



The Future of African Bandwidth Markets

African International Capacity Demand, Supply and Economics in an Era of Bandwidth Abundance

A XALAM ANALYTICS INVESTOR REPORT



May 2017



Our analysis goes deeper. For we know no other way. Xalam.



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About this Report

- The Xalam Analytics reports offer our take on key strategic and tactical questions facing market players in the markets we cover. They leverage continuous primary and secondary research and our Africa digital infrastructure, services and applications forecast models. Our general objective is to provide our customers with alternative, independent views of the forces driving the marketplace, along with a view on outlook and value.
- We purposefully refer to our reports as “Investor Reports”, though we do not provide stock recommendations. This, we believe, emphasizes the general focus of our analysis on economic value – from an investor’s perspective.
- The insights in this reports are our views, and our views only. Some of the elements are speculative and/or scenario-based.
- This report follows a format purposefully designed to be easy to read, with a style that aims to be straightforward, while adding value.
- We are obsessed with not wasting our customers’ time, and providing them with commensurate value for the investment they are making in our content. A key principle of our research is that it is only as useful as our clients’ ability to easily absorb it and gain from it. The style and overall design and structure of this report reflect that ambition, as we continuously seek that elusive balance between depth of substance and ease of readability. We’re not there yet, but hope we’re getting closer with each report.
- We seek and embrace feedback. Please do not hesitate to contact us at info@xalamanalytics.com with any questions and/or observations you may have.

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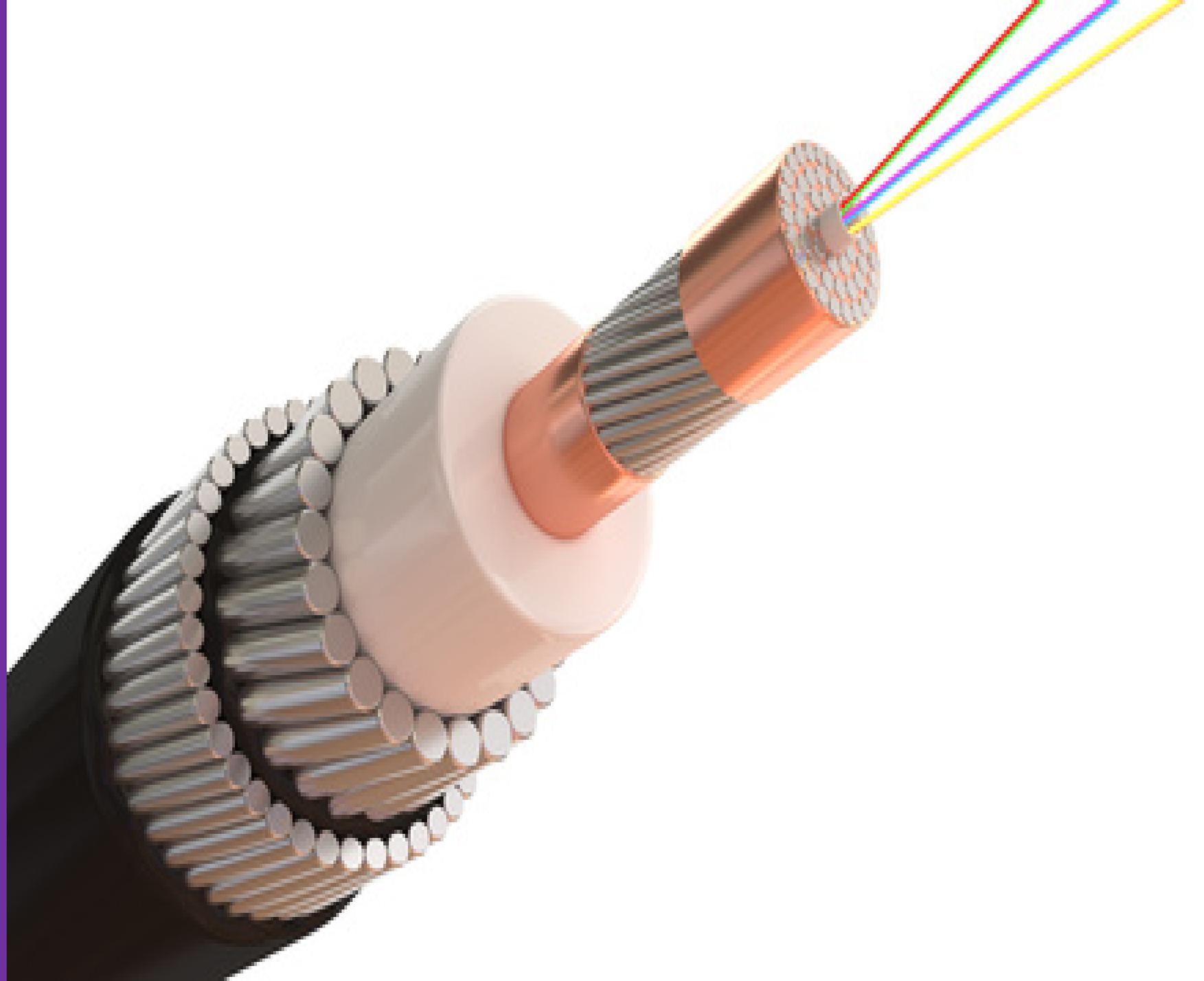
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INTRODUCTION:
Of Data Reliability,
Sources, and
Definitions



Data Quality Scale in this Report

"In God we trust. All others must bring data." - W. Edwards Deming

This report, like much of our content, uses a lot of data. Data is a foundational pillar of our analysis and insights, and we use the quality scale below to assess its reliability. As a general research policy, we do not release a report if “weak” data accounts for more than 25% of the data points gathered. Data quality in the African international capacity space is volatile, with material differences between countries and individual data points. We provide our reliability assessment below.

DATA QUALITY

Data Scale	Definition
Very Strong	This is hard data reported under some form of regulatory requirement; to a regulator, government or other entity (with some implicit, or explicit threat of sanction if the data is misleading). Included here is data from financial reports, some regulatory data (where the regulator has a strong history of data reliability).
Strong Data	This is data reported by the provider, publicly or through formal and informal interviews, discussions with our research team or other sources. While the data point is considered solid, it is nonetheless subject to exaggeration, definitions; this type of data is typically cross-checked against other sources (other reports, competitor assessment, etc.), and if applicable, “normalized” for benchmarking with others.
Weak Data	<p>This is data for which there is no formal, reliable source point. In this case, our research team generates its estimates based on conversations with market players, regulators and other market observers. While this type of data point provides a general feel for order of magnitude, its reliability, by its very nature, is weak.</p> <p>As a general research policy, we do not release a report if weak data accounts for more than 25% of the data points gathered – which explains why our Africa research often leaves out markets such as the Central African Republic, or to some extent, the Democratic Republic of Congo.</p>

DATA RELIABILITY ASSESSMENT FOR THIS REPORT – SAMPLE

Data Point	Weak	Strong	Very Strong
Supply Capacity (Design & Lit)	20%	60%	20%
Retail Broadband Data	10%	30%	60%
Capacity Usage, Other	40%	50%	10%
Capacity Pricing	30%	60%	10%
Operator Analysis and Data	30%	60%	10%
Operator Capacity Ownership Estimates	20%	60%	20%

Key Abbreviations Used in this Report

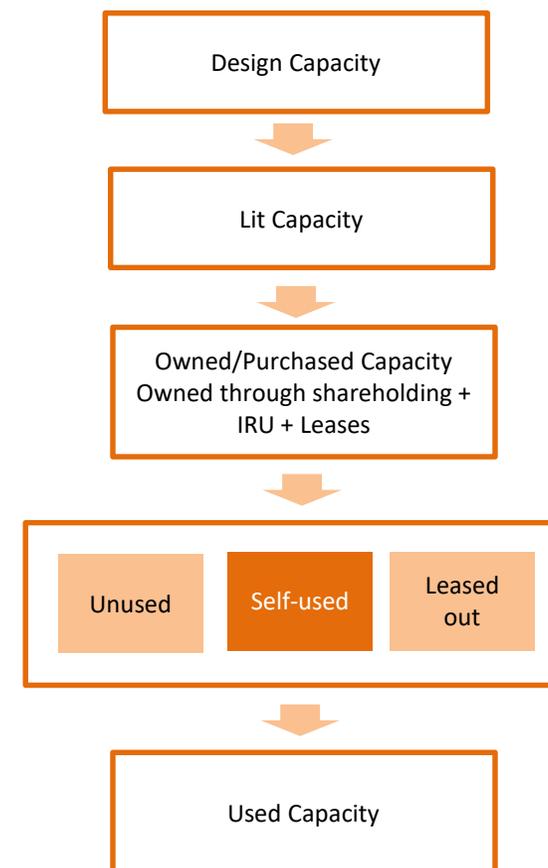
BB	Broadband
CapEx	Capital Expenditures
CEMAC	Central African Economic and Monetary Community
FBB	Fixed Broadband
FTTH	Fibre to the Home
IRU	Indefeasible Rights of Use
IXP	Internet Exchange Point
MBB	Mobile Broadband
OpEx	Operating Expenses
PPP	Public Private Partnership
RFS	Ready for Service
SA	South Africa
SADC	Southern African Development Community
SPV	Special Purpose Vehicle
SSA	Sub-Saharan Africa

Note: This report makes a liberal use of the term “Africa”. Unless otherwise indicated, such references pertain to the focus of this report, sub-Saharan Africa.

Design, Used, Owned, Equipped Capacity and More – Our Definitions

Getting a solid grasp on bandwidth capacity usage and adoption in the African market can be a most vexing task. At best, definitions are inconsistent from carrier to carrier, and country to country. At worst, some of the data is a morass of obfuscation and exaggeration. We collected it all, and “normalized” the data based on our knowledge of the market, credibility of the source, consistency with other data points and other factors. We used the definitions below for the purposes of this report, which may or may not match definitions in other data sources that may be available to the reader.

Item	Definition
Design Capacity	Maximum capacity of the system.
Lit or Equipped Capacity	Actual capability of the system, based on how much capacity has been “lit”, or “equipped”. Equipped capacity is a fraction of design capacity.
Owned/Purchased Capacity	Total amount of capacity owned by a carrier or customer; based on percentage of lit capacity they own as part of shareholding in a cable system, and amount of capacity purchased (on an IRU or leased basis) from a capacity provider. Owned capacity includes all capacity that belongs to a carrier/customer. That capacity is split into self-use capacity (the carrier uses to serve his own requirements) and leased capacity (extra capacity is leased out – or sits fallow).
Leased Capacity	Total amount of capacity that is purchased from a capacity provider in exchange for recurring (typically monthly) payments. Often used as a proxy for “used” capacity – though it’s not quite the same thing.
Used Capacity	Actual amount of traffic carried on cable system.
Capacity Demand	See page 31 for a more elaborate explanation of how we estimate international capacity demand.
Capacity Supply	Lit capacity and owned capacity are the two main proxies in our assessment of capacity supply.
International Bandwidth	At a broad level, we found this item to be a material source of market confusion in the marketplace , with some market stakeholders using design, lit, leased capacity to estimate international bandwidth. At a general level, we stayed away from international bandwidth as reported by some carriers and regulators, other than using it as a sanity check for our preferred sources. We nonetheless note that reported international bandwidth can be a reliable indicator of owned or leased bandwidth in landlocked market – and less so in competitive markets where carriers have access to multiple sources of capacity



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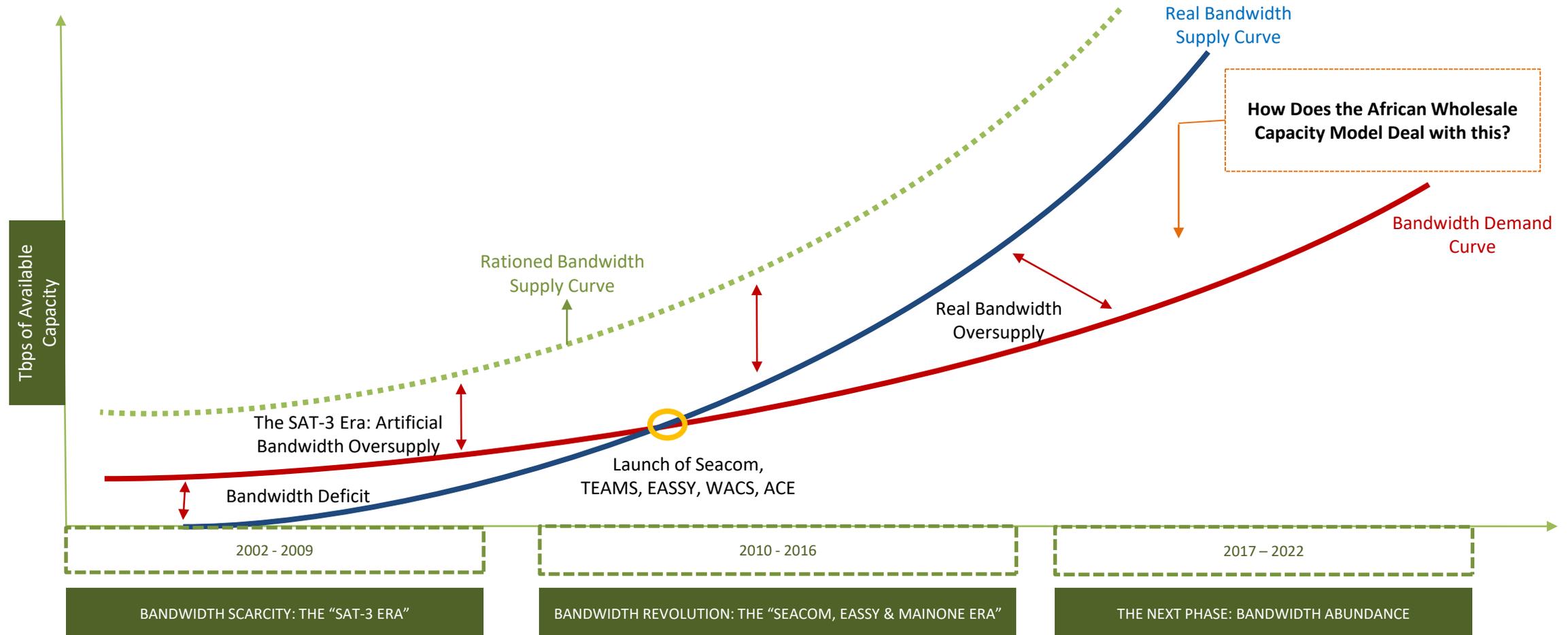
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EXECUTIVE
SUMMARY



The African International Capacity Market Has Entered a New Era

The African international capacity market has entered a new era, a new phase that comes after a period of dynamic growth between 2010 and 2015, and follows a miserable decade of bandwidth scarcity between 2000 and 2010. **Things are different in 2017.** Today's African international capacity market is facing a seminal challenge to its economic structure, a paradoxical predicament at a time when Internet traffic is booming across the continent. **Growth in the segment has remained fairly steady, and yet, rarely has the future of African international capacity models been so uncertain.** The dynamics behind these changes and their implications for market players and investors are at the heart of this report.



Africa's International Capacity:
On the Demand Side— An African
Broadband Revolution

- **The African broadband revolution has been a key catalyst of capacity demand** . The headline number of broadband connections in Sub-Saharan Africa has grown 10x between 2010 and 2016, to reach ~175m; we are projecting it to break the 200m mark in 2017 and hit close to 300m by 2020.
- **There is more depth to this demand**. Africa's 4G base is still small, accounting for only about ~4% of SIMs, and less than 1% of the world's total, but it is growing, and fast – we have a target of ~90m-100m 4G SIMs in SSA by 2020. 5G is not yet on the African radar screen, but it is the next step in mobile broadband access evolution and will require substantially more backhaul capacity. FTTH growth is on the upswing – we expect the total number of FTTH connections to hit the 2m mark by 2020, with a run rate of ~330k new connections a year.
- **Network traffic growth has been explosive**. Data from the Cisco Visual Network Index (VNI) suggests that the Middle East and Africa regions will have fastest mobile data traffic growth in the world over the 2016 – 2021 period, a pattern confirmed by individual African operator data, and this despite the fact that video has yet to truly pick up in the region.
- **Broadband growth is pushing up requirements for international capacity**. By our estimates, African demand for international capacity has been doubling every two years. Demand requirements hit around 3Tbps in 2016 and will get close to 7 Tbps by 2020. **This market, unquestionably, will continue to need international bandwidth – and lots of it.**

The Supply Side – More Capacity Coming

Africa's International Capacity:
The Supply Side – More Capacity
Coming

- **There are changes on the supply side as well** ; terrestrial backhaul capacity remains a bottleneck, but is largely improving*. At the international capacity level, the emergence of 100Gbps wavelength technology is transforming the economics of African international capacity. Around 4 subsea cable systems had 100Gbps wavelength technology in 2015, a number that should surpass 10 by 2018.
- **The average cost of submarine cable buildout has fallen sharply**; the Capex per Gbps of design capacity of a cable becoming operational in 2017-18 is 2x lower than in 2012 and more than 800x lower than the cost of the initial SAT-3 roll-out in 2002.
- We counted 14 operational, major submarine cables in sub-Saharan Africa in 2016 (including regional cables and excluding international, non-Africa focused cables), providing ~70 Tbps of design capacity and ~5.3 Tbps of lit capacity.
- **Overall capacity supply has been nearly doubling every other year since 2011, and there is more capacity on the way.** Between system upgrades, new cable rollouts and technology improvements, **African markets will add 4x more design capacity over the next four years than they did over the 2009-2015 period.** We are projecting cable design capacity to reach close to 270 Tbps by 2020 – this is ~20x 2010 levels and almost 4x 2016 levels.
- **Likewise, we are projecting equipped capacity to double from 2016 levels, to reach around 10 Tbps.** Unlike the 2010-2016 period, where incremental capacity came primarily through capacity upgrades on existing systems, more than half (~55%) of Africa's new equipped capacity will come from new cables deployed over the 2016-2020 period – **all of which will use 100Gbps technology.**

*We analyze African terrestrial metro and backbone market dynamics and opportunities in a separate, dedicated Xalam investor report.

The African Market is Oversupplied – but there’s More to that Story

Of Supply vs. Demand, Bandwidth Oversupply and Deficits

- **The African international capacity market is structurally oversupplied.** Between 2010 and 2015, capacity requirements have represented around 20% to 40% of capacity supply, before peaking at ~50% in 2016. In effect, and by our estimates, the market has around 2Tbps to 2.5 Tbps of extra international capacity above market requirements. **The gap between equipped capacity and actual usage is even deeper.** If the 2000-2010 era was a decade of bandwidth scarcity, the 2010-2020 decade is, unquestionably a decade of bandwidth abundance.
- **At a macro level, demand for capacity has been rising nearly 2x faster than supply,** a sign of the high velocity of demand requirements, but also (and primarily, perhaps) , supply volumes that are already fairly high.
- **Despite that, African capacity surplus volumes are actually trending upwards,** largely due to new cable projects being rolled out. New cables will push up the overall capacity oversupply, to more than 4 Tbps by 2020. **In short, African capacity players will have a lot more capacity to sell – and for a variety of reasons, a relatively limited number of markets to soak up that capacity.**
- **At some level, this is source of great concern –** especially for those investors that lived through the great transatlantic capacity bust. **In truth, we are getting less convinced that bandwidth gluts are as bad as they used to be (in the African context).**

African Capacity Oversupply is Uneven

- Besides, our analysis suggests that while there is oversupply at macro level, country and regional patterns are a little more complicated. **Only one market, in our estimation, displays characteristics of a bandwidth glut (South Africa)** – that is a unique combination of material excess capacity and highly dynamic downward pricing.
- **Another ~15% of markets are in a state we refer to as bandwidth rationing** – they have enough capacity to go around, but due to a variety of factors, that capacity is not being made available at price points that would reasonably stimulate demand. In such cases, the oversupply is merely technical; this is the SAT-3 scarcity model – albeit at lower price points.
- **Nearly a third to a quarter of the markets we examined have a bandwidth deficit** – they are using as much capacity as they can afford – but for a variety of reasons, they’re just not getting enough capacity supply at equilibrium price points.
- **When bandwidth rationed markets and bandwidth deficit markets are combined, nearly 40% of African markets still have less than optimal access to international capacity** – despite being in technical oversupply.

Surviving an Era of Bandwidth Abundance

- **After a (relatively short) fast growth period between 2009 and 2015, the African international capacity market is facing a seminal challenge to its economic structure.** To be sure, the sector's quandary is paradoxical, at a time when Internet traffic is booming across the continent. Growth in the segment has remained fairly steady, and yet, rarely has the future of African international capacity models been so uncertain.
- **There are questions as to whether the proposed new international cables are truly needed.** We say that on the face of it, bringing in new capacity into the market does look like overkill; **indeed, our projections show that new cables will merely add surplus to an oversupplied market.** Another argument is that the market price of an STM-64 IRU or above has fallen so much that in theory, a cable provider may be able to achieve his goals more cost-effectively using IRUs vs. building up brand new capacity.
- **We nonetheless still see a solid case for building out new capacity.** First, demand may be bigger than most are projecting it to be (including ourselves); when it comes to what traffic volumes will look like over the long term, for dynamic markets such as South Africa, the truth is, nobody really knows.
- Further, we argue in this report that the African capacity market is facing a different model paradigm, one where oversupply is ingrained into the model itself. **Bandwidth gluts still matter, to be sure – they are just no longer as threatening as they used to be.** The core business model consideration is not as much demand vs, supply – it's how fast capacity prices decline to adjust to the explosive levels of supply.
- **There are other factors too;** route diversity and latency are stronger considerations than ever; further, the ability by a first-tier wholesale telco to self-provision is probably as important as it's ever been (this, at a different level, is why global Internet players such as Google and Facebook are investing in their own subsea cables).
- **The other implication of this evolution in economic model, is that the business case for a stand-alone, pure play international wholesale carriers (like Seacom) will be highly tenuous in the future.** In an era of bandwidth abundance, only telco consortia and telcos (or Internet players) with strong traffic-generating retail units to soak up some capacity will be able to make a strong business case for building out a private international subsea cable.
- **All in all, the African wholesale model has to evolve** – we lay out some pathways.

