizon, Vodafone

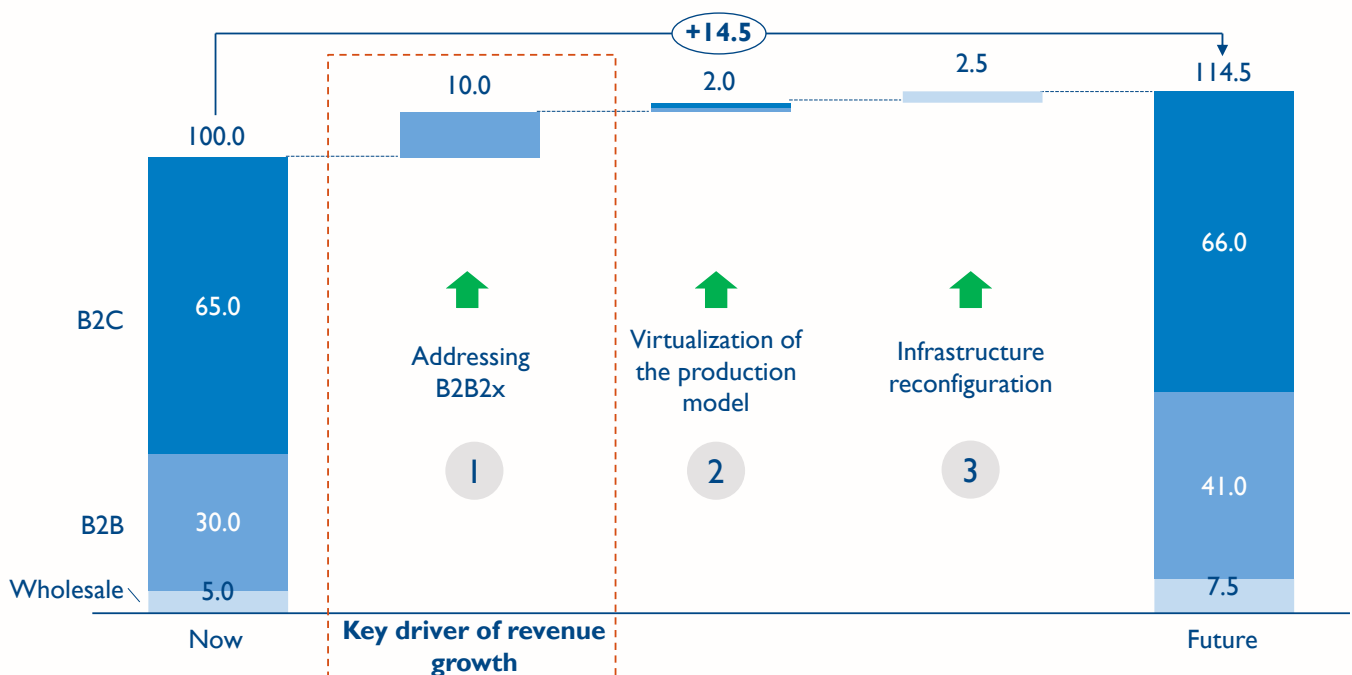
In this section, we try to quantify the impact of a traditional telco moving away from an asset-heavy model to becoming a new-type agile telco which pursues solutions-as-a-service instead of plain connectivity, with a virtualized production model that is leaner to operate and faster to market, and an asset-light structure that creates a good balance between asset utilization and infrastructure exclusivity. We look at these aspects using standard financial KPIs: revenue, opex, capex and overall valuation.

Financial driver	Key strategic lever
Revenue	Pursue B2B2x as a growth opportunity
Operational expenditure (opex)	Virtualize the production model to streamline network operations
Capital needed (capex)	Asset-light ownership structure with a shared capex model and equity dilution
Enterprise value	The transformed telco is not evaluated as a monolithic whole, but a sum of different parts

For this analysis, we consider an example telco with 100 in revenue, 70 in opex (i.e., a 30x EBITDA margin) and about 18 capex per year on average. We consider the impact of the above transformation over 10 years. We assume no other extraneous factors affecting revenue, costs or capex during this time period.

Note: Our analysis is based on an estimated impact and is clearly subject to an individual operator in a specific market

Figure 41: Revenue impact



Source: Arthur D. Little

and situation. Clearly all of the assumptions given below can be challenged. The purpose of the analysis is to illustrate the impact, more than to model a particular situation.

1. Impact on top-line growth

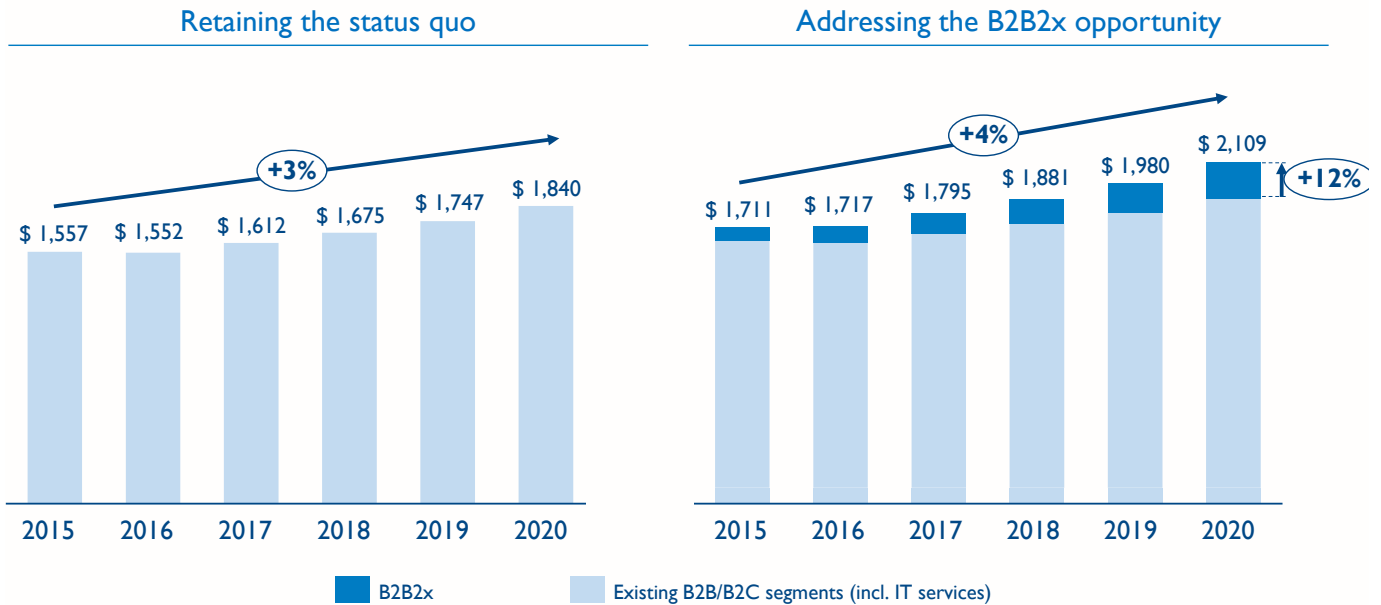
a) B2B2x is a high-growth, unaddressed opportunity for top-line improvement