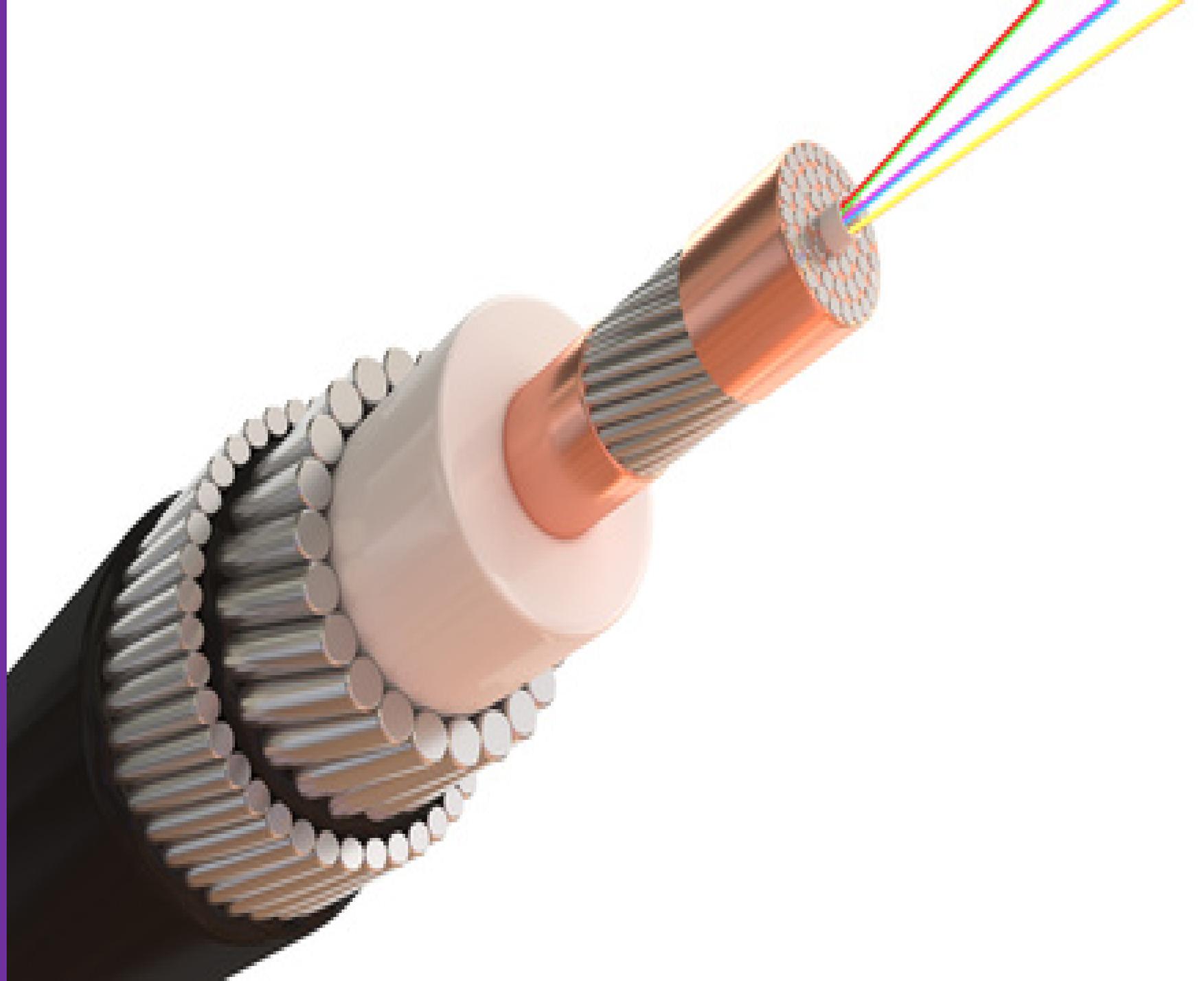
Of African Transit Pricing and the impact of IXPs

- **The impact of submarine cables on African international transit pricing suffers little debate** . Nearly all markets that witnessed a subsea cable rollout between 2010 and 2015 have seen material declines in the cost of their international capacity.
- **There are a number of other evolving features in African competitive capacity markets.** One is the notable evolution in the reference point for capacity unit price, from E-1 to STM-1, and increasingly, STM-10 in some markets. Another notable feature is the gradual shift of capacity purchases from IRUs to leases as cash gets tighter, along with more pressing customer requirements for IP and city to city connections.
- **We also note material variations in capacity pricing between markets - up to 50x.** This is leading to an increasingly pronounced African divide, one with inevitable consequences on retail connectivity costs. In some cases, the variations largely reflect a difference in price between coastal countries (with direct access to a landing cable) and landlocked countries. Increasingly, the uneven capacity pricing reflects differences in wholesale market structure and constraints on the availability of capacity as monopolies give way to oligopolies.
- **On the impact of IXPs in curbing international capacity requirements, our research finds that it is commensurate to the relative cost of international capacity;** where capacity is expensive, the case for IXPs is stronger; where prices are falling fast, ISPs are getting more transit capacity for less money and the IXP impact on international capacity uptake is relatively marginal (while positive in other areas, such as latency).

Of African International Capacity Market Disruptors

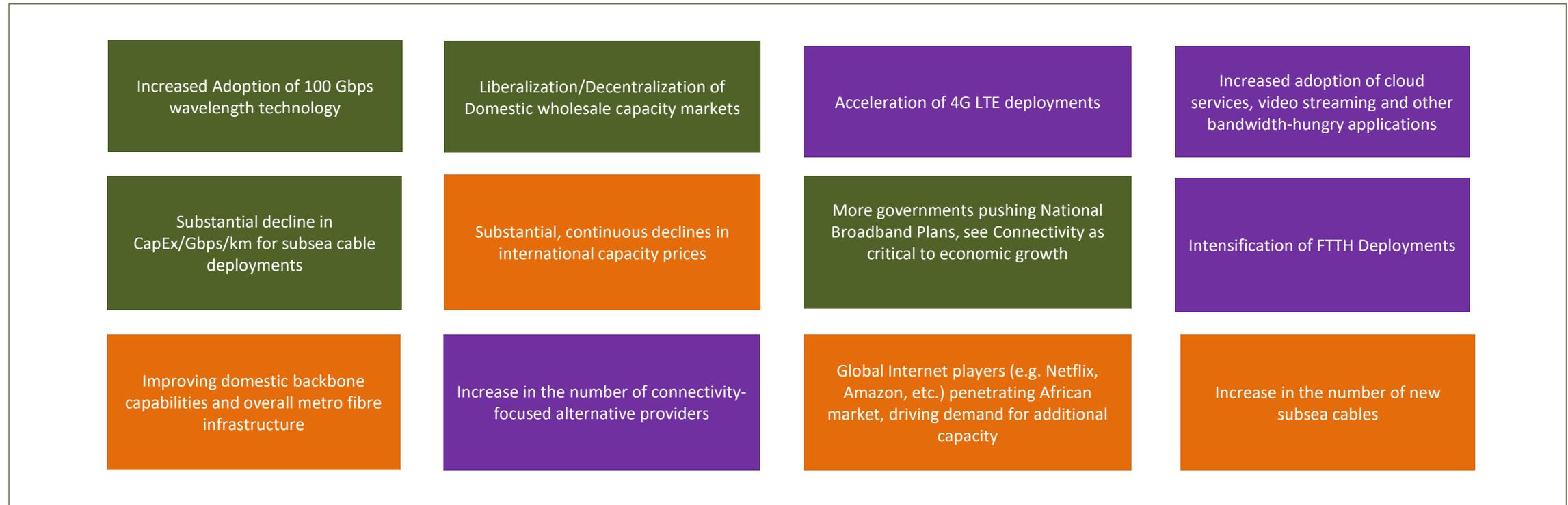
- **Our research has identified a number of African carriers we characterize as potential disruptors in the international capacity market:** Angola Cables, Camtel Cameroon, Djibouti Telecom and Telecom Namibia.
- **They (will) have a substantial surplus of international capacity, and for the most part, it's not entirely clear how they plan to use it.** The core question is therefore – **will they be rational actors, or will they, as they can in theory, fundamentally disrupt the African wholesale market?** We place our bets.

Market Context: of
Africa's Explosive
Data Growth,
4G/5G, FTTH, and
100Gbps Technology



The African International Capacity Market is in the Midst of Deep-seated Transformation

The African Internet market is in the midst of deep-seated transformation, all aspects of which would be too extensive to cover exhaustively here. It's a virtuous, self-feeding and relentless cycle, a continuous interplay of supply and demand dynamics, typically in the same direction, and surprisingly too often in opposite directions. Technology and regulatory changes feed broadband demand for Internet content and services; demand drives traffic, investment and business models – and the cycle repeats. **The fragmented nature of the African market means that this cycle does not occur at the same pace or in the same manner in all markets** – but the transformation is unquestionably pervasive. The next few pages focus on a few of these trends.



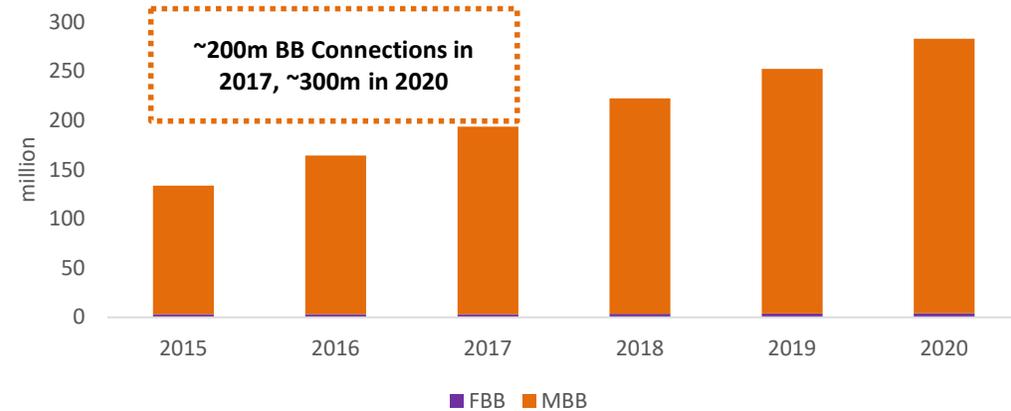
Sources: Xalam Analytics Research.

Backhaul Capacity Demand Catalysts – A Remarkable Growth in Retail Broadband Connections

The Number of Broadband Connections in Africa is Growing Fast

- ~175m broadband connections in Sub-Saharan Africa at the end of 2016
- The headline number of BB connections in SSA has grown 10x between 2010 and 2016
- Average annual broadband connection growth of ~55% over 2010-2015 period
- ~20 SSA countries have a broadband connection base >1m
- Growth has been mobile-driven – MBB accounts for 98% of connections
- But this is about more than mobile
- FTTH rising fast, to be second largest access technology in SSA by 2020

Broadband Subscriber Base in Sub-Saharan Africa – 2010-2020

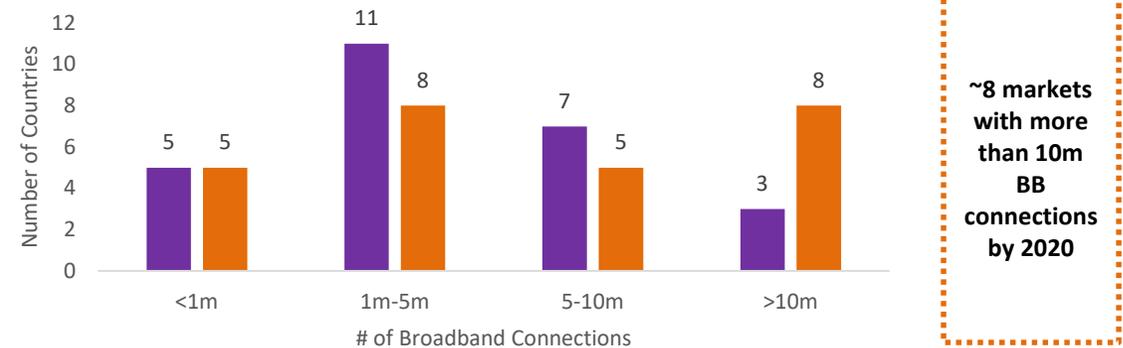


*MBB including 3G and 4G connections only; FBB including wireline and fixed wireless connections higher than 1Mbps
Source: Xalam Analytics Research

...And there's Still Room for Further Top Line Growth

- Number of broadband connections in SSA projected to break the 200m mark in 2017, hit close to 300m by 2020
- Average top line BB connection annual growth around 15% over 2015 -2020 period
- Top line median broadband penetration was ~20% in 2016 – projected to rise to ~35% by 2020
- ~8 markets will have more than 10m BB connections by 2020 (from only 3 in 2016)– around 21 of SSA's countries will have more than 1m broadband connections

Distribution of Sub-Saharan Africa Broadband Markets by Size – 2016E



Backhaul Capacity Demand Catalysts: 3G Stabilizes, 4G Rises, and 5G is Coming

The Pace of African LTE Deployment is Accelerating

- Around 15 4G networks became operational in 2015
- Another ~20 in 2016 (including multiband networks);
- Slightly more than half of African mobile operators have an LTE network at the end of 2016;
- Two-thirds of African markets had at least one commercial LTE network at the end of December 2016

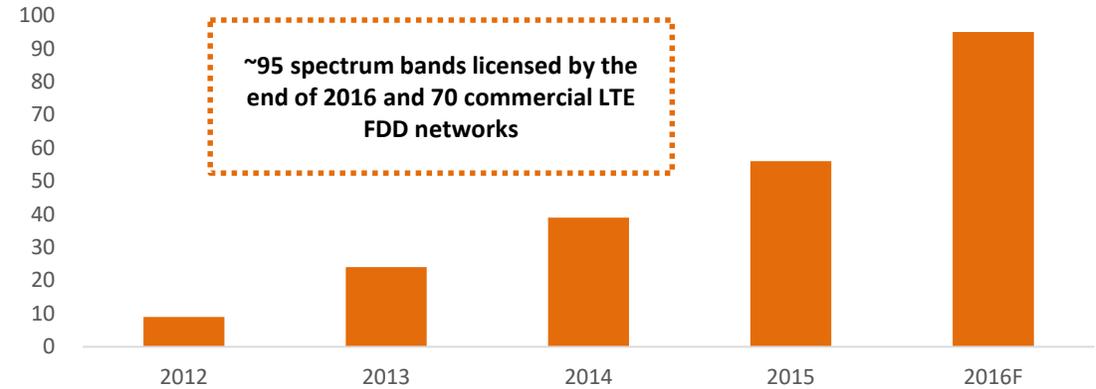
There is Substantial Growth Runway for 4G - ~90m-100m Subs by 2020

- The 4G base is still small - ~17.5m in SSA in 2016; only about ~4% of SIMs, and less than 1% of the world's total
- But it is growing, and fast – Target of ~90m-100m 4G SIMs in SSA by 2020
- That would still be only around 20% of African SIMs
- 3G/3G+ will be solid over the medium term - ~60% of SSA Mobile Broadband will still be 3G based in 5 years

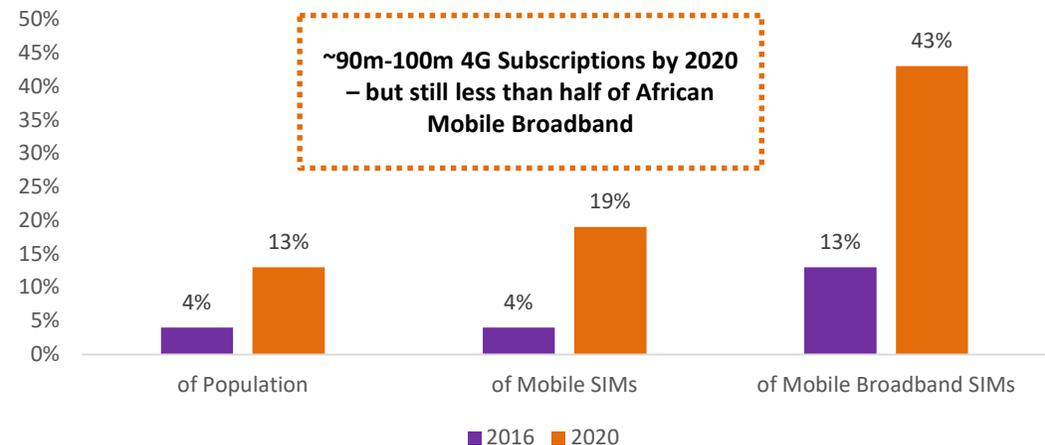
The 5G Impact Could be even More Dramatic

- 5G is not on the African radar screen
- But it is the next step in mobile broadband access evolution , a platform for ultra high-speed broadband (~1Gbps and above), IoT, and smarter, virtualized networks
- Designed to help usher new, bandwidth hungry applications – e.g. augmented reality
- 5G will also require substantially more backhaul capacity
- First African deployments possible around 2020-2021

Africa 4G Commercial Network Roll-Out – 2012-2016*



Evolution of 4G Penetration in Sub-Saharan Africa – 2016 - 2020

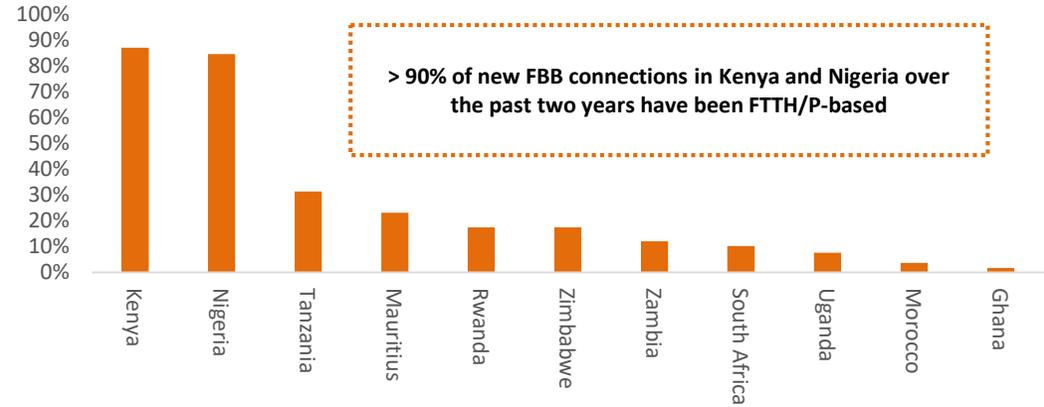


Backhaul Capacity Demand Catalysts: The African FTTH Boom Has Started

The African FTTH Boom Has Started...

- We estimate that the total number of FTTH connections in Africa passed the 500k mark in the third quarter of 2016.
- Around 75% of Africa’s FTTH connection growth since 2010 has occurred over the past two years.
- About 800 new FTTH connections go active every day across Africa
- Pace of uptake is ~2x 2015 levels and continues to accelerate as supply and demand fundamentals come together.

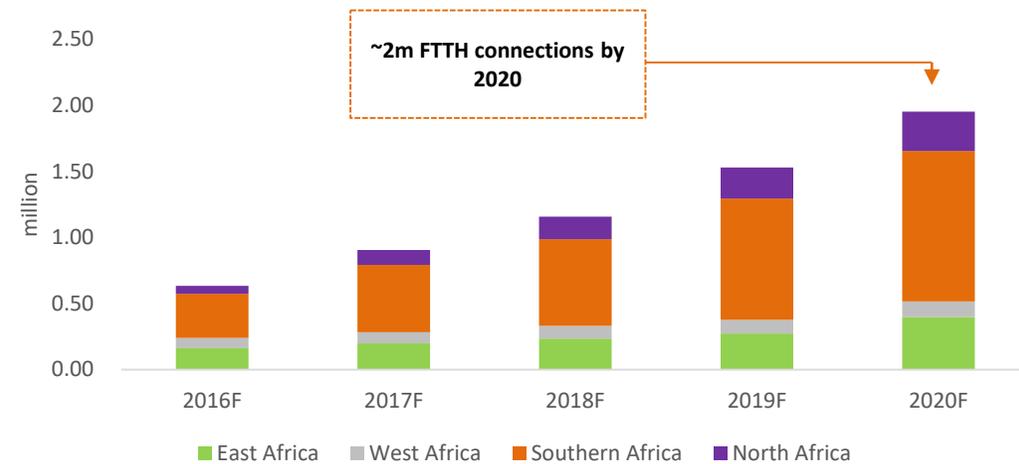
FTTH Share of FBB In Sample Markets – 2016E



...And the Upside Is Strong

- FTTH only touches ~2% of Africa’s fixed broadband addressable target market.
- We expect the total number of FTTH connections to hit the 2m mark by 2020
- That’s ~1.3m new connections added between 2016 and 2020 – a run rate of ~330k new connections a year.
- The numbers could be higher subject to what happens in Nigeria, Egypt, Algeria, where we have highly conservative projections.
- With average speeds above 10Mbps, along with a dramatic increase in video content, the rise of African FTTH is a fundamental driver of demand for domestic and international capacity.

FTTH Connections in Africa – 2016-2020

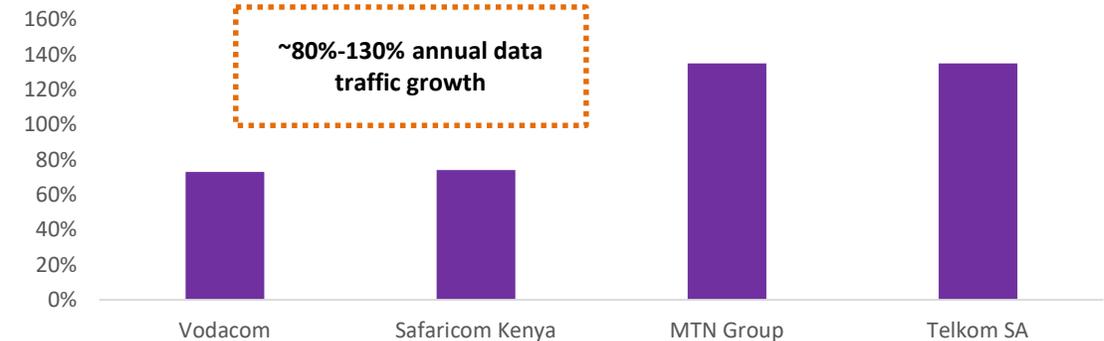


Backhaul Capacity Demand Catalysts - The Explosive Growth of (Mobile) Data Traffic

African Data Traffic Growth Has Been Explosive...

- Middle East and Africa (MEA) regions had the fastest mobile data traffic growth in 2016
- ~96% year-on-year, according to Cisco Visual Network Index (VNI);
- According to VNI projections - MEA will have fastest mobile data traffic growth in the world over the 2016 – 2021 period - ~65%
- Individual African operators are confirming this trending
- Sample operators in Kenya, Nigeria, South Africa show mobile data traffic growth in the 80%-130% range

Average Mobile Data Traffic Growth for Sample African Operators

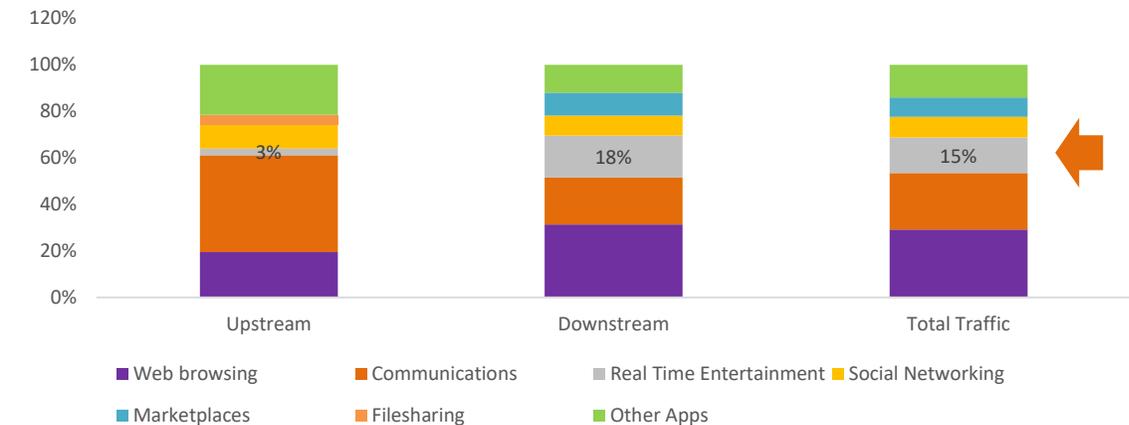


*MTN across group operations; All data for 12 months to March 2016 or September 2016
Source: The Companies

...Despite the Fact that Video Consumption Hasn't Truly Picked Up

- Sandvine 2016 traffic analysis data suggests that communications is the largest non - browsing activity in Africa;
- People use the Internet to browse, and to communicate through voice and messaging, using WhatsApp, Viber and other communications OTT.
- Communications is now the largest upstream traffic category in Africa – more than 40% of total. WhatsApp alone now generates close to 10% of traffic
- In most other regions, real-time entertainment (e.g. Netflix, or YouTube) dominates;
- **In Africa, real time entertainment is still only ~15% of overall traffic- ~ 20% of downstream traffic**
- This is consistent with relatively low levels of ultra-high-speed BB, 4G
- But will change as broadband penetration expands – **there is more growth coming**

Structure of Peak Period Data Traffic in Africa*



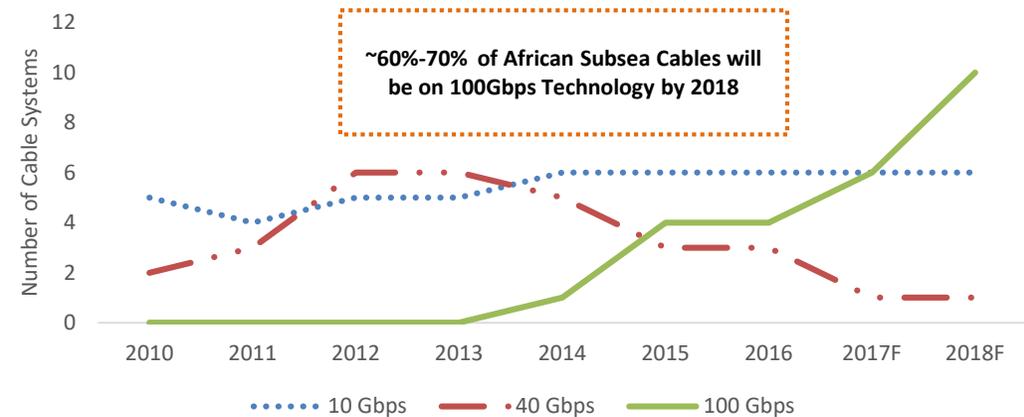
*Based on data from 20 African mobile networks;
Source: Sandvine Internet Global Phenomena Report, October 2016

100 Gbps Wavelength Technology Has Transformed African Cable Economics

The Number of 100Gbps Systems Will Double Within the Next 24 Months

- **100 Gbps wavelength technology is transforming the economics of African international capacity**
- Around 4 subsea cable systems had 100Gbps wavelength technology in 2015; that number should surpass 10 by 2018
- **In turn, the average cost of submarine cable buildout has fallen sharply;** the Capex per Gbps of design capacity of a cable becoming operational in 2017-18 is 2x lower than in 2012, when the WACS cable was rolled out, more than 800x lower than the cost of the initial SAT-3 roll-out in 2002.

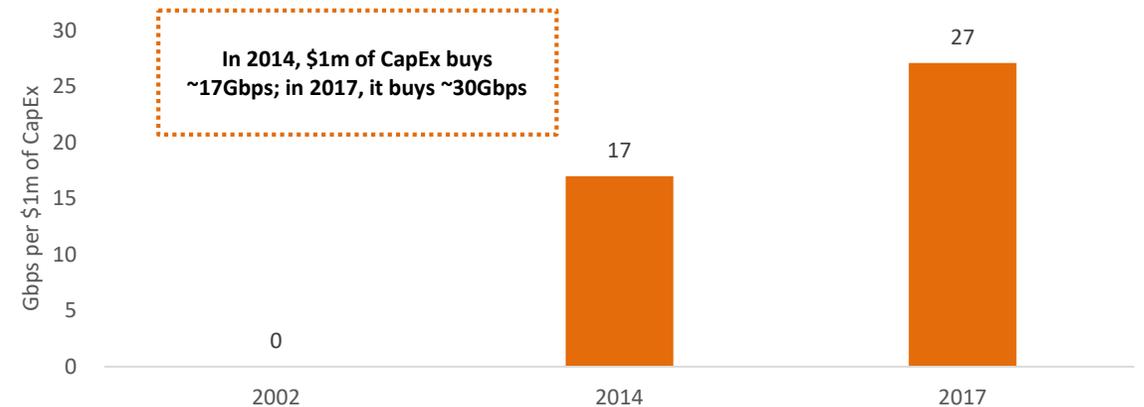
Evolution of African Cable Systems by Wavelength Technology



\$1m Gets ~2x more Capacity than It did in 2014

- **In effect, African operators are getting more bang for their CapEx;**
- When SAT-3 was first rolled out, \$1m bought a mere ~35Mbps of capacity. In 2014, the same ~\$1m got Senegal’s Sonatel around 17Gbps in the SAT-3 system upgrade.
- **At the 2017-18 rate, an operator could get ~30Gbps of equipped capacity on a cable between South Africa and Portugal.**

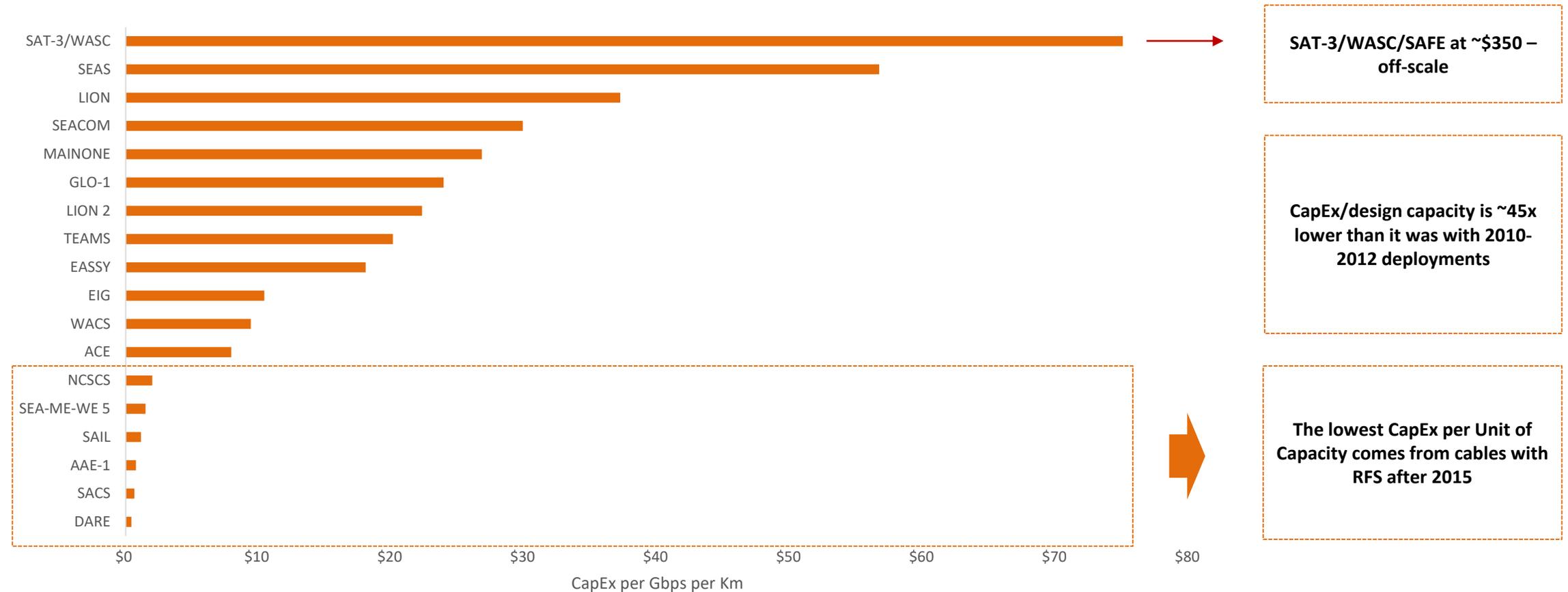
How Much Equipped Subsea Fibre Capacity Does \$1m Buy? Evolution over Time



*Estimate based on theoretical cable between South Africa and Portugal; 2002 estimate based on SAT-3 initial rollout cost; 2014 based on actual SAT-3 upgrade costs paid by an African carrier; 2017 is a projection based on SEA-ME-WE 5 cost per Gbps per km. Sources: Xalam Analytics Estimates

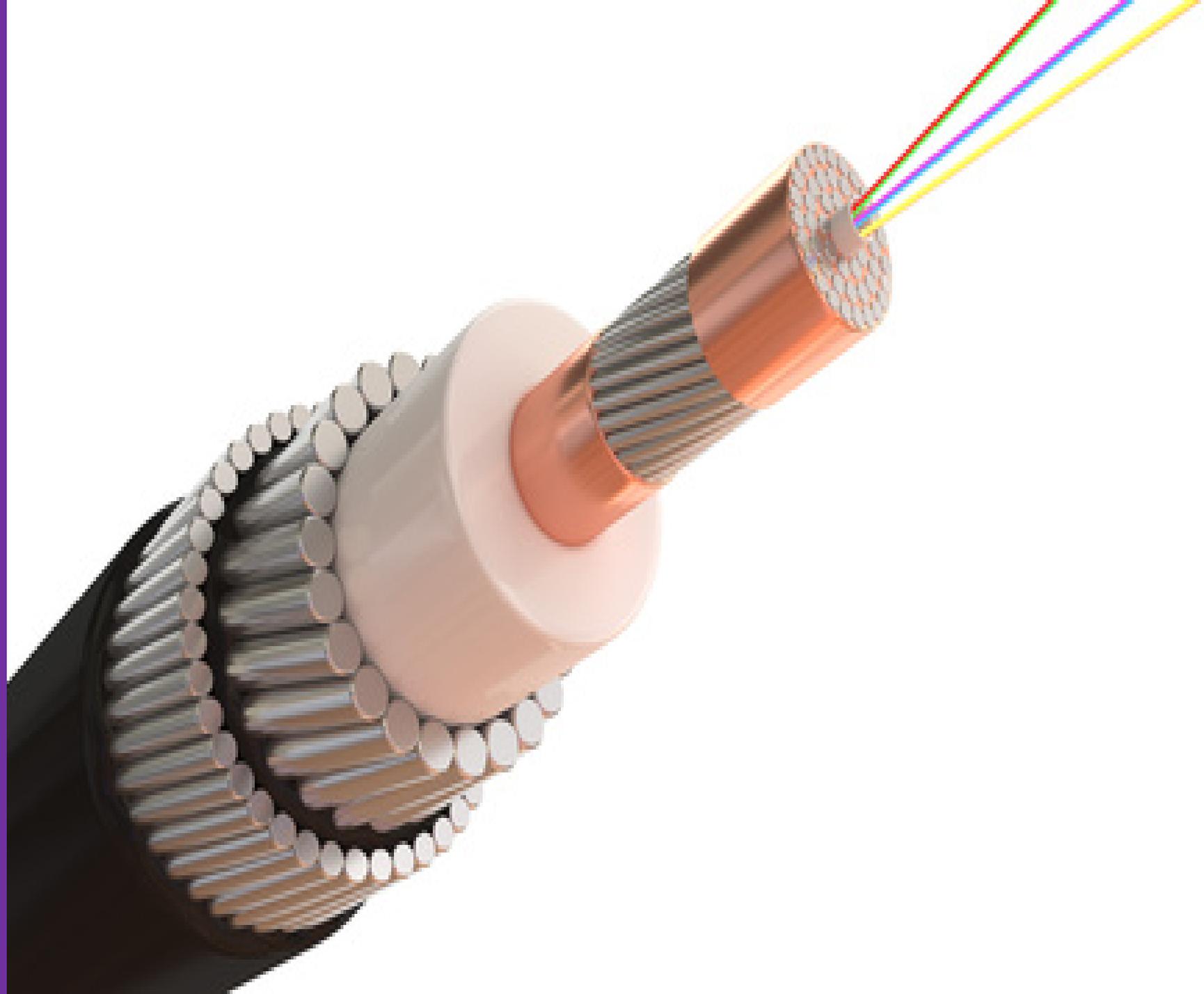
100Gbps Technology is Upending Africa Submarine Cable CapEx Fundamentals

Africa Submarine Cable CapEx per Gbps per km – As 2016, excl. System Upgrades – Based on Design Capacity - USD Million



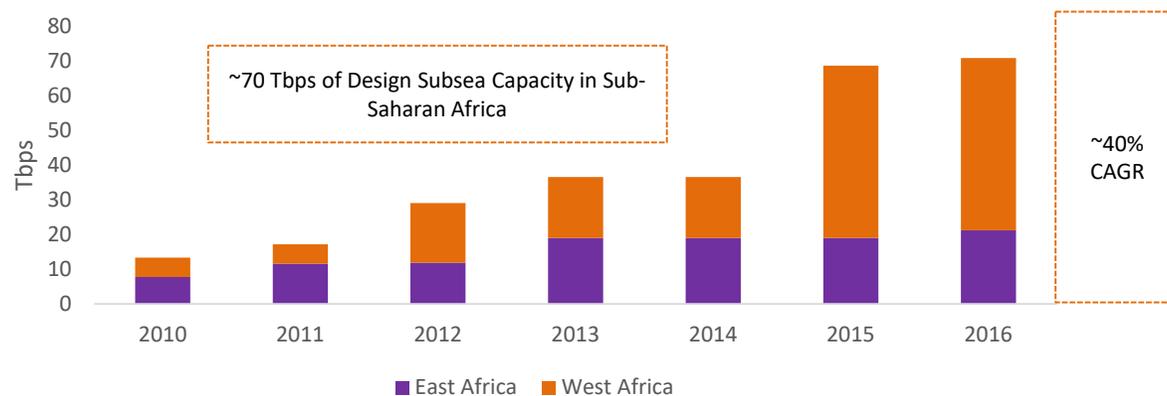
Sources: The Companies, Xalam Analytics Research

African Capacity
Demand vs. Supply:
of Bandwidth
Oversupply, Deficits
and Rationing

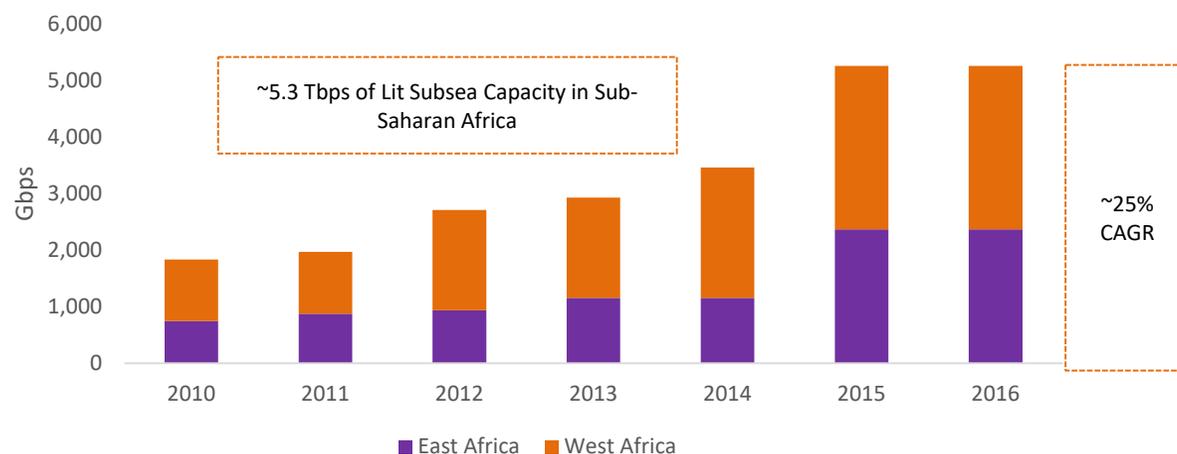


Africa Bandwidth Supply – A 5 Tbps Market

The Supply Side Historical View: Africa Subsea Design Capacity – 2010-2016



The Supply Side Historical View: Africa Subsea Lit Capacity – 2010-2016



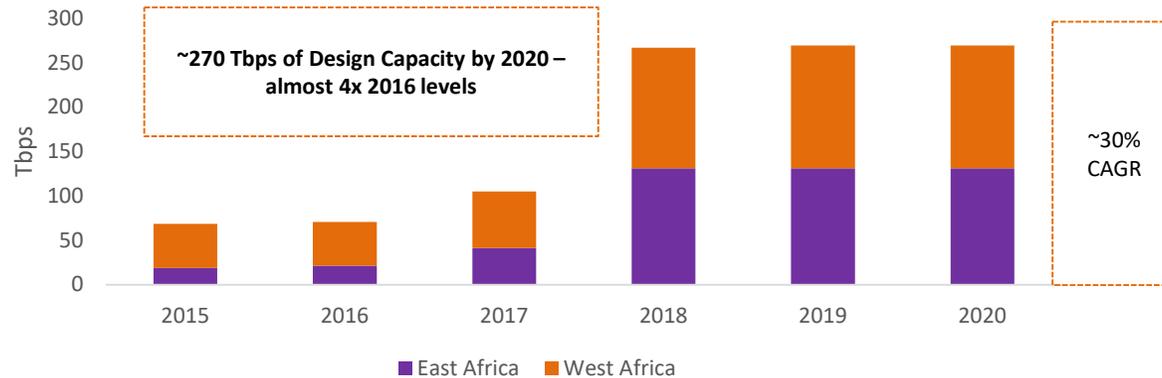
Sub-Saharan Africa's International Capacity Supply - ~25% Annual Growth

- **~14 operational, major submarine cables** (including regional cables and excluding international cables)*
- **11 new cables rolled out between 2009 and 2016, providing ~70 Tbps of design capacity**
- **~5.3 Tbps of lit capacity, an average lit to design ratio of around 7%.**
- **Average annual lit capacity growth of around 25%** between 2010 and 2015.
- **Overall capacity supply has been nearly doubling every other year** since 2011
- Other than a regional connection between Cameroon and Nigeria, no cross country submarine cable was launched between 2012 and 2016.
- **The near-entirety of incremental lit capacity over that period (~2500 Gbps, almost half of Africa's 2016 equipped supply) has come through system upgrades.**
- The West African coastline attracts around 40% of all operational subsea cables in Africa – but 55% of the continent's equipped capacity.

*Submarine cables only; including regional cables, but excluding International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, IIG, AAE-1, etc.). Source: Xalam Analytics Estimates

Africa Bandwidth Supply Forecast View – Another International Capacity Boom is on the Way

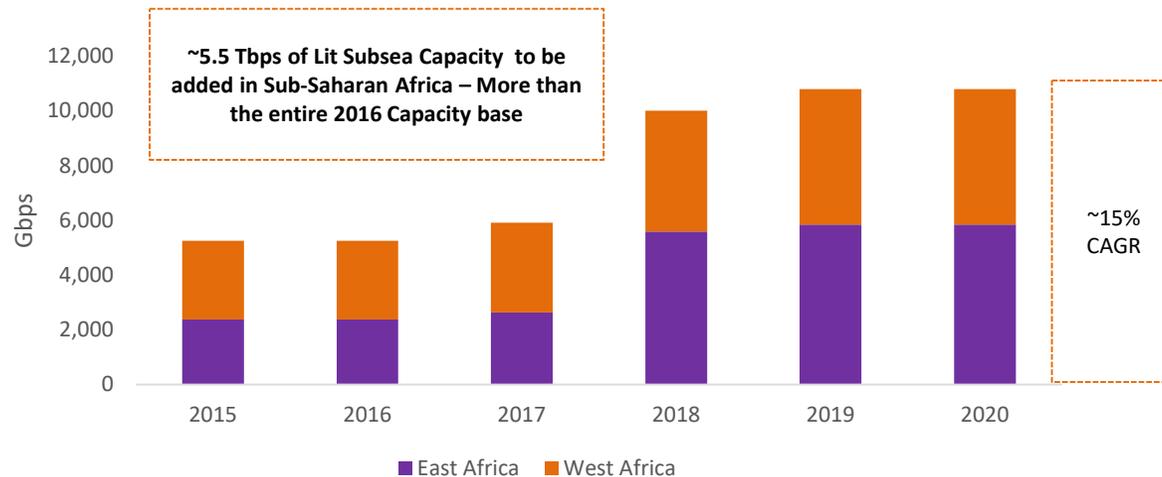
The Supply Side Forecast View: Africa Subsea Design Capacity – 2015-2020



Another International Capacity Boom is on the Way

- Between capacity upgrades, new cable rollouts and technology improvements, **African markets will add more than 4x more design capacity over the next four years than they did over the 2009-2015 period.**
- **~4 to 5 new cables will be rolled out between 2016 and 2020: G2A, SACS, SAIL, LIQUID SEA and potentially, AFRICA -1.**
- **Subsea cable design capacity projected to reach close to 270 Tbps by 2020 – this is ~20x 2010 levels and almost 4x 2016 levels. We are projecting equipped capacity to double from 2016 levels, to reach around 10 Tbps.** Our projections assume that only one of Liquid Sea or Africa-1 will be deployed over the forecast period. Should both cables make it, our projections would be conservative by ~10%-20%.
- Unlike the 2010-2016 period, where incremental capacity came primarily through capacity upgrades on existing systems, **more than half (~55%) of Africa’s new equipped capacity will come from new cables deployed over the 2016-2020 period – all of which will use 100Gbps technology.**
- **Planned cable projects split out evenly between East and West Africa (~2 new cables on each coast).** We nonetheless expect East Africa’s supply volumes to overtake West Africa’s, representing ~55% of Africa’s capacity supply over time – thanks to larger capacities and more consistent upgrades on existing systems.
- **A projected lit to design ratio of around 4%** - this could be conservative; the potential for volumes even higher than what we’re projecting is real.