Successfully addressing the emerging B2B2x segment can potentially improve the prospects of top-line growth for the telco. Overlaying the full B2B2x market potential over the current and projected telecom market reveals a significant top-line improvement, as shown below.

By 2020, in the abstract, the B2B2x segment can be expected to reach 12% of total telecom revenue, on our estimates. In reality, however, it is unlikely that telecom operators will be agile enough to achieve the full potential by that time. Thus, we also assume that our hypothetical telco will not reach 12% top-line improvement by 2020 from B2B2x activities.

In addition to that, a portion of the potential opportunity comes from cannibalization of existing B2B segments, or re-classifying some of the existing B2B revenue streams as B2B2x – these revenue streams in the connectivity and network operation areas. Following these assumptions, we estimate 10% top-line growth from B2B2x in our example.

Figure 42: Scenarios regarding developments in global telecom market share, 2015-20 (USD bn)



Source: Arthur D. Little

However, to achieve this revenue growth there needs to be a change in the existing production and sales set-up, as well as a partnership model to both sell and deliver, which we evaluate in the next section on opex and capex.

b) NFV/SDN-managed networks open new revenue opportunities

Introducing SDN and NFV in managing the telco’s network not only enables B2B2x, but also holds the potential for new opportunities in existing B2B and B2C. It leads to a decrease in the time to market needed for development and deployment of solutions, as well as an increased number of available market offerings in the company’s portfolio. This could result in an

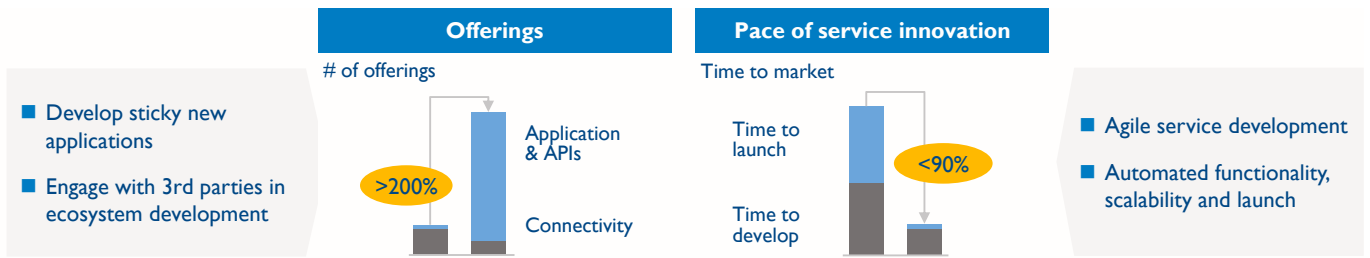
additional, say, 2% top-line growth due to the ability of the telco to better compete in the market.

c) Sharing network assets increases utilization and – consequently – wholesale revenue

Having an independent infrastructure model with shared ownership incentivizes the new management of the infrastructure to run it more efficiently and improve utilization. This leads to increased wholesale infrastructure services as well as reducing future duplication of infrastructure in the market. We assume that a telco can achieve a net incremental 2.5% of its existing revenue base as additional wholesale infrastructure revenue. Most of the increased wholesale infrastructure revenue comes from higher sales of existing legacy and fiber

Strategic lever	Revenue impact	Opex impact	Capex impact
Addressing B2B2x	Additional 10% growth over current revenue obtained by delivering solutions-as-a-service and moving up the value chain	New B2B2x revenue assumed at a margin of 20%, based on a partnership model to deliver new services	Additional 1.5% of revenue as capex per year to account for small-scale M&A and investment in new production & sales competencies
Virtualization of the production model	Additional 2% growth over current revenue due to shorter time to market and broader, modular product portfolio	10% savings on existing opex base, driven by change in production model – automated, modular, simple, self-serviced	Additional 10% of revenue as capex per year to virtualize the (active) infrastructure base
Infrastructure reconfiguration	Additional 2.5% growth over current revenue due to increased wholesale activity and improved asset utilization	Selling costs for revenue growth and increased cash expenses from ownership dilution result in a 5% increase in opex	Capex savings of 5% of revenue per year due to shared ownership-model (of passive and access) infrastructure

Figure 43: Number of offerings and pace of service innovation impact by SDN/ NFV



Source: Arthur D. Little

infrastructure, as well as better utilization of new infrastructure such as data centers and small cells.