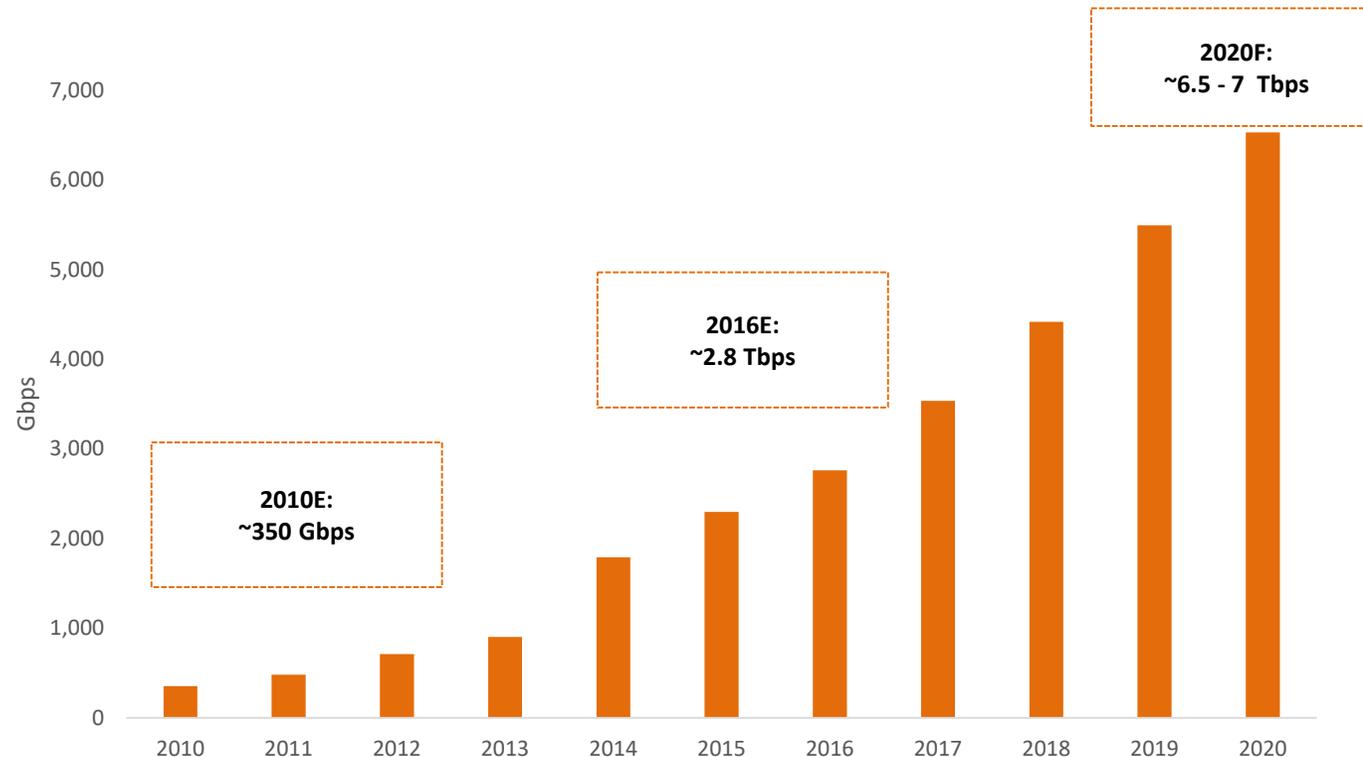
The Supply Side Forecast View: Africa Subsea Lit Capacity – 2015-2020



*Submarine cables only; including regional cables, but excluding International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, EIG, AAE-1, etc.).
Source: Xalam Analytics Estimates

African Demand for International Capacity Has Been Doubling Every Other Year

International Capacity Demand Requirements in Sub-Saharan Africa – 2010 - 2020



Source: Xalam Analytics Estimates; see next page for key demand assumptions.

The Demand Outlook: Close to 7 Tbps by 2020

- By our estimates, demand for international capacity in sub-Saharan Africa hit around 3Tbps in 2016; it will get close to 7 Tbps by 2020
- African demand for international capacity has been doubling every two years, mostly driven by the strong growth in broadband connections as Africa enters the age of the Internet.
- While efforts to keep traffic local are intensifying, they face the critical challenge of a capacity market where volume prices continue to decline steadily.
- With median broadband penetration around 20%, there's room for growth still. **We are projecting annual growth of international capacity requirements between 25% and 30% over the 2015-2020 period**, on the back of a broadband base slated to double.
- This market, unquestionably, will continue to need international bandwidth – and lots of it.

Core Demand Assumptions

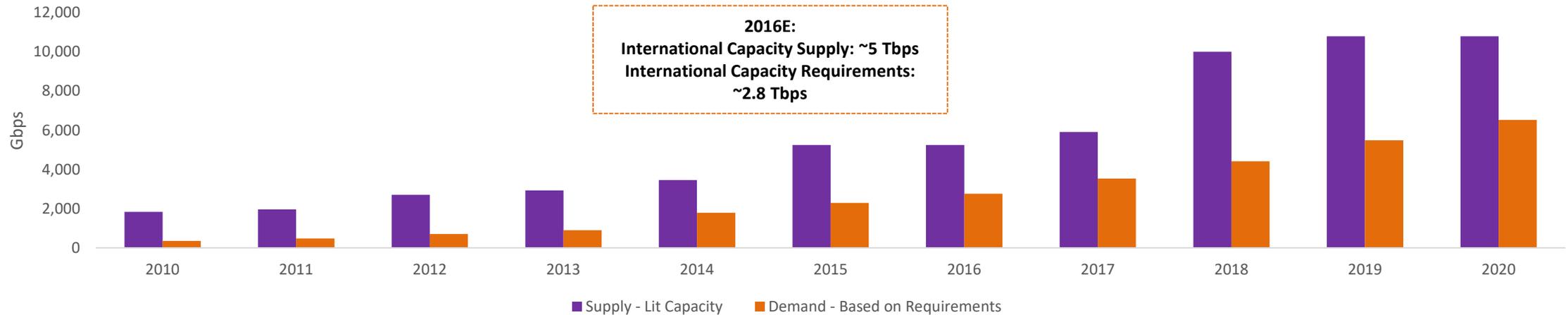
- **Projecting capacity demand is a quintessential micro-level exercise**, given the nature of the assumptions that must be made. It is an inherently ill-fitting exercise at macro-level – one that was nonetheless important for the purposes of this report.
- **Our “demand” projections are forecasts of bandwidth requirements:** how much international capacity would an ISP need under a certain number of conditions, including number of connections, average download speeds, bandwidth contention ratios, and proportion of traffic that is international?
- While assumptions are adjusted for country differences, building on ISP insight (South African oversubscription ratios and average speeds, for example, are different from Nigeria’s), they are still just estimates. ISPs can have working assumptions that are more or less conservative than our estimates. We encourage the reader to make his or her own tweaks based on proprietary information as may be necessary.
- **To build our Africa projections, we developed country-level projections for 12 markets**, which we estimate account for around ~90% of all broadband connections in Sub-Saharan Africa: South Africa, Nigeria, Kenya, Angola, Cameroon, Ghana, Ethiopia, Zimbabwe, Ivory Coast, Tanzania, Namibia, Mauritius.
- Demand in other countries was estimated on a “Rest of Region”, proportional basis.

- **Number of broadband connections**, including consumer broadband and dedicated leased lines. In this, we only included 3G and 4G mobile connections, as well as fixed broadband connections higher than 512Kbps.
- While recognizing that many markets still have a relatively important narrowband (2G base), we ignored that segment, as we do not believe it represents a material proportion of overall traffic over our forecast period.
- **Download speeds** – adjusted for current estimated average by technology in each market (download only)
- **Contention or oversubscription ratio** – at a broad level, we used 1000 to 1 for 3G and 4G (except for a few markets, such as South Africa and Mauritius, where we used 500 to 1); we used 50 to 1 for wireline (FTTH/ADSL) connections, and 1:1/2:1 for dedicated connections.
- **Proportion of traffic that is international** – we started with a baseline of 95% in most cases, decreasing by a few percentage points a year depending on presence and speed of adoption of a local IXP
- **We added a redundancy mark-up of 25%** on top of our baseline projections.

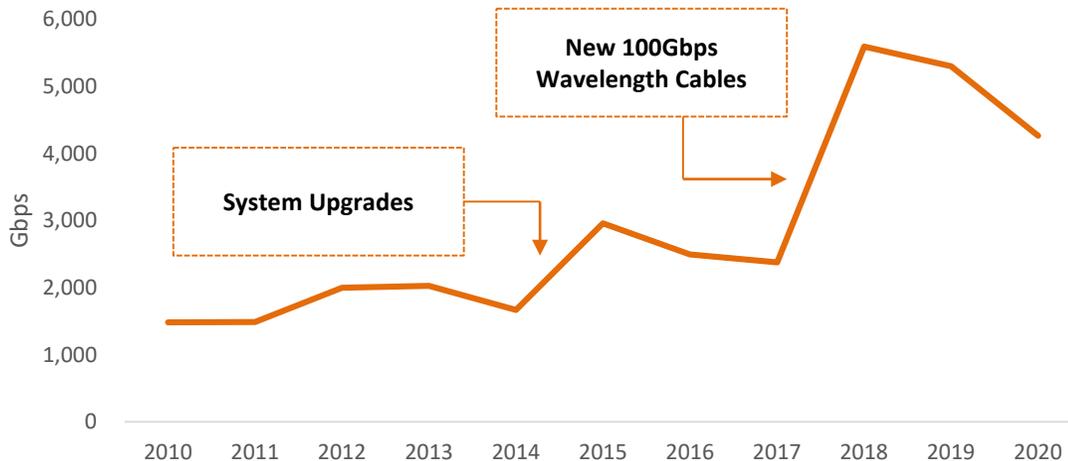
**AFRICA
INTERNATIONAL
CAPACITY
DEMAND
PROJECTIONS**

Supply vs. Demand: After a Decade of Bandwidth Scarcity, a Decade of Bandwidth Abundance

International Capacity Demand vs. Supply in Sub-Saharan Africa – 2010 - 2020



Evolution of International Capacity Surplus in Sub-Saharan Africa – 2010 - 2020



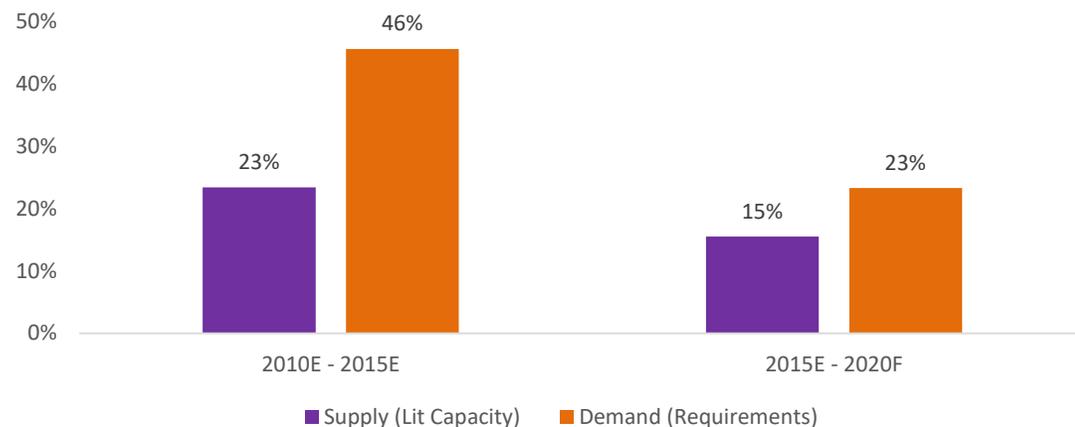
The African Market is Structurally Oversupplied

Our analysis of macro demand and supply of international capacity leads us to a number of observations:

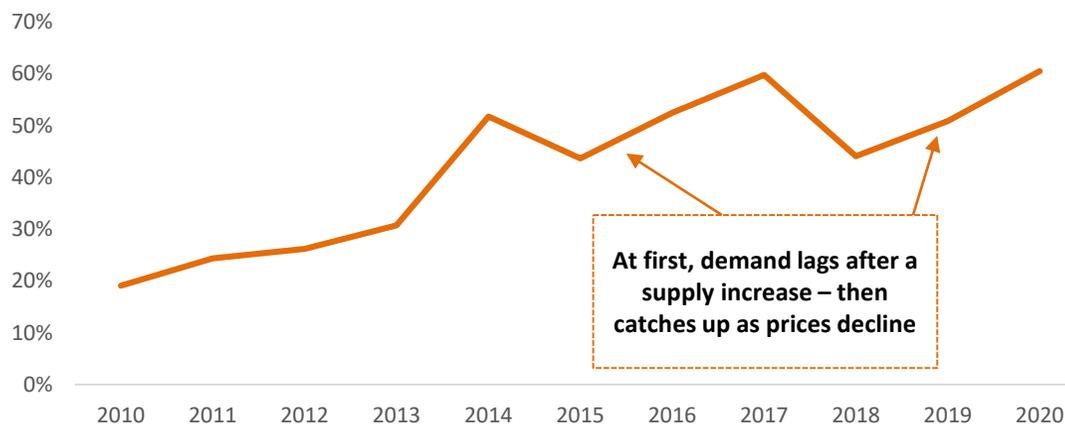
- **The African market is structurally oversupplied.** Between 2010 and 2015, capacity requirements have represented around 20% to 40% of capacity supply, before peaking at ~50% in 2016. In effect, the market has around 2Tbps of 2.5 Tbps of extra international capacity above market requirements. The gap between equipped capacity and actual usage is even deeper (see next pages).
- **If the 2000-2010 era was a decade of bandwidth scarcity, the 2010-2020 decade is, unquestionably, a decade of bandwidth abundance.**

Bandwidth Begets Bandwidth – Demand Growth Dovetails Supply Growth

Average Annual Growth – African Capacity Demand vs. Supply – 2010 - 2020



Sub-Saharan Africa Capacity Demand as a Proportion of Supply – 2010 - 2020

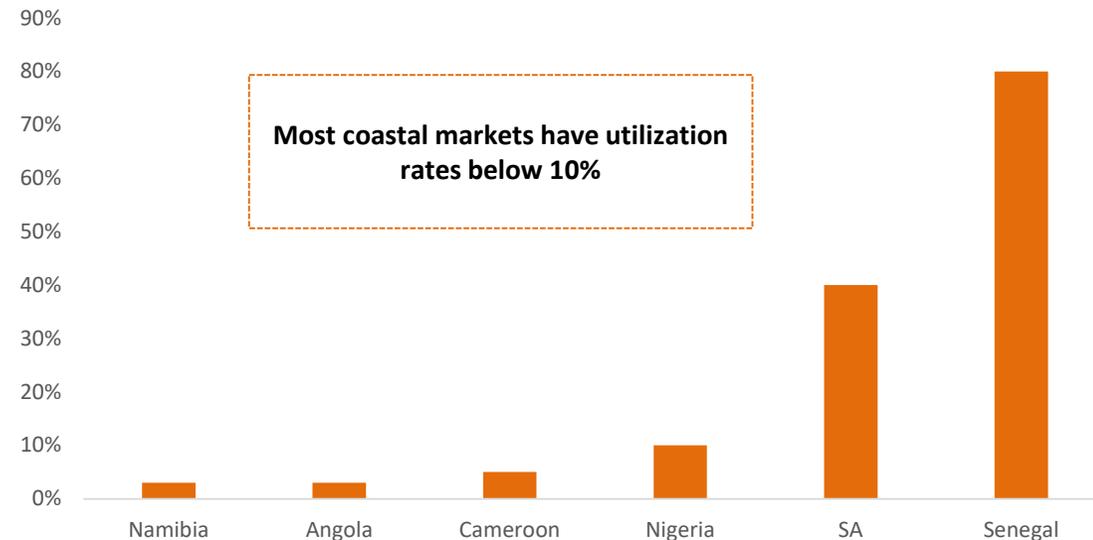


Demand is Rising 2x Faster than Supply – But Supply Volumes are Materially Bigger

- At a macro level, demand for capacity has been rising nearly 2x faster than supply, a sign of the high velocity of demand requirements, but also (and primarily, perhaps), supply volumes that are already fairly high.
- As requirements continue to rise, we generally expect the pace of growth between the two curves to narrow.
- Despite that, African capacity surplus volumes are actually trending upwards, largely due to new cable projects being rolled out.
- Between 2010 and 2016, African cable providers added an average of ~600 Gbps in new lit capacity annually. Between 2016 and 2020, that annual average will rise to slightly more than 900 Gbps as new cables come to market.
- This should in turn push up the overall capacity oversupply, to more than 4 Tbps by 2020.
- In short, African capacity players will have a lot more capacity to sell – and for a variety of reasons, a relatively limited number of markets to soak up that capacity.
- At some level, this is source of great concern – especially for those investors that lived through the great transatlantic capacity bust. In truth, we are getting less convinced that bandwidth gluts are as bad as they used to be (in the African context).

Oversupply Analysis: Utilization vs. Lit Capacity

International Capacity Utilization Rates* in Sample Markets – 2016 E



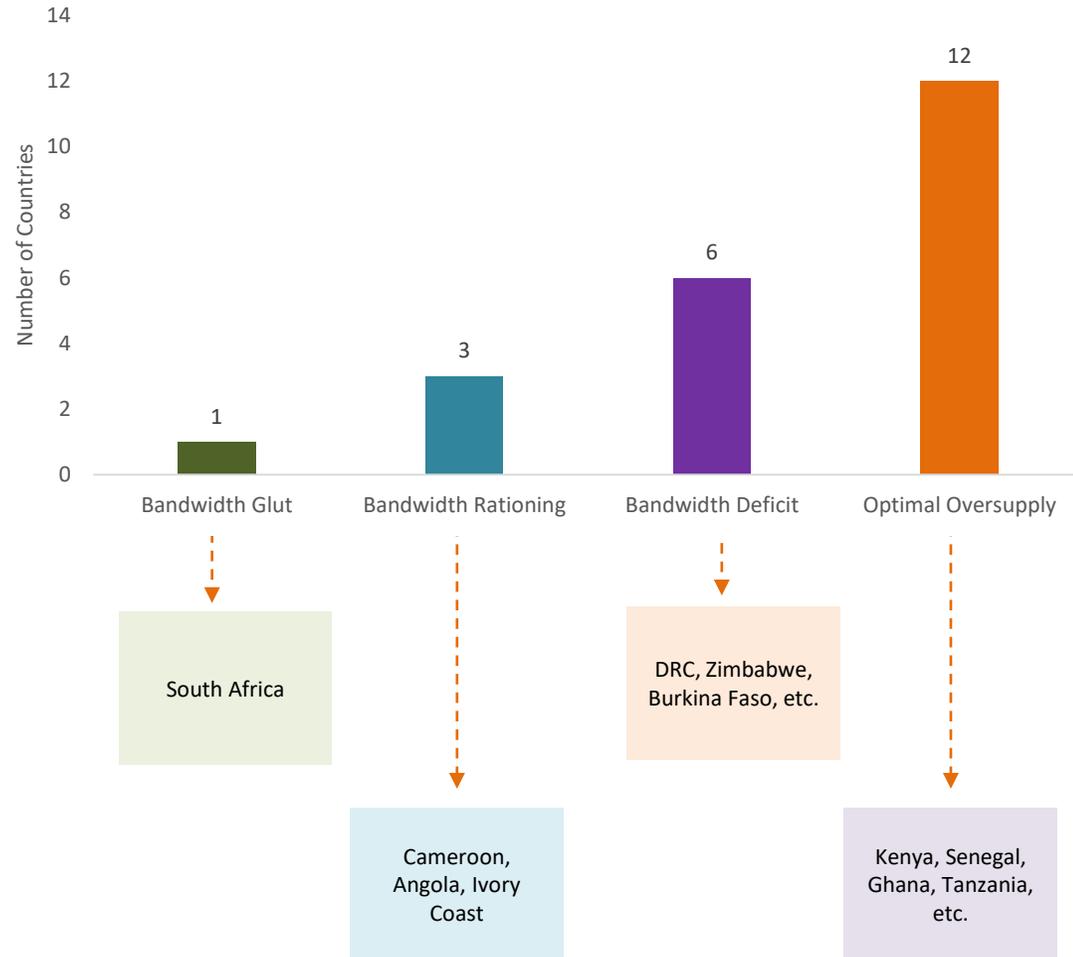
*Purchased/Leased/Used capacity as a proportion of available lit capacity
Source: Xalam Analytics research; these estimates are highly volatile and for indicative purposes only.

Utilization Indicators Point to Even More Capacity Overhang

- **Estimating actual African capacity usage in a reliable way is an arduous task**, one that is nearly impossible at Africa level, absent a long, extensive, and highly intensive research effort beyond the intended scope of this report. Most providers are not forthcoming with utilization data – and even when they are, definitions are highly volatile.
- Our estimates in this respect are therefore mostly anecdotal, and for the most part, could not be supported to our satisfaction with empirical data. **Available insights nonetheless point to lower utilization levels** – especially in less competitive markets. Several subsea cable providers put utilization rates below 10% - typically referring to design capacity, but in other cases referring to lit capacity.
- As a top level proxy for utilization, we used capacity “purchased”, that is the amount of international capacity carriers and other users are actually paying for, on a recurring leased basis or on an IRU basis. On this basis, utilization ratios appear similarly low.
- In Cameroon for example, local providers were only purchasing 4%-5% of the international capacity pool available to monopoly provider Camtel. Angolan numbers suggest relatively similar ratios, as does Namibian data.
- In South Africa, cable providers suggest 5-10% of design capacity, which would be equivalent to 40% to 50% of the available lit capacity in the country.
- **The larger point, ultimately, is that the large majority of markets appear to be highly oversupplied.** Market structure determines how that oversupply is managed (see next page).

Bandwidth Oversupply in Most Markets, Bandwidth Glut in South Africa Only

Not All Equal: African Country Distribution – Bandwidth Oversupply vs. Deficit vs. Rationing



Africa is Technically Oversupplied – but Most Markets Have Less than Optimal Access

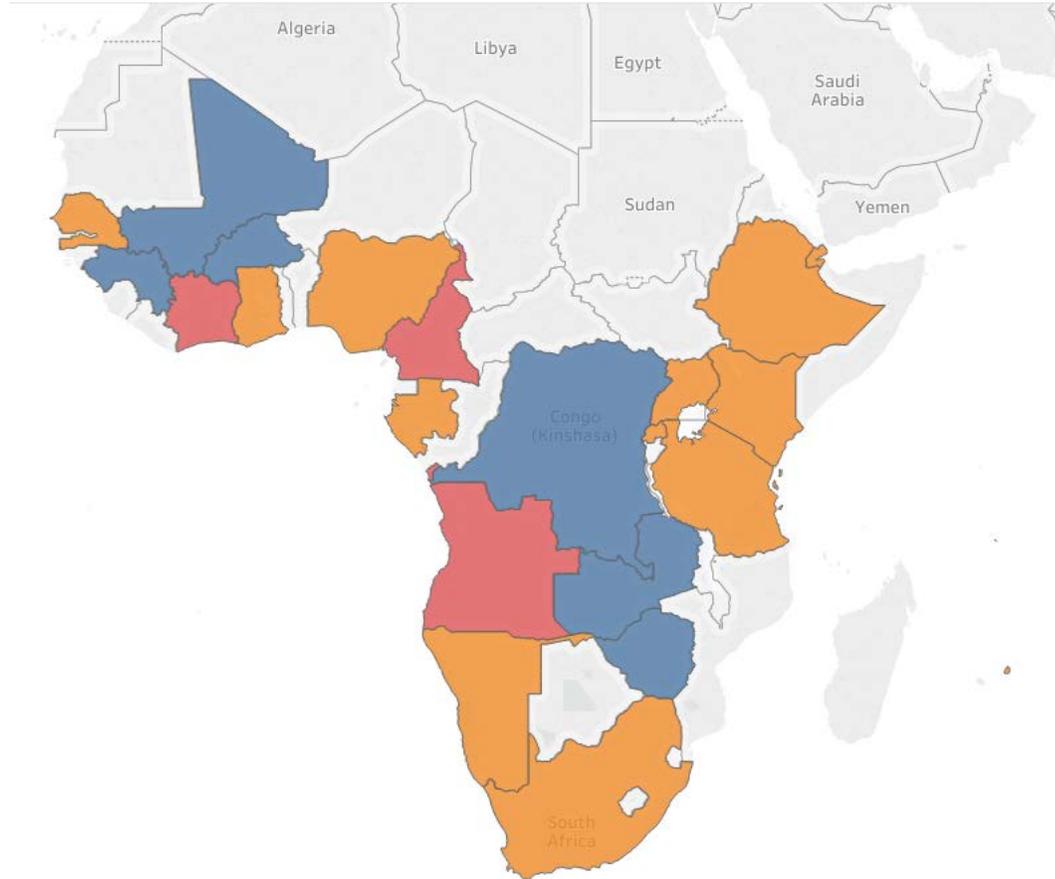
- **Looking at a country level, we find that most African markets are technically oversupplied in international capacity** – that is, existing bandwidth supply is materially higher than can be absorbed by demand at current price levels (or assuming moderate declines in prices). But we also found excess capacity dynamics to be highly uneven.
- **Only one market (South Africa) displays characteristics of a bandwidth glut** – a unique combination of material excess capacity and highly dynamic downward pricing. In effect, there’s so much capacity on the market than can be absorbed even with persistent price declines. **Prices are falling , capacity usage is increasing, but the surplus is either stable or continues to increase, feeding a seemingly unstoppable cycle of continuous decline in marginal capacity costs.**
- **Another ~15% of markets are in a state we refer to as bandwidth rationing** – they have enough capacity to go around, but due to a variety of factors, that capacity is not being made available at price points that would reasonably stimulate demand. In such cases, the oversupply is more nominal than effective; pricing is not dynamic, and in many cases, demand remains highly constrained despite ample availability of capacity. Such a rationing model, in a pernicious twist of fate, is closer to the SAT-3 era of scarcity – just at lower price points.
- **Nearly a third to a quarter of the markets we examined have a bandwidth deficit** – they are using as much capacity as they can afford – but for a variety of reasons, they’re just not getting enough capacity supply at equilibrium price points. Most landlocked countries fall into this group, as do some coastal markets such as the DRC, where capacity is largely stuck un the coast due to the inadequacy of the existing terrestrial network.
- It is notable that when bandwidth rationed markets and bandwidth deficit markets are combined, **nearly 40% of African markets still have less than optimal access to international capacity** – despite being in nominal oversupply.

*Based on sample of 22 markets in sub-Saharan Africa

Source: Xalam Analytics research

Bandwidth Glut, Deficit, or Rationing? How African Countries Map Out

Africa Mapping – Real Bandwidth Oversupply vs. Deficit vs. Rationing



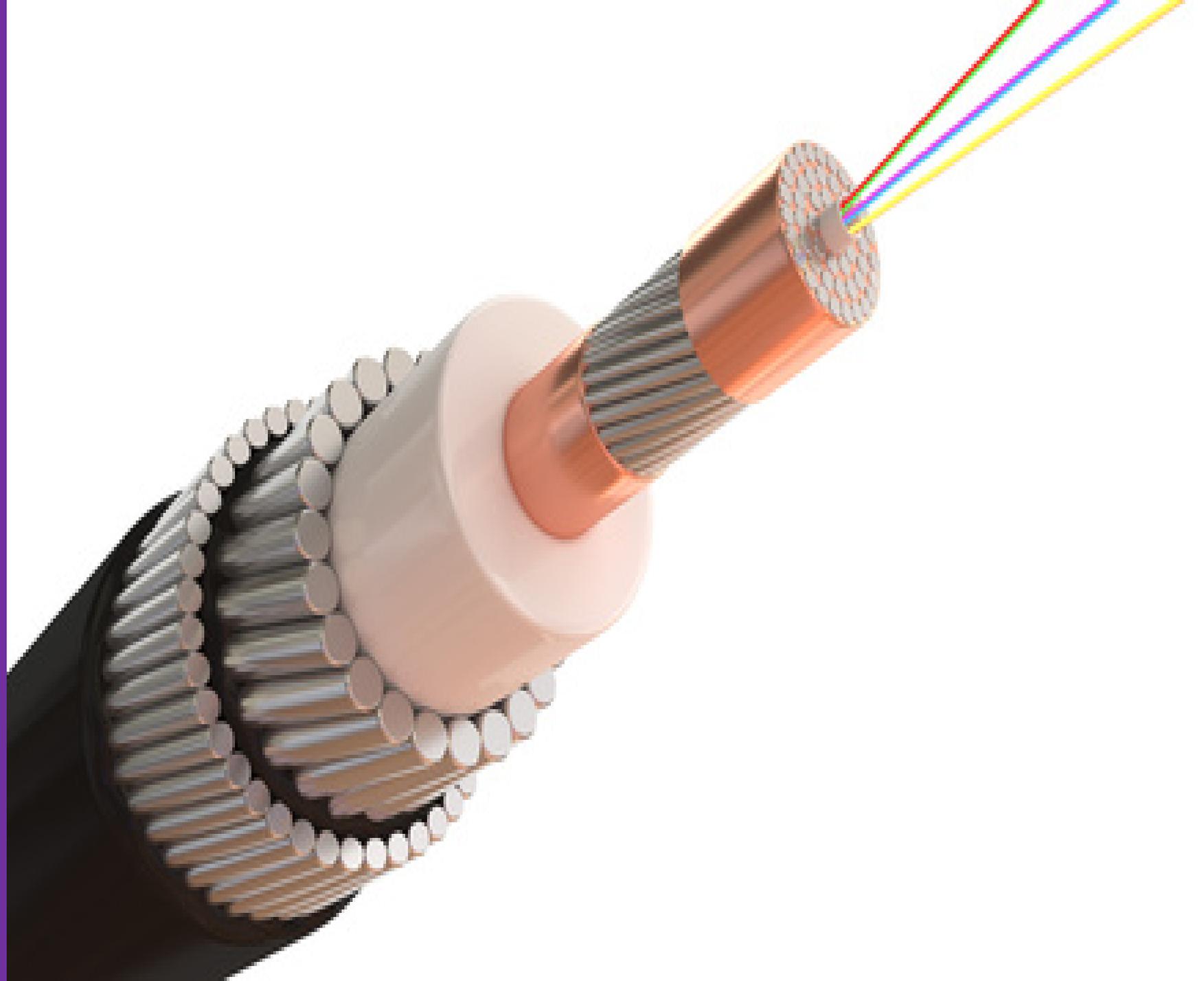
■ Bandwidth Deficit
 ■ Bandwidth Oversupply
 ■ Bandwidth Rationing

How We Define It: Bandwidth Oversupply vs. Deficit vs. Rationing

	Real Bandwidth Oversupply	Bandwidth Deficit	Bandwidth Rationing
Competition in the International Capacity Market	Intense; at least 3 separate providers	Moderate 1-2 separate providers	On paper only, or non-existent < 2 separate providers
International Capacity Prices	In lower Half of African Sample; evolving dynamically	Mid to Upper Half of African Sample	In lower Half of African Sample; evolving slowly
Can Available Supply* Meet Demand Under Optimal Conditions?	Yes – Available Supply is higher than estimated “Optimal Case” Requirements	No - Available Supply is lower than estimated “Optimal Case” Requirements	Yes – Available Supply is higher than estimated “Optimal Case” Requirements
Leased/Purchased Capacity as % of Available Equipped Capacity	Typically > 25%	Typically > 50%-75%	Typically < 10%

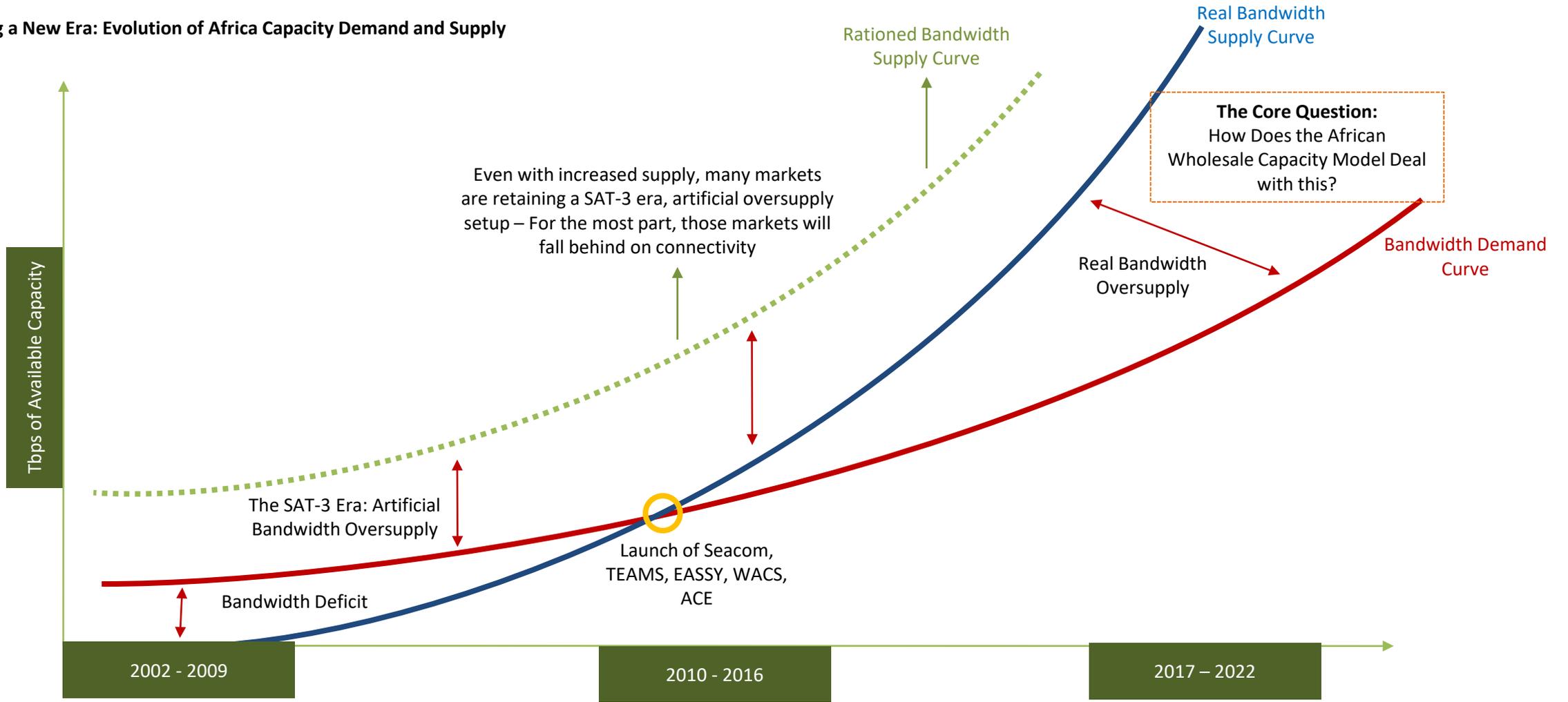
*Available supply is capacity actually owned by all the providers in a market, including IRUs; “optimal conditions” assume at least near-best download speeds available, reasonable oversubscription levels to provide excellent QoS; to get demand requirements under optimal conditions, we apply optimal conditions assumptions to the existing Broadband Internet Base
 Source: Xalam Analytics Research

Can the African
Wholesale Model
Survive an Era of
Bandwidth
Abundance?



After a Decade of Bandwidth Scarcity, a Decade of Bandwidth Abundance

Entering a New Era: Evolution of Africa Capacity Demand and Supply



The African International Wholesale Market Paradox – Strong Traffic Growth, but Business Under Pressure

After a fast growth period between 2009 and 2015, the African international capacity market is facing a seminal challenge to its economic structure. The sector's quandary is paradoxical, at a time when Internet traffic is booming across the continent. **Growth in the segment has remained fairly steady, and yet, rarely has the future of African international capacity models been so uncertain.** Our research lays out a number of factors for this, many of which are analyzed in more depth in other sections of this report.

Capacity Oversupply; Average Capacity Price Declines

- Arguably the most visible feature of the new era of bandwidth abundance; **markets are oversupplied (vs. estimated requirements under optimal conditions) by upwards of 50%;**
- Annual STM volume price declines of 20% to 50%+ annually
- Highly competitive market environments on some key routes

The Rise of the Disrupters

- A number of new players emerging with large volumes of capacity surplus built up at relatively low cost
- For a variety of reasons, the international wholesale segment is critical to their outlook – and they have a lot of capacity to play with
- **They are also unpredictable, as likely to act rationally as they are to crash market prices further**

Narrower Addressable Demand Base for Leased Capacity

- In some regions, the absolute number of ISPs needing to acquire leased international capacity in material volumes (and having the cash to do so) has been declining
- **Due to increased % of self-provisioning; larger telco consortia such as EASSY, ACE – Larger ISPs that need bandwidth typically own some.**
- Cloud players, corporate customers are compensating – but their requirements are not as large – for now.
- Mostly a Francophone West Africa challenge

More Challenging Customer Requirements

- **Price is a critical factor – customers have options**
- But also ability to offer city-to-city deals, within Africa and in Europe; coast to coast is no longer enough
- More than wavelengths – customers want IP
- Cash is tight – so short term leases are preferred – and increasingly available
- Resiliency, competitive latencies are critical factors

From Liquid Sea to Africa-1 – The Case Against New Cable Systems

At least four new transatlantic cables are planned in Africa over the next two years, as summarized in the table below. **At a time when, as our demand and supply estimates suggest, the market is in a state of structural oversupply, questions have arisen as to whether the new cables are really needed.** The answer, as we outline below, is not straightforward.

On the face of it, bringing in new capacity into the market does look like overkill

- As we have noted in our demand vs. supply analysis, the African market is structurally oversupplied at a macro level
- Supply > Demand by ~50%+ if based on top level requirements
- Surplus is likely closer to 70%+ if based on actual capacity purchases and leases.
- **Assuming at least three of the four proposed transatlantic cables are launched, lit capacity oversupply could reach close to 4 Tbps by 2020, from ~2.5Tbps in 2016**
- This is with less than 10% of the total design capacity being lit.
- **In effect, new cables will merely add surplus to an oversupplied market.**

Do Carriers Really Need to Build New Cables to Achieve their Goals?

- Another argument against the new cables is that in pure economic terms, the need to build new capacity is arguably not as critical in a market like South Africa – Africa’s most competitive international capacity market.
- **Indeed, the market price of an STM-64 IRU or above has fallen so much as to be comparable to the average capex for similar capacities.**
- **In theory, a cable provider would be able to achieve his goals more cost-effectively using IRUs vs. building up brand new capacity (we were unable to test this assertion independently due to lack of solid data points).**

	SACS	LIQUIDSEA	AFRICA-1	SAIL
Cable Type	Private – Single Promoter	Private – Single Promoter	Private – Telco Consortium	Private – Single Promoter (or more precisely, “state-owned”, given Camtel’s status)
Lead Promoter	Angola Cables	Liquid Telecom	PCCW, STC, MTN, Telkom SA	Camtel Cameroon, China Unicom
RFS	2018	2018-19	2018-19	2018-19
Design Capacity (as of 2016)	40 Tbps	NA	NA	32 Tbps
Route/Path	Angola to Brazil – South Atlantic	Unclear – Initial Statements point to African Eastern Coastline	Unclear – Initial Statements point to African Eastern Coastline	Cameroon to Brazil – South Atlantic
Driving Force of the Business Case	Diversity route for SADC, Asia traffic to US market (see separate analysis)	Strengthening Liquid Telecom on-net capabilities; Diversity route for SADC	Strengthening on-net capabilities; Diversity route on East coast	Diversity route to US market – Otherwise unclear (see separate analysis)
Status	Deployment in progress	Unclear – Still likely, but no public update after initial statement of intent	Unclear – no public update after initial statement of intent and semi-denials by various companies on their level of participation; at this stage, arguably the least likely of the planned cables we have examined	Initial route analysis completed; start of deployment expected Q1 2017.

The Case for New Cables, Part 1: When It Comes to Traffic Volumes, Who Really Knows?

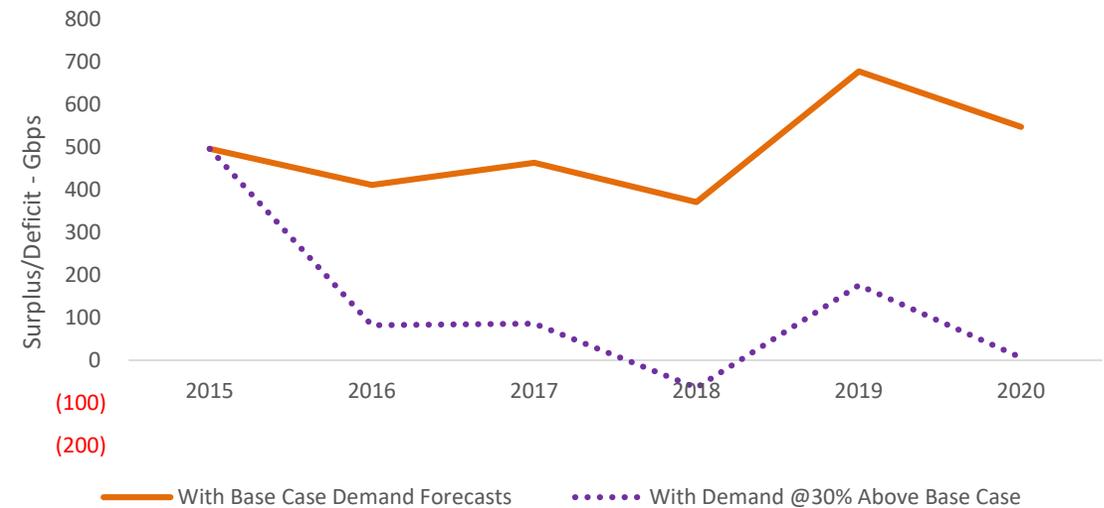
There is Nonetheless a Case for Building out New Capacity

- **First, demand may be bigger than most are projecting it to be (including ourselves);**
- Capacity demand is one of the most volatile indicators to project in building a capacity business case.
- What is certain is that Internet traffic is rising extremely fast – and indeed, faster than supply, as we have outlined in our demand vs, supply analysis.
- **What is less clear is what traffic volumes will look like over the long term,** for dynamic markets such as South Africa.
- **In truth, nobody really knows** – and from 5G to 5k video to IoT and artificial intelligence cloud applications, bandwidth-hungry applications are continuing to emerge that look somewhat exotic today – but may be standard in five years.

An Example: Our SA Capacity Demand Projections

- Take our projections of capacity demand in South Africa, for example;
- As they stand (and based on what we consider relatively reasonable assumptions around FTTH, 4G and other drivers), the market will stay relatively oversupplied by ~100-200Gbps over the forecast period;
- Our projections have yet to fully account for the impact of 5G – An impact that is difficult to ascertain at this stage
- **If demand rises 30%+ above our projections, demand vs. supply gets closer to neutral, and potentially even bandwidth deficit.**

Surplus or Deficit? Our South Africa International Capacity Projections – 2015-2020



*Projections assume capacity upgrades on existing cables, as well as launch of ACE, along with one of Liquid Sea or Africa-1, with a low lit-to-design ratio.

Source: Xalam Analytics Estimates

The Case for New Cables Part 2: The Latency & Self-Provisioning Case

Route Diversity and Latency are Stronger Considerations than Ever

- Where older African cables were almost entirely capacity plays, the new cables are a mix of capacity, resiliency and latency.
- New technologies are pushing the concept of ultra-low latency, with new architectures and systems allowing to cut latency 10%-20% from current levels.
- **The SACS and SAIL value propositions will largely be built around route diversity and lowest latency** to the US market. SACS in particular, aims to provide an alternate <100ms route to the US; this would be Africa’s lowest latency route to North America.
- **That alone may not be enough to sustain a business case – but combined with aggressive pricing, it becomes a rather potent proposition.**

Self-Provisioning Is Critical for a Tier-1 Carrier’s Carrier

- **The ability by a first tier wholesale telco to self-provision is probably as important as it’s ever been.**
- For Liquid Telecom, one of the primary drivers of considering the Liquid Sea project is on-net control, for **it is extremely difficult to drive up margins and control SLAs at tier-1 level of scale while leasing and buying IRUs from third parties.**
- This, at a different level, is why global Internet players such as Google and Facebook are investing in their own subsea cables;
- The same logic would drive a Telkom investment in Africa-1 – should the company feel it needs more capacity.

Sample African Route Latencies (ms)

	Chennai (India)	London	Marseille	Miami	New York
Cape Town	286	145	161	240	233
Dar es Salam	275	136	158	236	214
Kampala	310	173	194	273	243
Lagos	241	95	124	195	166
Nairobi	304	165	185	265	235

African latencies to the US and Asia are in the 200ms-300ms Range

Source: wondernetwork.com

The Case for New Cables Part 3: Bandwidth Gluts Don't Matter

We Believe the African Capacity Market is Facing a Different Model Paradigm

- **The African capacity market is facing a different model paradigm, one where oversupply is ingrained into the model;**
- **Bandwidth gluts are just no longer as threatening as they used to be.** Oversupply is a built-in feature of the market - and business models just have to adjust accordingly.
- Ultimately, the core business model consideration is not as much demand vs, supply – **it's how fast capacity prices decline to adjust to the explosive levels of supply.***

The Stand-Alone International Wholesale Business Case is Dead

- **Bandwidth gluts may not matter as much, but they certainly complicate the business case for an African wholesale-only, single private promoter international play.** The feasibility of project such as the first iteration of Seacom is increasingly improbable.
- **In an era of bandwidth abundance, and absent some intermittent irrationality,** only telco consortia and telcos (or Internet players) with strong traffic-generating retail units to soak up some capacity will be able to make a strong business case for building out a private international subsea cable.