2. Impact on operational expenditures

We look at revenue growth above, along with the corresponding opex²⁴ impact. Pursuing new B2B2x growth requires corresponding partnerships (opex) and changes in the production model (capex), resulting in changes in the opex structure.

d) B2B2x increases operational expenses

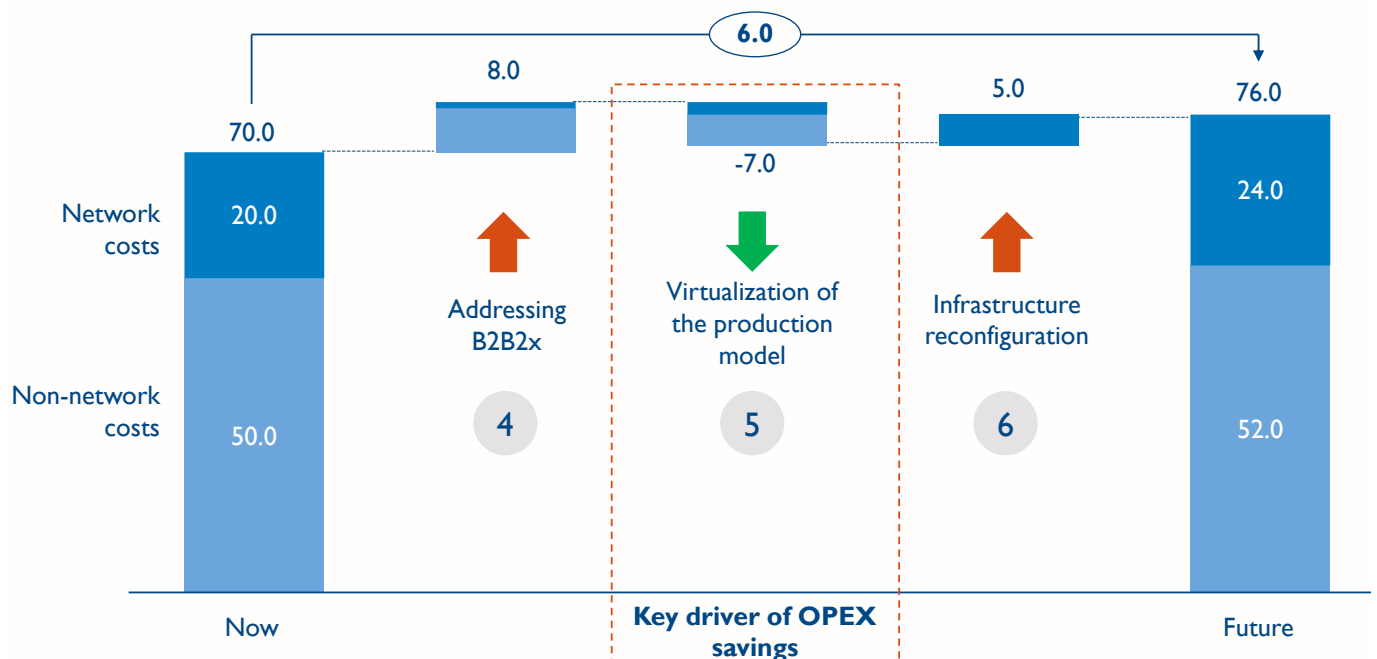
As already mentioned, addressing the B2B2x opportunity requires introduction of new modes of operation, including more partnerships (hence revenue sharing) and sales personnel with a different skill sets. All of this results in higher opex to deliver

B2B2x solutions. We estimate that a gross margin of 20% is possible for this new business segment in steady state (after a period of four to five years). This margin assumption comes from our belief that the segment will be more labor intensive and less reliant on the scalability of network operations. At the same time, it will also generate significant value for customers in two ways: bringing together holistic solutions and operating all the associated complexity for not-ICT industries. This allows telecom operators to obtain higher margins than simple reselling markups. Hence, we assume opex of $10 \times (1 - 20\%) = 8$.

e) Standardization and automation from NFV/SDN allow for significant opex savings

Network operations are streamlined when a network is virtualized. Our research in partnership with Bell Labs²⁵

Figure 44: Opex impact

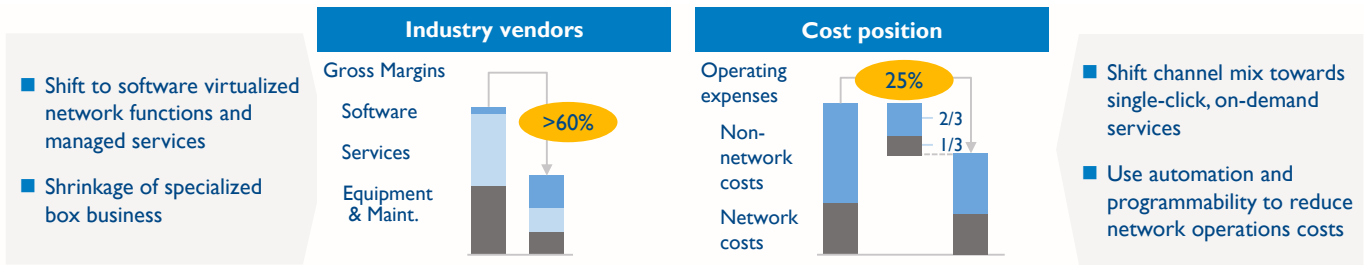


Source: Arthur D. Little

24 Opex refers to all expenses leading to the EBITDA margin (excludes depreciation, amortization, financing expenses, taxation and profits or losses stemming from valuation changes).

25 http://www.adlittle.com/downloads/tx_adlreports/ADL_BellLabs_2015_Reshapingthefuture.pdf

Figure 45: SDN / NFV impact on industry vendors and cost positions



Source: Bell Labs and Arthur D. Little

examined how SDN and NFV can significantly reduce network operation expenses and provide the potential for further savings in other business processes thanks to increased automation.