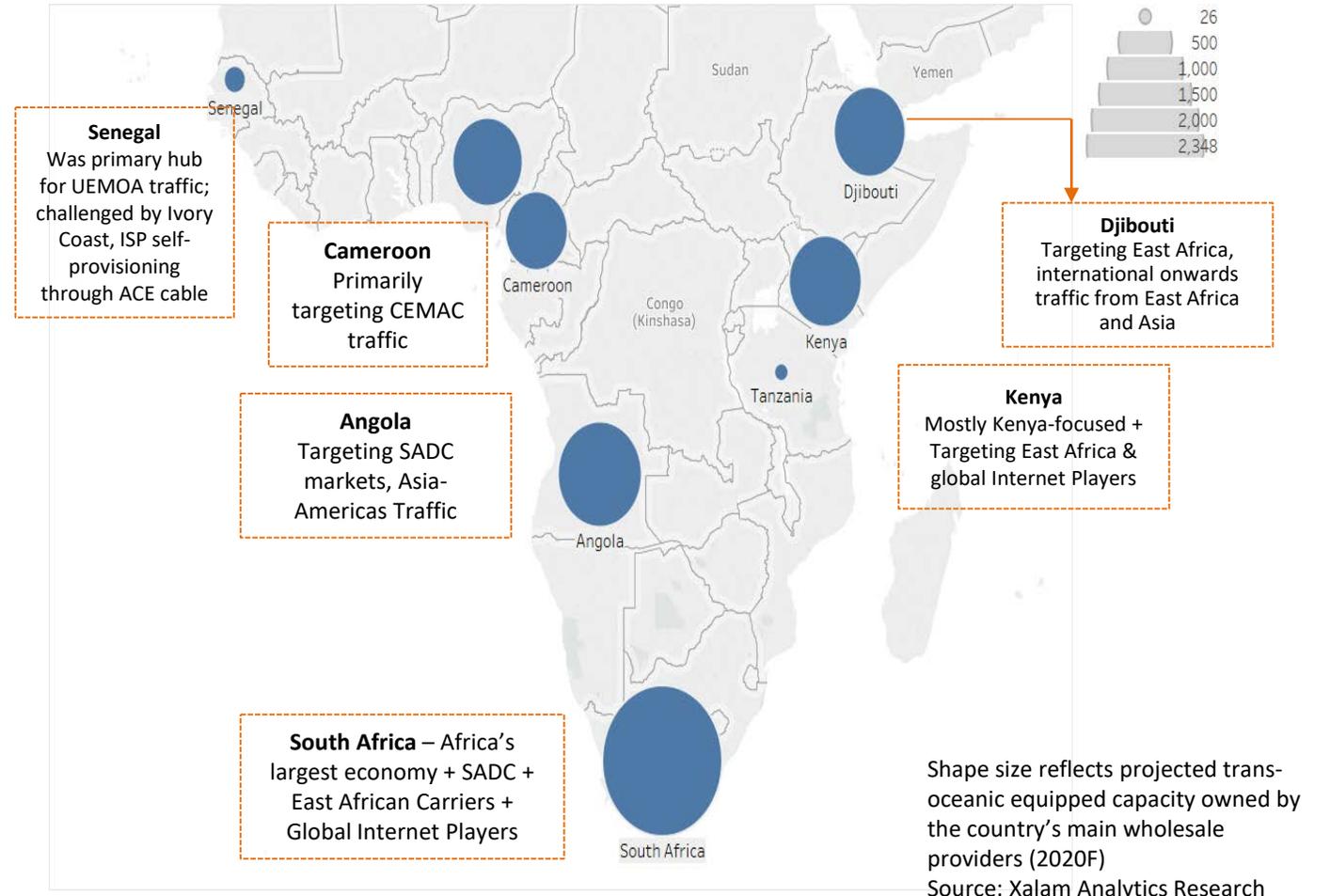
*This analysis applies primarily to competitive capacity markets, such as South Africa; in many African markets where the model is still built around regulation-supported bandwidth rationing, prices will not fall as fast and capacity consumption will be even lower.

Who's the Hub? Benchmark of African Countries' Hub Strategies, From Dakar to Dar and Djibouti (1)

Building Strategic Capacity Hubs

- **More countries are looking to build strategic hubs of international and regional capacity** – the approach is at the heart of strategies by players such as Djibouti Telecom, Angola Cables or Camtel Cameroon;
- **But hubs are not created equal** with many countries falling short on route diversity, cost of capacity, or inadequate supporting infrastructure (e.g. colocation data centres).
- **We see South Africa and Djibouti as Africa's most important capacity hubs**; Kenya, Nigeria and Angola lead a second tier group.

Looking for Hubs: Mapping of Projected International Fibre Capacity in Sample African Markets



Who's the Hub? Benchmark of African Countries' Hub Strategies, From Dakar to Dar and Djibouti (2)

Africa Capacity Hub Benchmark Table

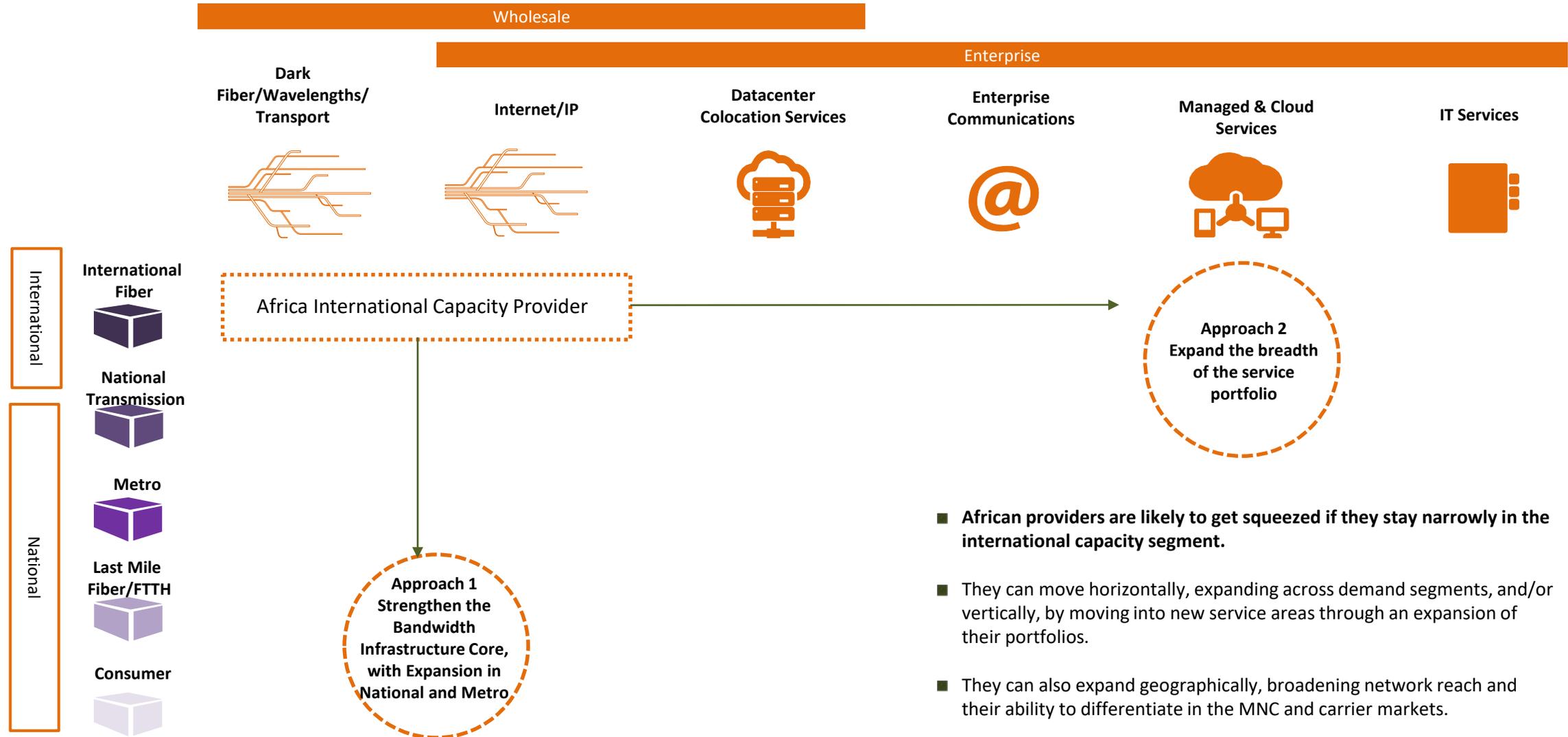
	Number of Submarine Cables Landing in the Country (2018-19)*	Available International Capacity (2020F)**	Availability of Supporting Data Center Infrastructure	Attractiveness of Wholesale Capacity Prices (International & Domestic)	Projected 2020 Route Diversity (based on # of continents hit by available cables)	Primary Target Markets
South Africa	~7	>2 Tbps	✓✓✓	✓✓✓	✓✓✓	SADC + East African Carriers + Global International Players
Djibouti	~10+	> 1 Tbps	✓✓✓	✓✓✓	✓✓✓	East African Carriers + Global International Players
Kenya	~4	~0.8 Tbps	✓✓✓	✓	✓✓	East African Carriers
Nigeria	~5	~0.8 Tbps	✓✓✓	✓	✓	Nigeria
Angola	~3	~1 Tbps	✓✓✓	✗	✓✓	SADC
Cameroon	~4	~0.5 Tbps	✓	✗	✓✓	CEMAC
Tanzania	~2	< 0.15 Tbps	✓	✗	✓	East Africa landlocked Markets (Uganda, Rwanda, Malawi, etc.)
Senegal	~2	< 0.15 Tbps	✓✓	✓	✓	UEMOA (French-speaking West Africa)
Namibia	~1	~0.7 Tbps	✓	✗	✓	SADC

*Trans-oceanic only; Angola and Cameroon assume SACS and SAIL are operational; Senegal excluding Atlantis II (too small)

**Equipped capacity owned by the country's main wholesale providers; 2020 is a Xalam Analytics Projection

Source: Xalam Analytics Research

What's the Path Ahead for African International Capacity Wholesale?



- African providers are likely to get squeezed if they stay narrowly in the international capacity segment.
- They can move horizontally, expanding across demand segments, and/or vertically, by moving into new service areas through an expansion of their portfolios.
- They can also expand geographically, broadening network reach and their ability to differentiate in the MNC and carrier markets.

How Others Have Evolved – The Level 3 Model

Five Years Ago, Level 3 Faced Structural Model Challenges

Level 3's Challenges - 2009

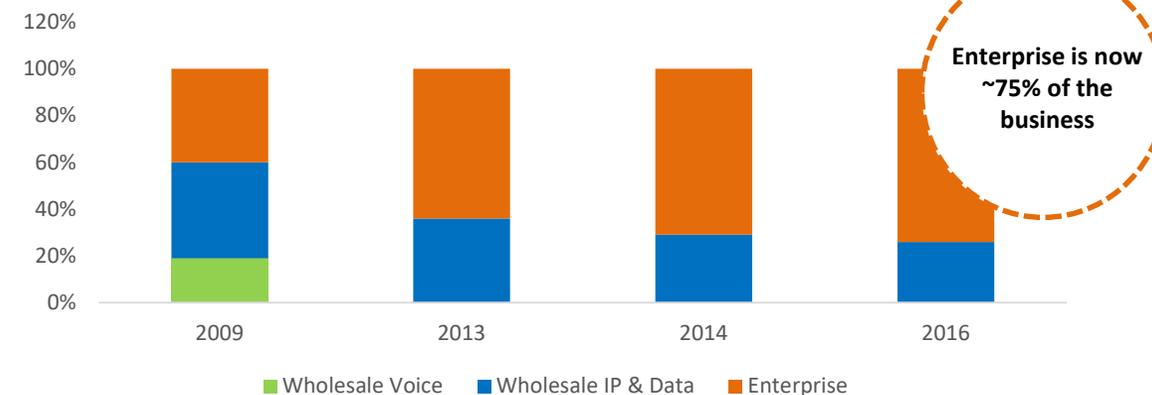
- Level 3 was primarily a wholesale business - ~60% of revenue
- IP & Data services accounted for about 25% of revenue
- Level 3 faced substantial price pressure in its core US transport markets
- Revenue growth was fairly flat – Minus 2% to +3% range
- EBITDA margins at ~24%, but operating and net losses; until 2014, hadn't posted a net profit after years of substantial CapEx, highly frustrating investors.
- Highly leveraged, the burden of its infrastructure build

How they did It – Targeted Acquisitions and Unyielding Focus on the Enterprise

- Enterprise as the engine of growth
- Wholesale growth is declining; the company increasingly considers this revenue line inconsequential over the long term
- The value of wholesale lies in the scale and relationships it provides
- A number of acquisitions to deepen the fiber infrastructure portfolio – Global Crossing – International Fiber assets
- A number of targeted acquisitions of enterprise specialists to deepen the offering to enterprises portfolio: Genesis, cyber security specialist Black Lotus
- Increasing IP & Data services – 40% of revenue – shifting business to higher margin foundation
- Stronger revenue growth foundation - +5% to +7% range
- EBITDA margins at ~29%, swung to net profit

In Response, Level 3 Transformed its Revenue Structure

Evolution of Level 3 Revenue Structure



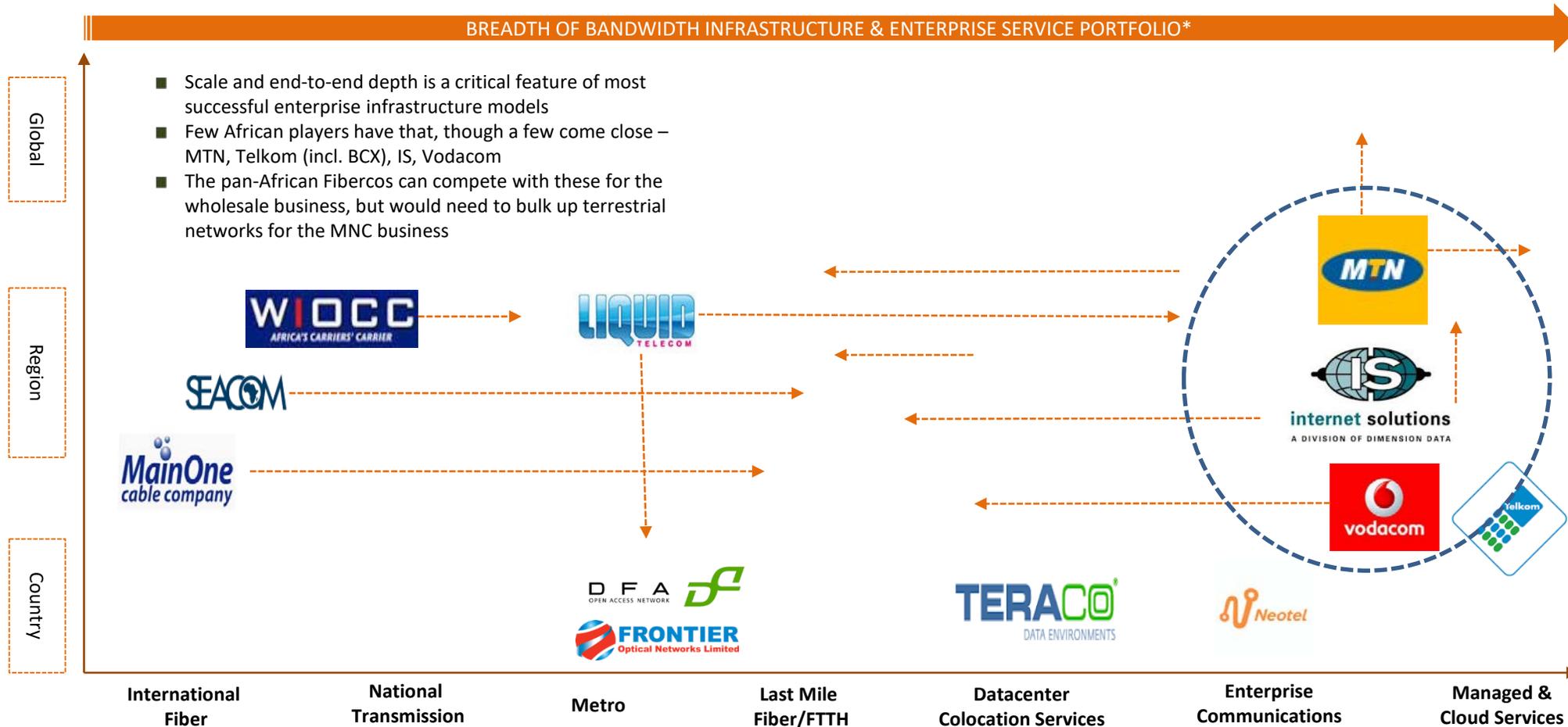
Source: Level 3

How Level 3 Sees It

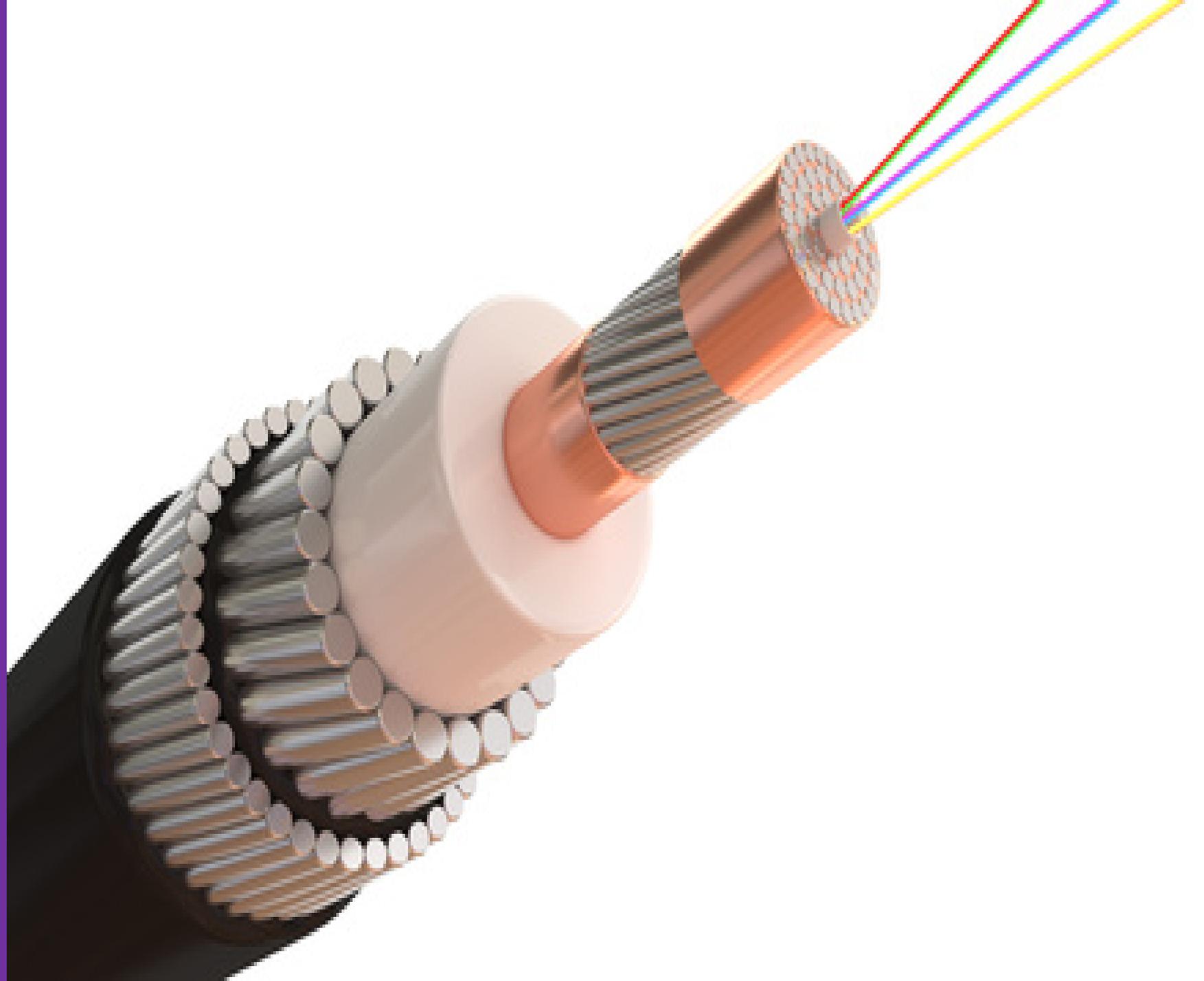
[...]...We are 100% focused on the wireline needs of enterprise customers. We're not distracted by wireless, by consumers or by pay television. We do serve wholesale customers, but even then, we're really targeting the needs of enterprises that those wholesale providers serve. Wireline enterprise networking isn't a piece of our business. It isn't an add-on to our business. It is our business.[...]

Jeff Storey, CEO, Level 3 Communications – August 2015

Building Regional or Global Scale



African Transit
Pricing – Downward
Spirals, Deepening
Divide and the
Impact of IXPs

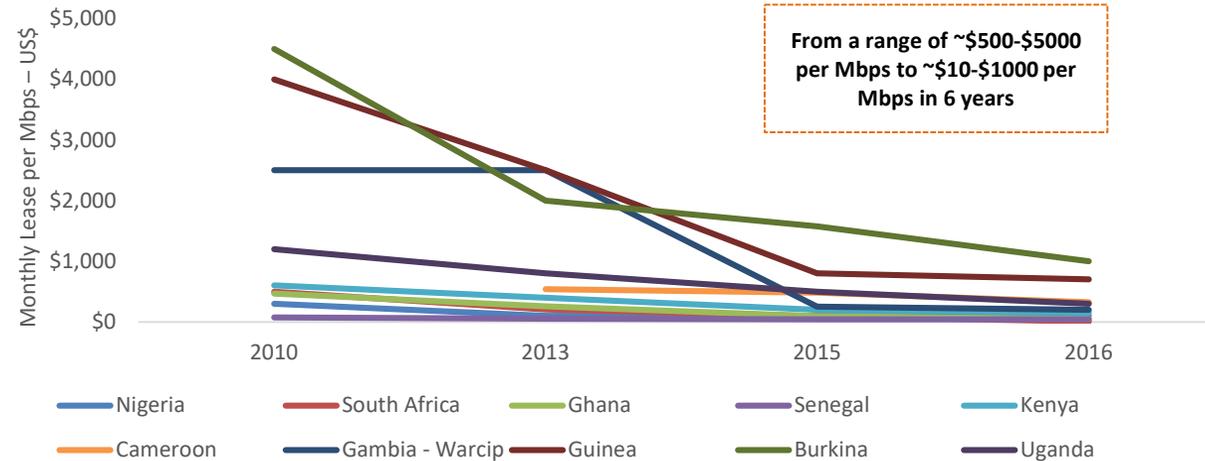


The Submarine Cable Impact on African Capacity Pricing Has Been Transformational

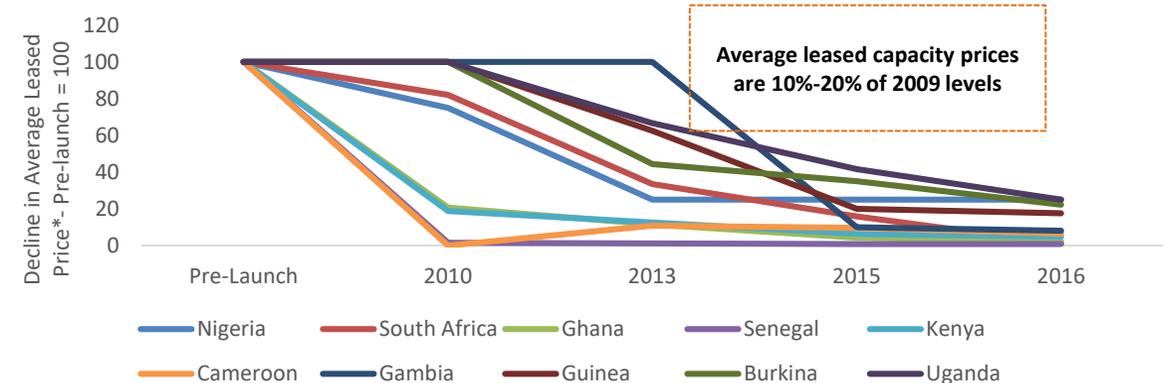
There is Nonetheless a Case for Building out New Capacity

- The impact of submarine cables on African international capacity pricing suffers little debate.
- Nearly all markets that witnessed a subsea cable rollout between 2010 and 2015 have seen declines in the cost of their international capacity.
- **Analysis of a sample of 15 markets in sub-Saharan Africa shows that 2016 median capacity prices were less than a tenth of their 2010 levels, with some markets seeing even sharper declines.**
- For example, two years after their launch, the Seacom and Eassy cables had managed to slash South African international STM-1 prices by at least 50% from pre-launch levels.
- Likewise, a connection to the ACE cable allowed operators in Guinea or Gambia to cut international wholesale connectivity prices by 80%-90% vs. pre-launch pricing.

Evolution of International Capacity Monthly Price per Mbps - 2010-2016 – Sample African Markets



Decline in Average Monthly Leased Prices in Sample Markets – 2009-2016



The Changing Nature of African Capacity Pricing – From E1s to STM-1s, IRUs to Leases

The nature of pricing in African capacity markets is evolving, with features more typical of competitive bandwidth markets.

Change in Reference Base Price Unit –
From E1 to STM-1

- We see a number of other critical features in African competitive capacity markets. **One is the notable evolution in the reference point for capacity unit price.** Until 2010-11, unit pricing was largely based on E1 (2Mbps) base multiples. Given the price point, that was the maximum the average capacity purchaser could afford.
- **Between 2011 and 2015, the capacity base unit pricing moved to an STM-1 (155Mbps);** in the more developed and more competitive capacity markets, it's now an STM-10 (2.5Gbps) or an STM-64 (10Gbps). In a few less competitive markets (in West Africa in particular), E1 remains a reference unit.

From IRUs to Leases

- **Another notable feature is the gradual shift of capacity purchases from IRUs to leases.** In the earlier phase of international capacity rollouts, acquiring an IRU was the primary way to get substantial volume discounts. A 20-year STM-1 IRU on SAT-3 for example (South Africa to London), ran for around \$4.7m in 2002 (vs. ~\$800k a month on a leased basis). A similar IRU on Seacom seven years later was around \$3m, with a monthly lease at close to \$100k, making the IRU option highly attractive for those who could afford it.
- **As capacity prices continue to decline, leasing prices are narrowing the gap with IRU prices.** IRUs still provide the best volume savings, to be sure, especially when accounting for present value discounting. Nonetheless, the IRU case is no longer as obvious, given the rate of decline lease capacity prices, the flexibility of making multiple providers compete, providers unwillingness to get stuck into overly long contracts and the fact that cash is very much at a premium now – less capex, more OpEx.
- **In turn, leasing is the increasingly preferred option for most buyers and the capacity purchase equation moves (back) to a more OpEx-focused and less CapEx-driven model.**

All these changes are applying unevenly, as illustrated in the next page, with some markets moving faster than the others in bringing down capacity prices. **In the process, a substantial African divide is emerging, around the volume, price, and rate of distribution of Internet capacity.**

Africa's Deepening International Capacity Pricing Divide

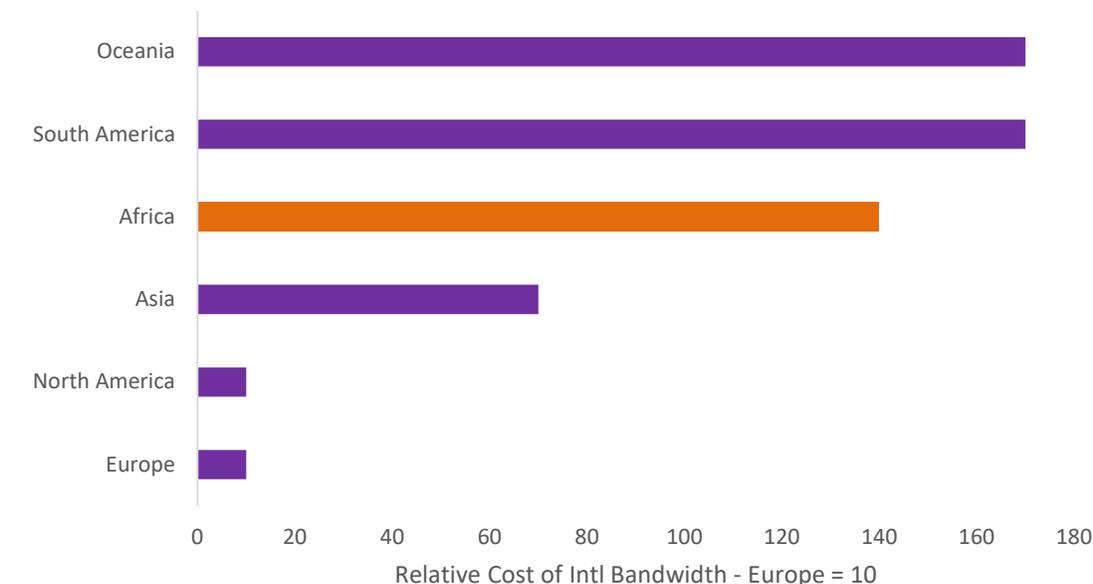
African International Capacity Prices are Starting to Compare Adequately

- At a broad level, capacity pricing data suggests that while African price points remain relatively high, compared to European and US international capacity pricing.
- 2016 analysis from CDN provider Cloudflare (which purchases capacity around the world) suggests that international capacity pricing in Africa's more competitive markets (South Africa, primarily) **is about 14x higher than European or North American pricing.**
- Nonetheless, more African markets are starting to compare adequately relative to other emerging economies, notably in South America and Oceania.

..But the Cost of Connectivity in Africa is Still Highly Uneven

- **Material variations in pricing exist** between markets - up to 50x. This is leading to an increasingly pronounced African divide, one with inevitable consequences on retail connectivity costs.
- In some cases, the variations largely reflect a difference in price between coastal countries (with direct access to a landing cable) and landlocked countries, which have to pay terrestrial transit fees to their neighbors to access international capacity.
- **Increasingly, the uneven capacity pricing also reflects differences in wholesale market structure and constraints on the availability of capacity.** In competitive wholesale markets, multiple providers sell international capacity and downward pressure on pricing is permanent.
- **In South Africa for example, operators report average yearly declines of 30% to 50% in the effective leased prices per STM-1.** Other competitive markets don't see quite the same high rate of decline – but at a minimum, see a steady, downward price evolution (~10%-20%+).

Relative Cost of Bandwidth – Africa vs. Other Regions



Source: Cloudflare (2016)

Africa's Deepening International Capacity Pricing Divide (2)

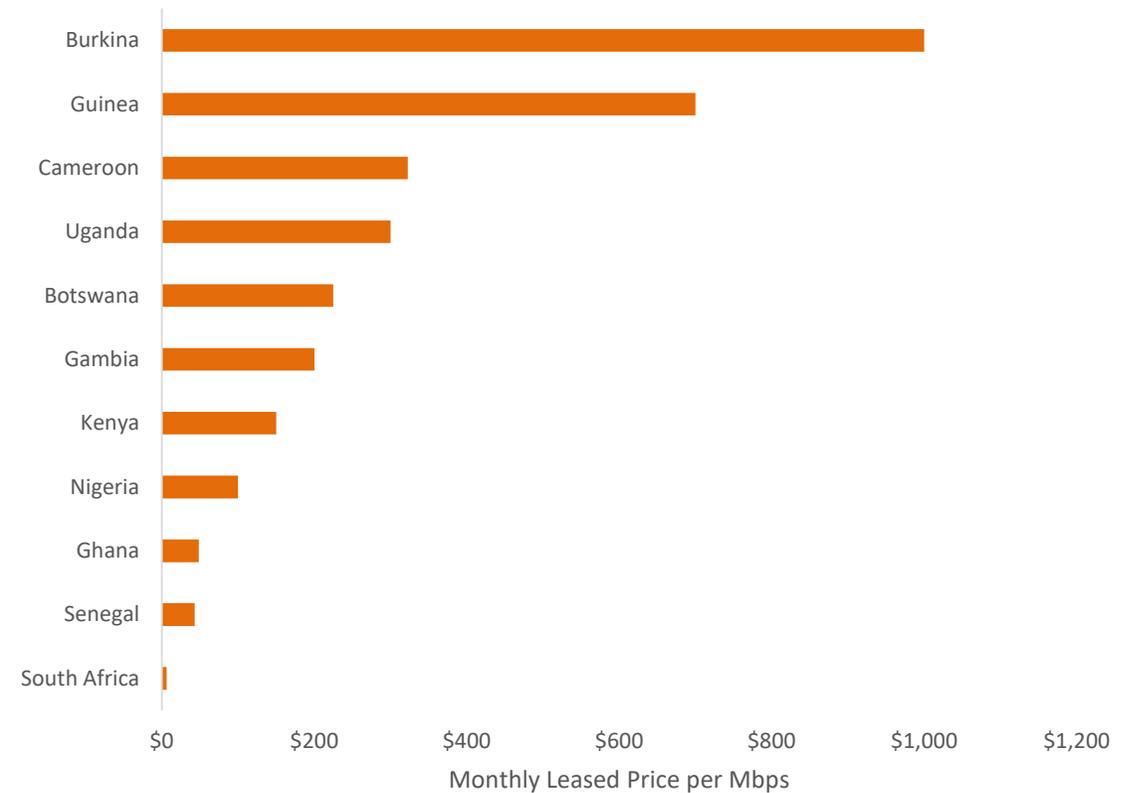
Monopolies Have Given Way to Oligopolies..

- In less competitive markets, price points have held up steady after the first wave of post-rollout cuts. **In a few cases, monopolies have given way to oligopolies, who use capacity primarily for their own needs, and treat surplus capacity as a premium asset to be slowly rationed.**
- This is leading to paradoxical market situations, where capacity usage is increasing (within the group of companies fortunate enough to own capacity) while other players see few price benefits – and indeed, may have to exit the marketplace.
- **A few markets see virtually no competition on international capacity provision, with a single provider controlling 90%+ of the market, through regulatory licensing and other factors.**
- For the most part in such cases, price points are higher than average, and in some cases (e.g. Cameroon), excessively so.

With a Few Exceptions

- **But monopoly does not always translate into higher prices.**
- In Senegal, Sonatel offers price points that are among the lowest in Africa.
- Price points in Botswana, where Bofinet is the primary capacity provider are similarly competitive by African standards.

Monthly Leased Price per Mbps in Sample African Markets – 2016E



Price points from Xalam pricing survey unless otherwise indicated; Gambia, Guinea and Burkina Faso from WARCIP program; all prices based on STM-1, except for Gambia, Guinea and Burkina Faso (E-1); prices are coast to coast prices, or capital-city to European coast for landlocked markets, including terrestrial transit fees. Sources: Xalam Analytics research.

Pricing – Various Levels of Competition in African Markets

Characteristics of International Capacity Price Competition

	Highly Competitive Markets	Moderately Competitive Markets	Limited to Non-Competitive Markets**
Number of Cables Landing in the Country	~ 3 or more	~ 3 or more	1 or 2
Number of Providers selling international capacity independently and at competitive prices	~ 3 or more	~ 2 or more	1 dominant provider (95%+)
Reference Unit for Capacity Purchases	STM 10 or above	E1 and STM-1	Mostly E1(STM-1 in some cases)
IRUs vs. Lease Gap for Large Capacities	Narrowing – Customers migrating from IRUs to leases	IRU economic case remains materially superior	IRU economic case remains materially superior – but few can afford large capacities
Customer Requirements	IP and City to City Solutions, Including Terrestrial Links	Coast to coast, IP International Capacity	Coast to coast, IP International Capacity
“Steady-State”* Capacity Pricing Status	Highly competitive – 20%-50% declines in effective annual capacity prices	Moderate - ~10% decline in effective annual capacity prices	Stable – Little to no decline in effective annual capacity prices
Examples	South Africa, Ghana, Kenya	Nigeria, Tanzania, Uganda, Rwanda, Zimbabwe	Senegal, Namibia, Gabon, Cameroon, Guinea

*State of the market 2-3 years after the new cables have launched

**The characterizations are not absolute; in some markets where competition is limited, some providers have managed to bring down international capacity costs materially; for example, Senegal and Namibia see more downward price movement than Cameroon, despite a wholesale capacity market structure that is relatively similar

Sources: Xalam Analytics research.

IXPs and the Race to Fix Africa’s Traffic “Tromboning” Problem

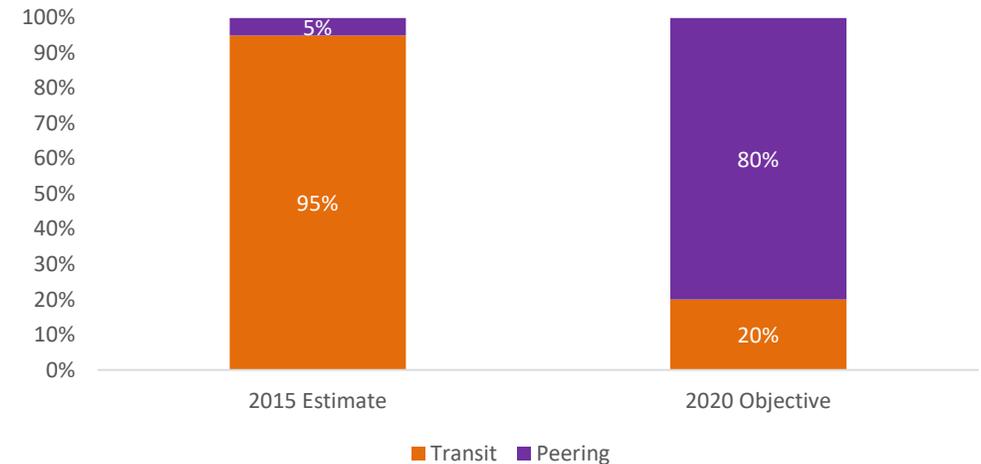
More IXPs are Being Set Up to Cut International Transit Costs..

- Traffic “tromboning” – whereby traffic between two ISPs located in the same city (or country) would be routed through Europe- has been one of the primary drivers of African demand for international capacity;
- **Traffic tromboning is a leading reason why ~95%+ of African Internet traffic has traditionally flown out of Africa.**
- In a bid to curb transit capacity expenses and improve service quality, more ISPs are establishing local peering exchanges (IXPs).
- Strong support for IXPs from the Internet Society (ISOC), the African Union and many African governments.
- **The Internet Society has outlined a top line target of 80% local and 20% transit by 2020 – from the prevalent ~90% transit/10% local in many countries.**
- This effort to cut transit traffic are another trend that is helping shift the value in African transport markets from international to domestic capacity.

..And Global Internet Players are Starting to Set Up Shop in African Data Centers

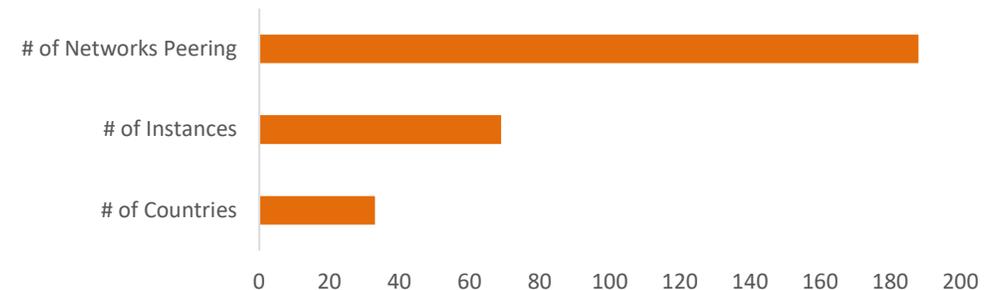
- Internet and CDN players looking to cut their own transit costs by peering locally
- Focus remains on a few hubs – South Africa and Kenya in particular
- Number of Google Caches in Africa has accelerated over the past two years
- GGC – Now in 33 African markets, peering with ~200 African networks (2016E)
- Netflix starting to expand its African network presence as well

Structure of African Internet Traffic - Transit vs. Peering



Source: ISOC

Google Global Cache Status in Africa - 2016



Source: Google

Can IXPs, Caches and CDNs Truly Curb the African Appetite for International Capacity?

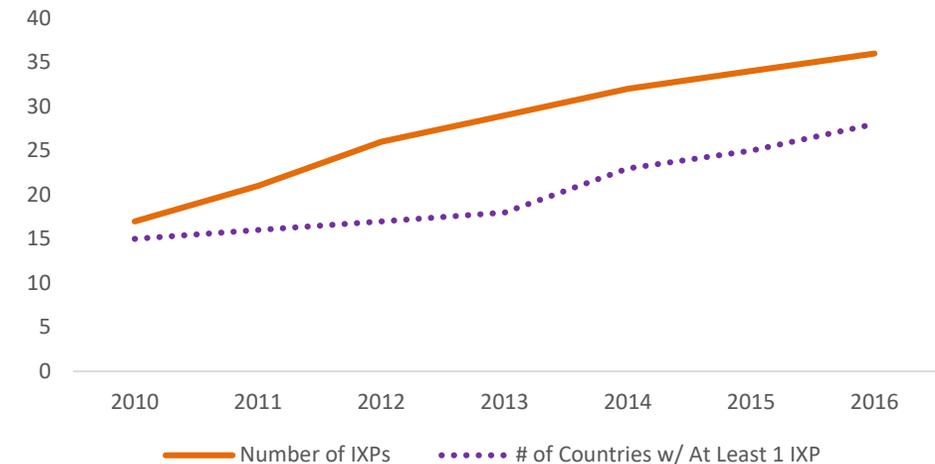
Strong Progress – But Obstacles to the 80% Local – 20% Transit Goal are Substantial

- **The number of IXPs in Africa has doubled since 2010, to 36 in 28 countries** as of December 2016, a sign of substantial progress; the deployment of CDNs and Caches in local data centers is also helping curb demand for international capacity.
- But the broader impact on international capacity demand is still relatively marginal – the forces against local peering are strong.
- **The sustained decline in international capacity costs is helping sustain** (and even increase) international capacity volumes (if not revenue).
- The national vs international transit premium that persists in many markets (e.g. Nigeria) also helps in keeping tromboning more economically attractive for ISPs.
- **International hosting of African content remains pervasive**

..IXP Impact on International Capacity Demand Inversely Proportional to Cost of Capacity

- The impact of IXPs has been strong. Many ISPs (notably in landlocked markets) are reporting cuts of 20% to 40% in their international transit costs, depending on the structure of the IXP and the availability of affordable domestic or cross-country fibre.
- Some of the more popular IXPs, such as NAPAfrica, are having an impact that is regional – as ISPs in neighboring markets come in to peer.
- Overall, however, IXPs have not fundamentally tamped down international capacity volumes. The impact of IXPs in curbing international capacity requirements appears to be commensurate to the relative cost of international capacity.

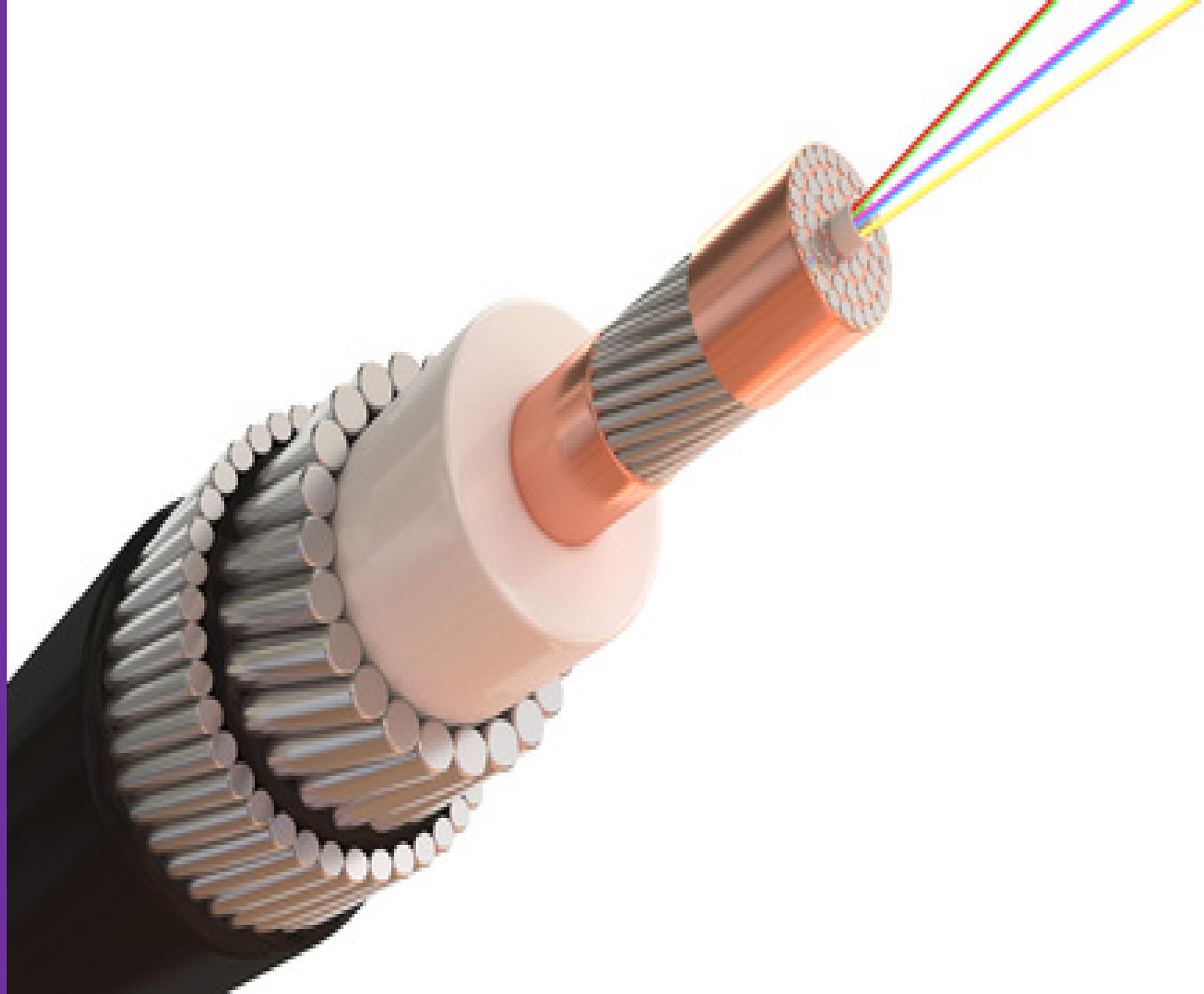
Evolution of Number of Active IXPs in Africa



Source: African IXP Association

- **Where capacity is expensive, the case for IXPs is stronger; where prices are falling fast, ISPs are getting more transit capacity for less money.** In this latter case, latency becomes the primary value proposition of the IXP.
- **We expect strong top line traffic growth and transit price declines to mostly mitigate the impact of IXPs on international capacity volumes** - even as proportion of local traffic continues to increase

The Rise of the Disruptors: How Angola Cables, Camtel, and Djibouti Telecom Can Transform the African Capacity Market



The Rise of the Capacity Market Disruptors

AFRICAN INTERNATIONAL CAPACITY MARKET DISRUPTORS

- We have identified several carriers we call “market disruptors”, in the African international capacity market. They are carriers that, somewhat unexpectedly, through heavy investments in international capacity, have become (or will become) critical players in the African capacity marketplace.
- The four main players in this group are **Angola Cables, Camtel Cameroon, Djibouti Telecom and Telecom Namibia**, the first three of which are analyzed in the next few pages. Before 2015, these companies were relatively marginal players in the African international capacity market. On current trajectory, their investments will vault them into the top-10 or 15 of primary owners of African submarine fibre capacity by 2020.
- These market disruptors have different motivations – but **all see the wholesale capacity market as a critical pillar of their business strategy over the next five years. What makes them disruptors is the relative absence of predictability.** They (will) have a substantial surplus of international capacity, and for the most part, it’s not entirely clear how they plan to use it. The core question is therefore – **will they be rational actors, or will they, as they can in theory, fundamentally disrupt the African wholesale market?**

- ANGOLA CABLES
- CAMTEL CAMEROON
- TELECOM NAMIBIA
- DJIBOUTI TELECOM



Home Market	Estimated 2020 International Capacity Holdings (excl. IRUs and Leases)*	Primary Cable Ownership	Targeted Regional Area of Focus	Disruption Factor
Angola	~1100 Gbps	SAT-3/WASC, WACS, SACS, MONET	SADC (Southern Africa)	✓✓✓
Cameroon**	~170 Gbps	SAT-3/WASC, WACS, ACE, SAIL, NCSC	CEMAC (Central Africa)	✓✓✓
Namibia	~700 Gbps	WACS	SADC (Southern Africa)	✓
Djibouti	~1250 Gbps	EASSY, SEA-ME-WE-3, SEA-ME-WE-5, EIG, AWE, AAE-1, DARE	COMESA & EAC (East and Southern Africa)	✓✓

*Numbers are Xalam Analytics estimates, based on cable ownership, projections of lit capacity; **Including capacity owned by government of Cameroon
Sources: Operators, Xalam Analytics Research

Disruptor Analysis: The Fascinating Rise of Angola Cables



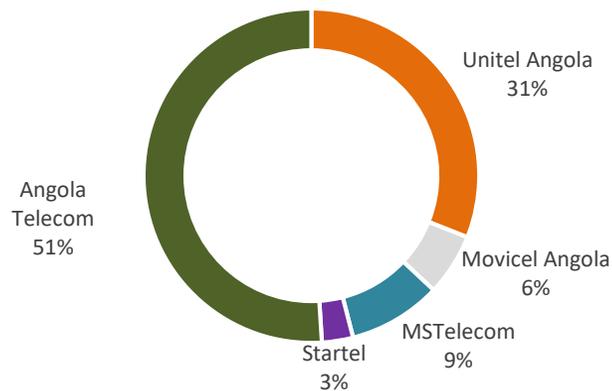
Population
~22m

Broadband %
~20%



- **Angola Cables is a regional (and increasingly global) wholesale player formed in 2009, with participation from Angola's top telecommunications companies.** The company was formed to more effectively pool and manage international capacity for the Angolan market, notably Angola's participation in the SAT-3 and WACS cables, as well as IRU purchases on other regional and global cables.
- With capacity assets largely surpassing the requirements of the Angolan market, Angola Cables is able to resell surplus capacity in the international wholesale market. Angola Cables also built and runs Angonap, Angola's largest colocation data center based in Luanda.
- But Angola Cables is now more than a simple SPV for Angolan international capacity assets. **The company's stated ambition is to become a global Tier 1 capacity player, building on a niche positioning between Africa and the Americas.** Two critical investments underpin this ambition:
 - **SACS:** the South Atlantic Cable System, a subsea cable connecting Luanda in Angola to Fortaleza in Brazil. A ~\$160m project, the new cable uses 100Gbps wavelength technology and is slated to bring in around 40 Tbps of international capacity on Africa's West Coast. The cable is expected to be operational in 2018.
 - **MONET:** The MONET cable will provide a connection between Fortaleza (Brazil, where SACS lands), Santos (Brazil) and Miami in the United States. Angola is a key member of a consortium that also includes Google, Algar Telecom (Brazil) and Antel (Uruguay). The new cable is slated to bring in 60Tbps in design capacity and offer an alternate route to the North American market. It is expected to be operational in 2017.