This will also alter the type of expenses incurred. Internally for the company, the largest savings will stem from savings in personnel expenses (reduction in call center, process and configuration personnel). When it comes to technology expenses, there is a shift from the weight of equipment, maintenance and other vendor services towards higher expenditure for software solutions.

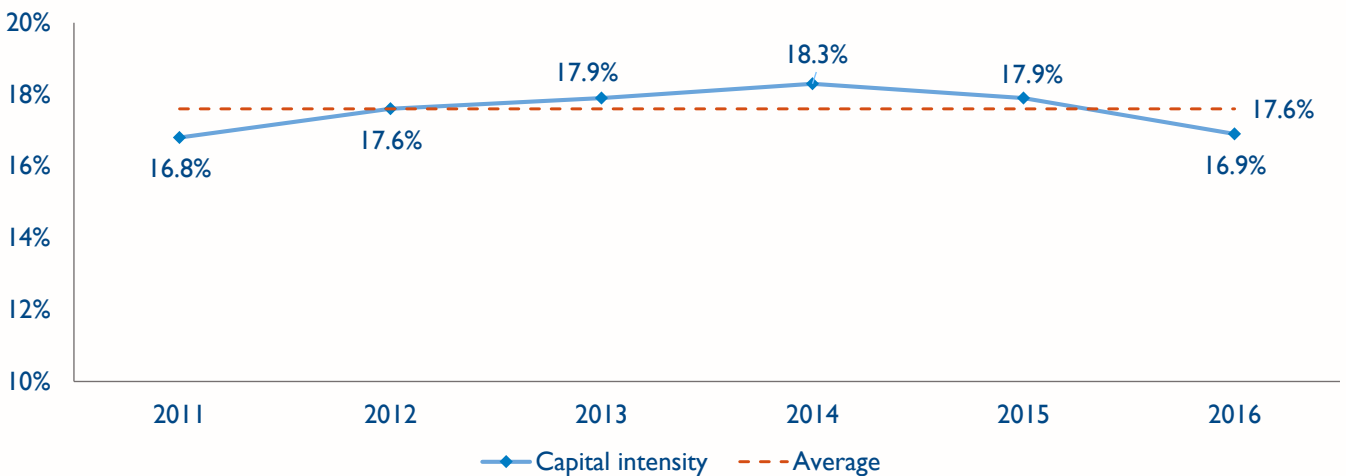
Cost savings from NFV/SDN are visible – they would be around one-quarter of total opex at the end of the transformation period. The costs of this transformation, however, are difficult to estimate – disruption of operations, planning phases, cultural clash, regulatory pressure on reducing people employed, etc. These considerations, coupled with the five-year planning horizon we use, gives us reason to assume that about half of the savings can be achieved, or 10% of opex in steady state (seven in this example), mostly in networking costs.

Cost savings from NFV/SDN are visible – they would be around one-quarter of total opex at the end of the transformation period. The costs of this transformation, however, are difficult to estimate – disruption of operations, planning phases, cultural clash, regulatory pressure on reducing people employed, etc. These considerations, coupled with the five-year planning horizon we use, gives us reason to assume that about half of the savings can be achieved, or 10% of opex in steady state (seven in this example), mostly in networking costs.

f) Increase in wholesale costs drives higher underlying opex

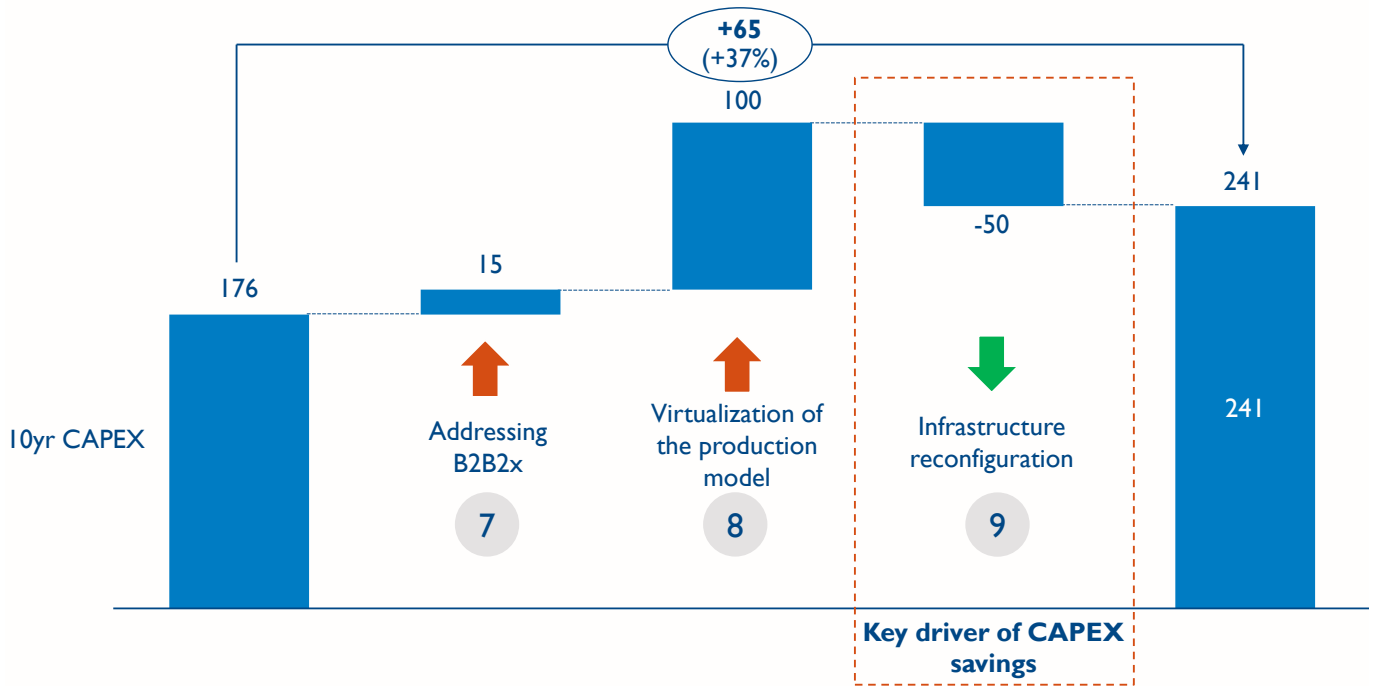
While wholesale activities have very high margins (approximately 50%), in our example, we consider a case of ownership dilution of 50%. This effectively means that previously non-cash expenses in depreciation are now cash-operating expenses between the market and the network entity. Although this scenario is heavily dependent on specific accounting practices and policies, we assume that the group entity will retain control of 50% of its additional network cash

Figure 46: Annualized capital intensity of global telecom operators, 2011-16 (capex/revenue)



Source: Arthur D. Little analysis, based on OVUM

Figure 47: Capex impact



Source: Arthur D. Little

expense. The selling costs and the additional network cash expenses in our example together amount to a 5% increase in opex.

3. Impact on capital expenditures

In the telecom industry, capex can change from year to year, but is stable overall because networks need to be kept up to date with technological developments driven by innovation from vendors, the telcos themselves or regulatory and user demands.

In this example, we assume a business-as-usual capex/revenue ratio of 17.6% pa over a period of 10 years (excl. license costs). That gives capex of $100 \times 17.6\% \times 10 = 176$. Below, we look at deltas to this capex due to B2B2x, SDN/NFV and infrastructure reconfiguration.

g) Nominal B2B2x capex due to competency development

Capex for B2B2x is due to investments in upgrading the current sales and production personnel, as well as to smaller M&A activity to obtain competencies in developing specific solutions for targeted industry verticals. In our model, we assume this capex to be 15 over the next 10 years.

h) One-off large capex for NFV/SDN to virtualize the production model

We estimate one-off large capex for NFV/SDN to virtualize the production model. This capex depends on the size and set-up of the network, as well as the business models of the suppliers

(software could be provided with revenue-sharing schemes rather than leased or sold).

The shift towards software solutions also creates different investment cycles in R&D and acquisitions. These solutions need to be updated much faster than physical assets, so the industry will tend to have shorter-in-duration and smaller-in-quantum investment cycles.

In our example, we assume that the company would need to invest an additional 10% of its revenue for the next 10 years to completely virtualize its production model. This gives capex of $100 \times 10\% \times 10 = 100$.

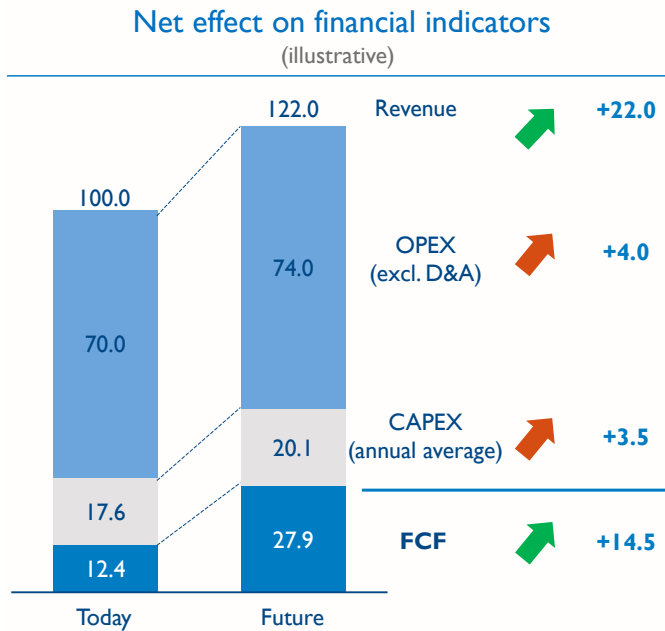
- i) Dilution of ownership of network assets can reduce future capex (co-investment) and free up cash (spin-off)

Changes to capex over time

Spin-off entity: (based on asset class):	Legacy-co	Fiber-co	Data center-co	Small cell-co
CAPEX impact:	-	Up to 50% saved by co-investment	Up to 50% saved by co-investment	Up to 50% saved by co-investment

Spinning off assets with equity dilution results in a shared ownership model. This also means all future capex is effectively shared with the new shareholder. This can result in up to 50% less capex investment. In this example, we assume a reduction in approximately 30% of existing capex, which gives savings of 50 over a period of 10 years.

Figure 48: Example based on EBITDA multiple

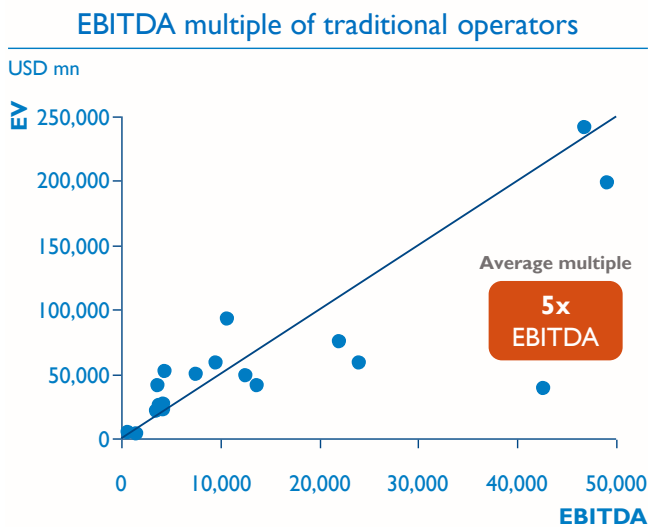


Source: Arthur D. Little

To summarize the effects of equity dilution, we see a decrease in the EBITDA margin, but an increase in cash generation from capex savings. This results in a net increase in cash generated from the networking assets thanks to optimized utilization, in addition to other benefits, such as more flexibility and lower upfront costs.

In summary, above we show the net effect of the revenue, opex and capex on our example telco.

Figure 50: Valuation impact for split telco



Source: Annual reports 2015 of 18 major telecom operators including AT&T, BTG, China Telecom, CK Hutchison, Deutsche Telekom, NTT, Ooredoo, Orange, Rogers, SingTel, Swisscom, Tele2, Telefonica, Telekom Austria, Telia, Telstra, Verizon, Vodafone

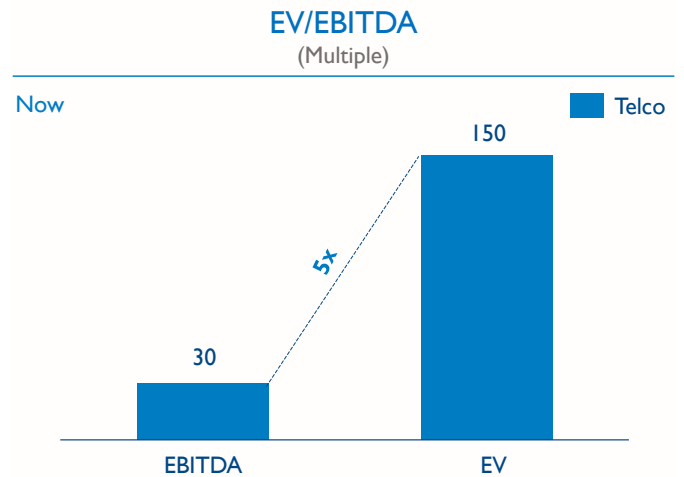
4. Impact on valuation

We also evaluate an additional KPI: valuation of the firm in order to understand the impact of B2B2x, virtualization and infrastructure reconfiguration.

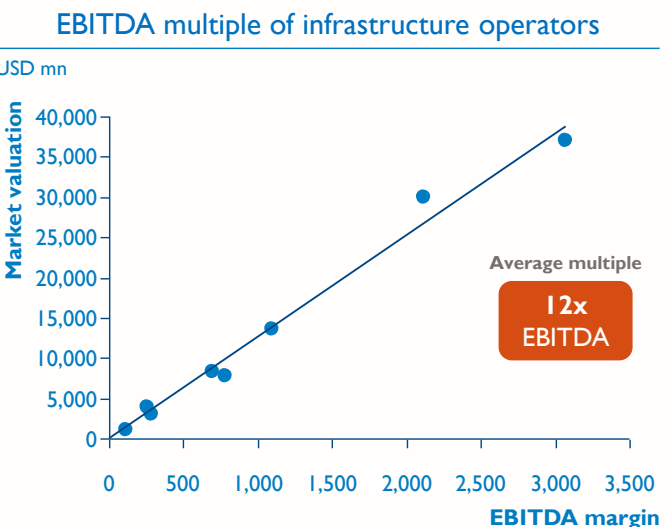
The most common valuation method used is EBITDA multiples to estimate the enterprise value (EV) of the firm.

For a traditional asset-heavy telco, we assume an EBITDA multiple of 5x. Our example telco has an EBITDA of 30, and this gives a valuation of our example telco as $30 \times 5x = 150$.

Figure 49: Net effect on financial indicators
(illustrative purposes only)



Source: Arthur D. Little



Source: Annual reports 2015 of 8 major telecom operators including American TowerCo, CellNex, Crown Castle, IHS Holding Ltd., Protelindo, Reliance Infracore, SBA Communications, Zayo Group Holdings

But once the telco expands its revenue base, transforms its production model, and reconfigures its infrastructure, its enterprise value is no longer derived like that of a traditional telco.

The market-facing entities – in this case, all the revenue-generating units and their respective virtualized production models – are now lean, agile, asset-light entities. They have a different operating model compared to traditional telcos – a wide product and solution portfolio, fast time to market, a less complex, innovation-driven structure. Consequently, this results in a different risk profile from an enterprise value point of view.

We assume that such a next-generation, asset-light telco or commercial-co (ComCo) will have an EBITDA multiple of 3-5x, as seen in the case of Spark in New Zealand.

The infrastructure entity – InfraCo – is also different from the infrastructure asset of a traditional telco. It is now independently managed and financed, and expected to have higher asset utilization. It also normally has long-term, stable contracts with its parent company and other third-party customers.

Such an InfraCo is an asset-heavy, long-term stable entity. Usually, such infrastructure-focused businesses command an EBITDA multiple of 8x, or even up to 12x, depending heavily on the asset types in question.

The move of diluting ownership of the telecom operator’s network assets is often viewed as a counter-intuitive, complexity-inducing decision, or even worse – as eliminating capabilities for differentiation.

While there may be some validity to these concerns, we need to consider that complexity is manageable (especially with

the standardization and automation of virtualized network management models) and networking assets are playing a decreasing role in determining room for differentiation. So far, we have encountered a number of cases in which such a move has generated positive net benefits: O2 in the Czech Republic, Spark in New Zealand and Swisscom in Switzerland.

Our traditional telco is now a sum of two different entities – a market-facing, lean ComCo and an infrastructure-focused InfraCo. We assume fair transfer pricing of all services between the ComCo and the InfraCo. The previous EBITDA of 30 has now grown to 38.5 due to the additional revenue and opex from the previous section. We split this EBITDA of 38.5 into a ComCo share of 29 and a NetCo share of 9.5 (assuming that the transfer price is done on a network cost basis).

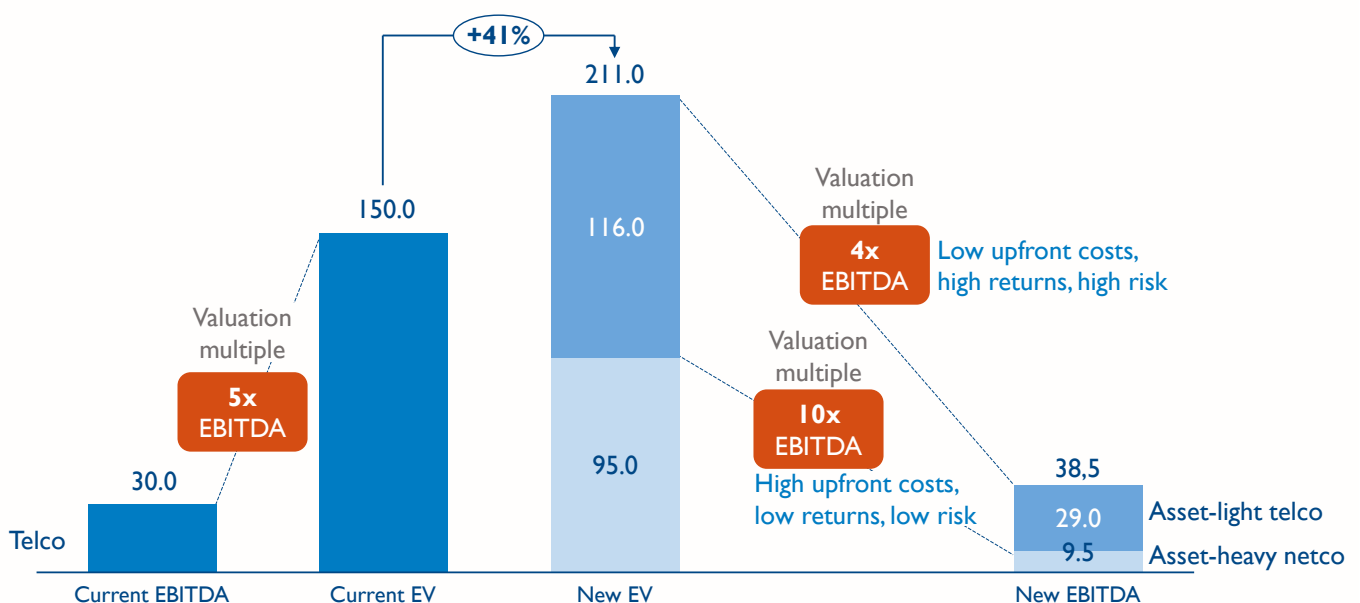
The new valuation is now $29 \times 4x + 9.5 \times 10x = 225$. This gives a valuation of the new telco (which is the sum of the ComCo and NetCo) of 211, which is 41% higher than that of the traditional telco.

5. New value drivers lie outside the traditional balance sheet

What drives value creation in a telco? Is it providing connectivity that was produced internally using its own assets? Or, is it providing solutions to its customers using virtualized production models and infrastructure-as-a-service from others?

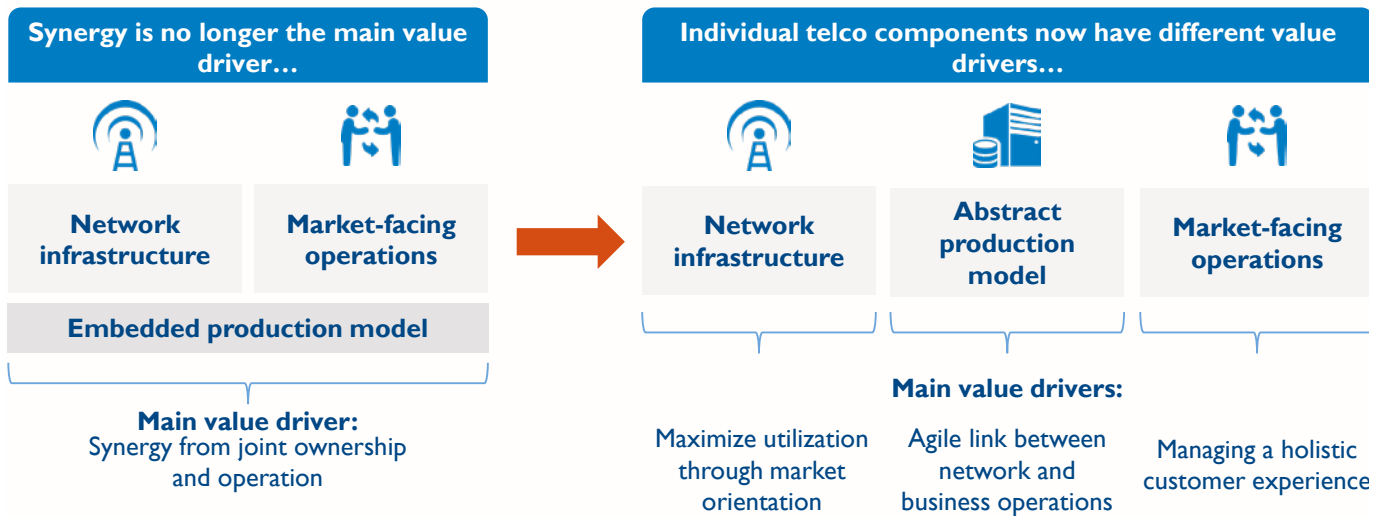
Traditionally, a telco derived its value from owning exclusive infrastructure, which provided competitive advantage. As competing firms also developed their own infrastructure, the value driver shifted from infrastructure to products and services.

Figure 51: Valuation impact for split telco



Source: Arthur D. Little

Figure 52: Value drivers in a telco



Source: Arthur D. Little

Telcos that focused on understanding the market need and providing connectivity products and services that were of better quality with good customer experience obtained greater market share and hence higher valuations. With the advent of infrastructure sharing, some of the redundant costs in managing overlapping infrastructures were reduced. This brings us to two principles telecom operators need to pursue in order to successfully position themselves for future developments: operational openness and a market-oriented asset approach.

- Operational openness

The importance of openness from a telco to its customers and partners is growing. With the increasing focus on holistic solutions telcos will need to be able to seamlessly adapt their systems to those of the customer. In addition, new considerations for business customers' industries will make openness to third-party partners another crucial point. Compatibility, flexibility and adaptability will thus be key to securing the projected market growth.

In order to radically transform itself, we believe a telco now should stop thinking of itself as a connectivity provider but, instead, as a solution provider – to both consumers and businesses. This can be done by not just providing high-quality connectivity, but also providing customers with solutions to business and other problems. For example, in B2B, a telco should aim to provide an end-to-end fleet management solution, instead of just M2M connectivity, to a logistics operator. As an example, on the consumer side, a telco could partner with content and OTT providers to give the consumer a high-quality content experience instead of selling complicated, throttled and tiered data bundles.

This will also change the pattern of customer relations, as the telco's value proposition and delivery process become

embedded in that of the customer, entailing much stronger customer relations and ultimately resulting in more certainty of returns in the future.

As a cumulative effect of this, we expect that telcos that have the capabilities for open business models towards their customers and partners will be able to obtain higher multiples of their EBITDA margins than comparable competitors in terms of balance sheet and market shares.

- Market-oriented asset approach

With competition further intensifying from infrastructure to connectivity products and services, and the added competition from the ICT market in the form of OTT services and other innovation, telcos' margins are being squeezed even further. Telcos are undertaking cost-cutting measures, but there is a limit to what cost-cutting can achieve if the production model remains the same as it was 30 years ago, when the mobile revolution began.

Conclusion

Throughout this report, we have discussed a number of opportunities that have emerged: B2B2x, changes in the production model, asset configuration, intangible assets, among others. We don't believe all operators should pursue all of these opportunities. But we do believe all operators will pursue one or more of these opportunities. This will result in telecom operators becoming more diverse: we will see asset-light and asset-heavy operators emerge. We will see more 'partner-open' and more closed operators. We will see both consolidated groups and groups as collections of parts. And, we will see operators with software-driven networks and overhauled BSS/OSS stacks, and others without. In all of this variety, one thing is clear: the industry remains dynamic and constantly changing!

Notes



Contributors

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A	Fast Web Free	N	T
3 UK		Naspers	Technetix
A1 Telekom Austria AG		Now TV	Tele2 Latvia
Altice	G	O	Telecom Italia
ACP	Google	O2 Czech Republic	Telefónica
ARCEP, Regulator		O2 Slovakia	Telefónica Chile
Arqiva	H	Orange Group	Telefónica Germany
AXTEL Mexico	H1 Telekom	Orange Poland	Telefónica Venezuela
B		Orange Slovakia	Telekom Slovenije
BICS	I	Orange Spain	Telenet
Bouygues Telecom	IBERDROLA	P	Telenor
BT	Indosat	Proximus	Telenor Bulgaria
C	Inteno	PT Indosat	Telenor Serbia
CamGSM / Cellcard (Cambodia)	Interbank Card Center Turkey	Q	Telia Company
CASER - Insurance company	Invitel	Qualcomm	Tesco
Cellnex	K		TIM
CEZ Distribuce, a.s.	Kcell	R	T-Mobile Austria
Cisco	KPN	Rundfunk und Telekom Regulierungs-GmbH	T-Mobile NL
Colt	KPN and Fortino Capital	RWE Energo, s.r.o., Czech Republic	Turk Telekom
D	L	U	
Deutsche Glasfaser GmbH	Liberty Global	UPC Austria	
Deutsche Telekom AG	Lattelecom	V	
D-Smart	LG U+	Velcom	
E	Lotte Group	Ventocom	
EE	M	Versatel	
Ericsson	Magyar Telekom Group	VIP Mobile	
ETB Colombia	Makedonski Telecom	Virgin Media Ireland	
Etihaad Etisalat Mobily	Maxtelecom Bulgaria	VIVA Kuwait	
Etisalat	MCI Iran	Vodafone Group	
Eutelsat	Medialaan	Vodafone Germany	
F	Merck	Vodafone Spain	
Facebook	Microsoft	Vodafone Turkey	
	Mobily	VTR Chile (Liberty Global)	
		Z	
		Ziggo/Vodafone	

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Contacts

If you would like more information or to arrange an informal discussion on the issues raised here and how they affect your business, please contact:

Austria

Karim Taga
taga.karim@adlittle.com

Italy

Giancarlo Agresti
agresti.giancarlo@adlittle.com

Norway

Diego MacKee
mackee.diego@adlittle.com

Belgium

Gregory Pankert
pankert.gregory@adlittle.com

Japan

Shinichi Akayama
akayama.shinichi@adlittle.com

Singapore

Yuma Ito
ito.yuma@adlittle.com

China

Russell Pell
pell.russell@adlittle.com

Korea

Hoonjin Hwang
hwang.hoonjin@adlittle.com

Spain

Jesus Portal
portal.jesus@adlittle.com

Czech Republic

Dean Brabec
brabec.dean@adlittle.com

Latin America

Guillem Casahuga
casahuga.guillem@adlittle.com

Switzerland

Clemens Schwaiger
schwaiger.clemens@adlittle.com

France

Didier Levy
levy.didier@adlittle.com

Middle East

Lokesh Dadhich
dadhich.lokesh@adlittle.com

Turkey

Coskun Baban
baban.coskun@adlittle.com

Germany

Michael Opitz
opitz.michael@adlittle.com

The Netherlands

Martijn Eikelenboom
eikelenboom.martijn@adlittle.com

UK

Richard Swinford
swinford.richard@adlittle.com

India

Srini Srinivasan
srinivasan.srini@adlittle.com

Nordic

Martin Glaumann
glaumann.martin@adlittle.com

USA

John W. Brennan
brennan.john@adlittle.com



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