Angola Cables Shareholder base - 2015

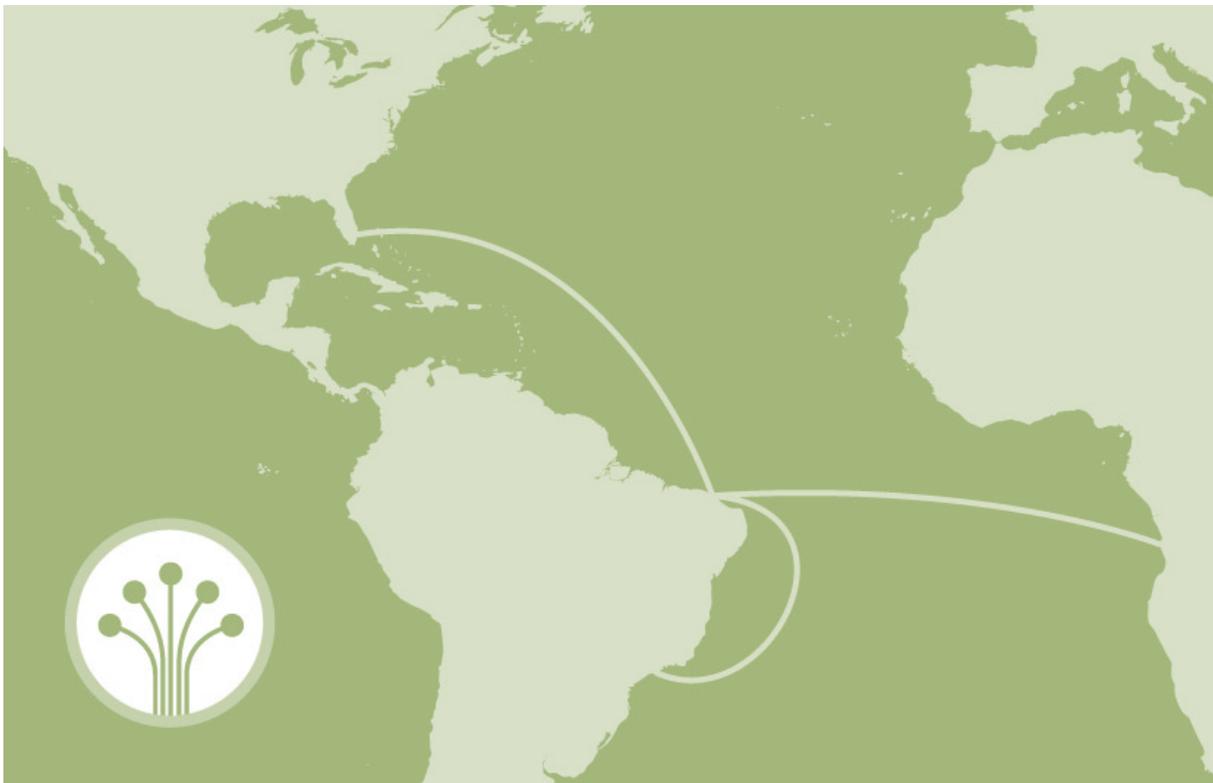


Source: Angola Cables

Angola Cables Subsea Project Overview: SACS and MONET



SACS & MONET Map



Source: Angola Cables, OSI

SACS & MONET Key Specifications

	SACS
RFS	2018
CapEx (Initial Only)	~\$160m
Length	6200 km
Starting & Ending Points	Luanda (Angola) to Fortaleza (Brazil)
Design Capacity (as of 2016)	40 Tbps
Cable Owner (s)	Angola Cables

	MONET
RFS	2017
CapEx (Initial Only)	NA
Length	10,556 km
Starting & Ending Points	Praia Grande (Brazil), Fortaleza (Brazil) to Boca Raton (USA)
Design Capacity (as of 2016)	60 Tbps
Cable Owner (s)	Angola Cables, Antel (Uruguay), Algar Telecom (Brazil), Google



Three-Pillar Strategy: Brazil, Asia and SADC Traffic

- **Unlike most Africa-focused carriers, Angola Cables is an ostensibly global play.** As noted, the company's stated goal is to become a global Tier 1 capacity player, building on three key markets:
- **Northeast Brazil-** Capturing demand from Northeast Brazil (mostly for Brazil to US traffic) is critical to the company's strategy. The SACS cable was initially conceived in a partnership with Brazilian company Telebras; Angola Cables decided to go at it alone once the Brazilian operator abandoned the project to focus on building the infrastructure for Brazil's 2014 Football World Cup. In addition, Angola Cables is building data center infrastructure in Fortaleza to support its landing station and offer colocation services to regional Brazilian ISPs.
- **Asia Traffic:** Angola Cables also aims to provide a diversity route for Asia to Northeast US traffic. Today, traffic from Asia to the US currently goes either directly to the West Coast or takes a longer trek through Europe. AC wants to offer an alternative that runs from Asia to South Africa to Angola, Brazil and Miami. It is perhaps not entirely coincidental that the SACS cable will be built by Japan's NEC, and financed in part by Japanese banks (the Japan Bank for International Cooperation (JBIC) and Sumitomo Mitsui Banking Corporation (SMBC)).
- **The third leg is capturing traffic from the southern African (SADC) region,** with a lower latency route to the Americas. It is on this segment, in our view, that the impact of Angola Cables could be most significant. Beyond bringing in new, cheap capacity, SACS could cut African latency to the US market by more than half.

The African Impact: Flooding the Market with Capacity

- **The potential impact of Angola Cables lies in the amount of incremental capacity they'll be able to bring to the market.** With a design capacity at 40 Tbps, lighting up even only 2.5% (our assumption) would make another 1000 Gbps of international capacity available on the African West Coast. **Depending on the timing of the Liquid Telecom Liquid Sea cable, this would make Angola Cables the second or third largest owner of African on-net capacity (excl. IRUs and leases)* in 2018,** only behind Orange/France Telecom Group.
- Even if our projections of Angolan market international capacity requirements are doubled (and we see no reason why they should be), the Angolan market would be able to absorb less than 10% of this incremental capacity. **Capacity from SACS will be surplus from launch in Angola.**
- **The question is therefore how Angola Cables chooses to handle this overwhelming surplus** – rationally, or disruptively? It's a tough read at this stage, but there are a few factors to consider:
- **While Asian traffic is an ostensible target, winning African (SADC) traffic market share will be critical to success** – perhaps even a condition for making the Asia play possible. The Southern and West African capacity markets are still less competitive than transatlantic and transpacific routes – there's still room for downward cuts.

*The median lit to design ratio for African trans-oceanic cables launched between 2002 and 2012 is ~7%.

*A more accurate reading should include IRUs and leases; but this data is largely impossible to track in any reasonable manner, given demand and supply fragmentation and the confidential nature of such agreements.



Will Angola Cables be a Rational Actor?

- **Further, Angola Cables has an asymmetric, built-in competitive advantage. The company can sell capacity in many other markets in the regions - but others can't really compete with it in its home turf**, thanks to an essentially impenetrable, China-like managed competition model. In addition, all major Angolan telcos (~95%+ of the country's capacity demand) are Angola Cables shareholders – and as noted above, they don't really have capacity sourcing issues, essentially dampening Angolan demand for potential capacity competitors.
- **The SACS cable will also benefit from a substantially lower CapEx base, thanks to new technologies.** By our estimates, the cable's CapEx per Gbps per Km is ~40x+ lower than that of Seacom and Main One, and 10x to 15x lower than the more recent ACE and WACS cables. **In effect, Angola Cables can disrupt the market and still stay within a number of reasonable investment economics parameters.**
- **Finally, Angola Cables' shareholders have enough cash to be patient with this investment** – especially one considered so highly strategic. Thanks to a unique mix of managed (protected) competition and inflated retail pricing models, Angola offers some of the highest operating margins in Africa – for top players that is. Unitel, Angola Cables' second largest shareholder generates \$1bn to \$1.3bn in EBITDA each year with a mere 11m subscribers – Africa's best profitability per customer ratio, and more profit than the entire Airtel Africa group.
- **Should Angola Cables decide to disrupt the market, its top shareholders will not feel much pain in the short term.**

Angola Cables – The Case for a Pragmatic Approach

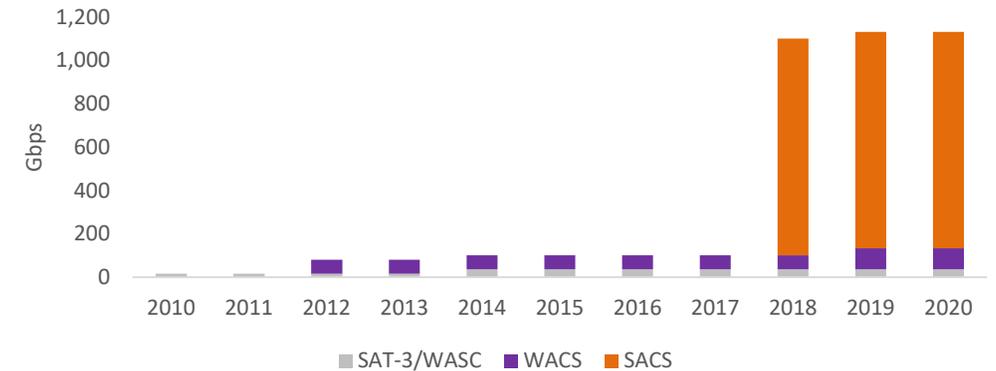
- **Other factors point to a potentially less disruptive approach.** For one, economic fundamentals have changed. When Angola Cables was formed, Angola was riding the wave of oil prices and on its way to temporarily dethrone Nigeria's as Africa's largest producer of oil.
- Between 2011 and 2014, real GDP growth averaged 5.2%. 2016 was more challenging as oil prices fell sharply. Likewise, the Brazilian economy has been in the doldrums, on the back of political uncertainty. **The two countries at the heart of Angola Cables' strategy are suddenly no longer on such firm a footing.**
- **Further, Angola Cables lacks a viable terrestrial network across the SADC region**, potentially weakening its ability to effectively compete with players such as Liquid Telecom or WIOCC in offering city to city capacity solutions – though this admittedly would not prevent it from disrupting transatlantic segments.

Will Angola Cables Be a Rational Actor?

We Expect Angola Cables to be Aggressive, but Pragmatic

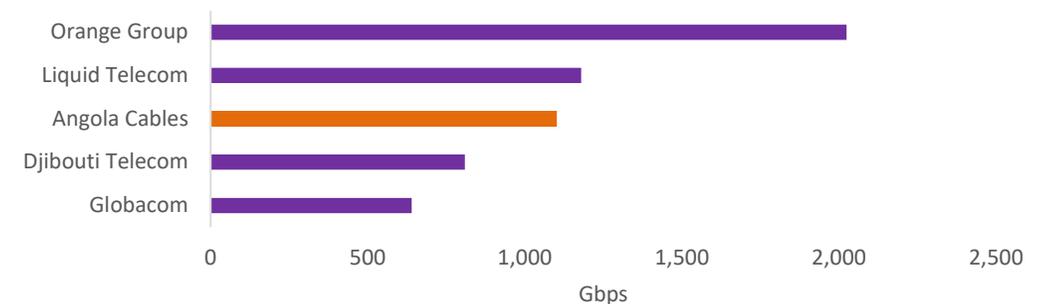
- Perhaps the strongest sign that Angola Cables may not fundamentally disrupt the market is its shareholders' track record. Angolan telcos have traditionally been quintessential premium players, perfectly content to keep prices high to protect margins.
- While the approach is largely a byproduct of the Angolan market structure, **disrupting African capacity markets through heavy price discounts would go highly counter-nature.** But it would not be the first time that a company is conservative at home but aggressive internationally, especially in light of its asymmetric regulatory advantages.
- **Were we to be forced to take a stance, we would expect Angola Cables to be aggressive, but pragmatic.** They'll do enough to put more pressure on international capacity prices (~15%-20% discounts), and will be extremely difficult to beat on price.
- **But they will not fundamentally disrupt West Africa capacity pricing fundamentals. In effect, aggressive, but fully rational behavior.**

Evolution of Angola Cables On-Net Capacity



*Based on on-net lit capacity only (excl. IRUs and leased assets); SACS capacity assumes ~2.5% of design capacity is lit; Source: Xalam Analytics Estimates

Sub-Saharan Africa Top 5 International Capacity Owners – 2018F



*Based on on-net lit capacity only (excluding IRUs and leased assets); SACS capacity assumes ~2.5% of design capacity is lit; 2018 are Xalam Analytics projections, assuming launch of Liquid Sea, but excluding Africa-1; assuming at least one upgrade on WACS, Seacom and Eassy. Estimates include on-net capacity on international cables passing through Sub-Saharan Africa, but not Africa-focused (primarily through Djibouti) – e.g. EIG or SEA-ME-WE 5. Source: Xalam Analytics Estimates



Population
~23m

Broadband %
~21%



- **Camtel is Cameroon's state-owned carrier.** The company holds a monopoly on the provision of wholesale capacity in the country, one of the last few players in the continent to hold such a legal advantage. All service providers are legally required to go through Camtel for domestic and international fibre capacity (though whether they need to do so for metro capacity is somewhat unclear).
- **Camtel also acts as the custodian and manager of the state's fibre assets,** a critical position in a market where the government has been resolute in its objective of retaining control of the country's Internet infrastructure.
- **Over the past few years, the government of Cameroon (GoC) has put its stamp on the fibre market.** In 2012, the GoC blocked the landing and launch of the ACE and WACS cables. Under initial plans, the Cameroon capacity allocation and landing point for the two cables was to be managed by the country's two mobile operators, Orange Cameroon (for ACE) and MTN Cameroon (for WACS), whose parent companies are the systems' leading promoters.
- As a condition for the cables becoming operational in the country –and in what was in essence, a soft form of expropriation-, the GoC acquired the landing points (at estimated initial value), giving management to Camtel, and itself becoming a key investor in the two consortia.
- Combined with a connection to the MainOne submarine Cable through a new Kribi-Lagos 40Gbps link (NCSCS), its existing stake in the venerable SAT-3 cable, and management of the critical Cameroon leg of the World Bank-financed Central African Backbone (CAB), **Camtel has been able to build out what is now the best pool of fibre assets in the Central African CEMAC region.**
- **Camtel's most daring initiative is more recent.** In 2016, Camtel formed a consortium with China Unicom to launch the South Atlantic Inter Link (SAIL), designed to connect Cameroon's coastal city of Kribi to Fortaleza in Brazil. The SAIL cable is expected to be ready in late 2018 and would be the main competitor to Angola Cables SACS' cable.

Review of Camtel Fibre Assets, From SAT-3 to SAIL

Camtel Key Fibre Assets - 2016

SAT-3	Camtel (then known as Intelcam) was one of the original investors in the SAT-3 cable; today, it controls ~3%-4% of available capacity on SAT-3.
WACS	The GoC took over MTN Cameroon's stake in the WACS consortium and allocated landing point management and about 20-25 Gbps of capacity to Camtel.
ACE	The GoC took over Orange Cameroon's stake in the ACE consortium and allocated landing point management and about 4-5 Gbps of capacity to Camtel.
NCSCS	~40Gbps connection to the Main One Cable from Kribi to Lagos, Nigeria.
SAIL	Arguably Camtel's (and the GoC's) biggest fibre gamble. Linking Cameroon to Brazil, RFS 2018-19.
CAB	Cameroon's national backbone network, providing transit access to Chad and the Central African Republic.



Source: China Unicom

South Atlantic Inter Link (SAIL)	
RFS	2018
CapEx (Initial Only)	~\$220m to \$490m*
Length	6000 km
Starting & Ending Points	Kribi (Cameroon) to Fortaleza (Brazil)
Design Capacity (as of 2016)	32 Tbps
Cable Owner (s)	Camtel, China Unicom (actual stakes unclear)
Financing	Government of Cameroon, China Eximbank, China Unicom, Camtel

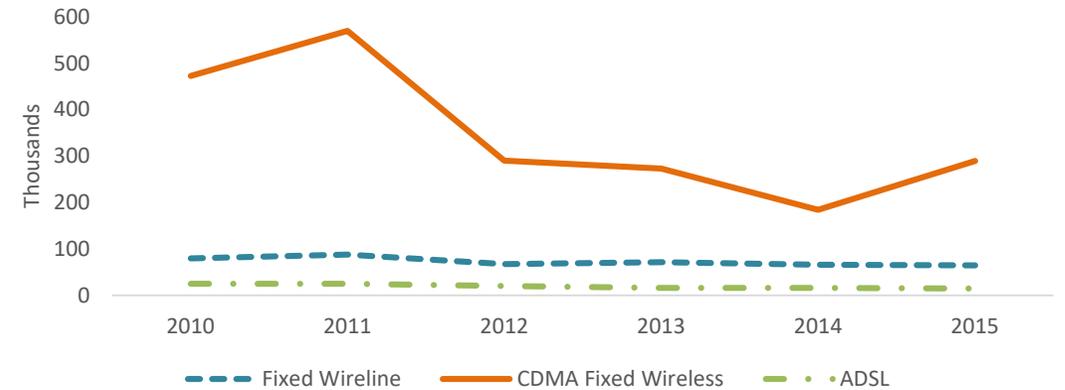
*Conflicting sources, in Cameroon and China
Sources: Camtel, China Unicom, Xalam Analytics Research

Camtel's Wholesale Play – A Matter of Survival



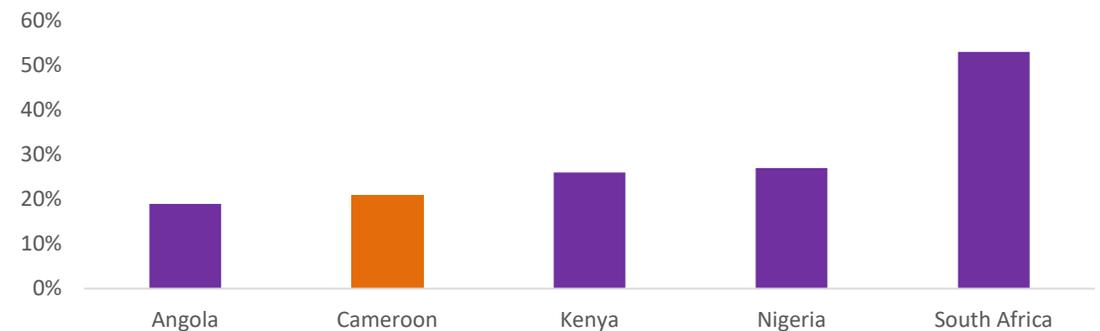
- **There is a strong strategic rationale to Camtel's push into the wholesale market.** The company's retail business has been under pressure; between 2011 and 2014, its fixed line base (mostly CDMA fixed wireless terminals) contracted by nearly 50%, before recovering slightly.
- **Camtel's share of the fixed broadband market has declined to the 35%-40% range** as smaller ISPs picked up customers; its ADSL base is stuck around 20k connections and its FTTH base has been stubbornly marginal. **Further, Camtel is absent from the sector's largest segment, mobile services,** despite intermittent suggestions that it would receive a licence to formally enter that business.
- **This has made the wholesale business and Camtel's monopoly on it critical to the company's outlook, and an asset worth protecting. For the GoC, protecting Camtel goes beyond an ostensible inclination to control the Internet.** Camtel accounts for only around 15% of Cameroon's ICT sector revenue, but slightly more than 50% of the sector's full time formally employed staff, according to ART data. Keeping the company afloat is critical, and for now at least, the wholesale business appears to be the most obvious path to doing so in a relatively profitable manner.
- **Chinese support has been critical.** China is one of Cameroon's top trade creditors, and Chinese companies have long supported Camtel's CDMA focus. 85% of the cost of the SAIL project is financed by China's Eximbank, through a loan to the GoC.
- **China Unicom is Camtel's technical partner,** though the extent of its stake in the project is somewhat unclear, and Huawei Marine Networks will build the SAIL link.

Evolution of Camtel's Retail Connections - 2010-2015E



Sources: ART, Camtel; 2015 is Xalam Analytics estimate

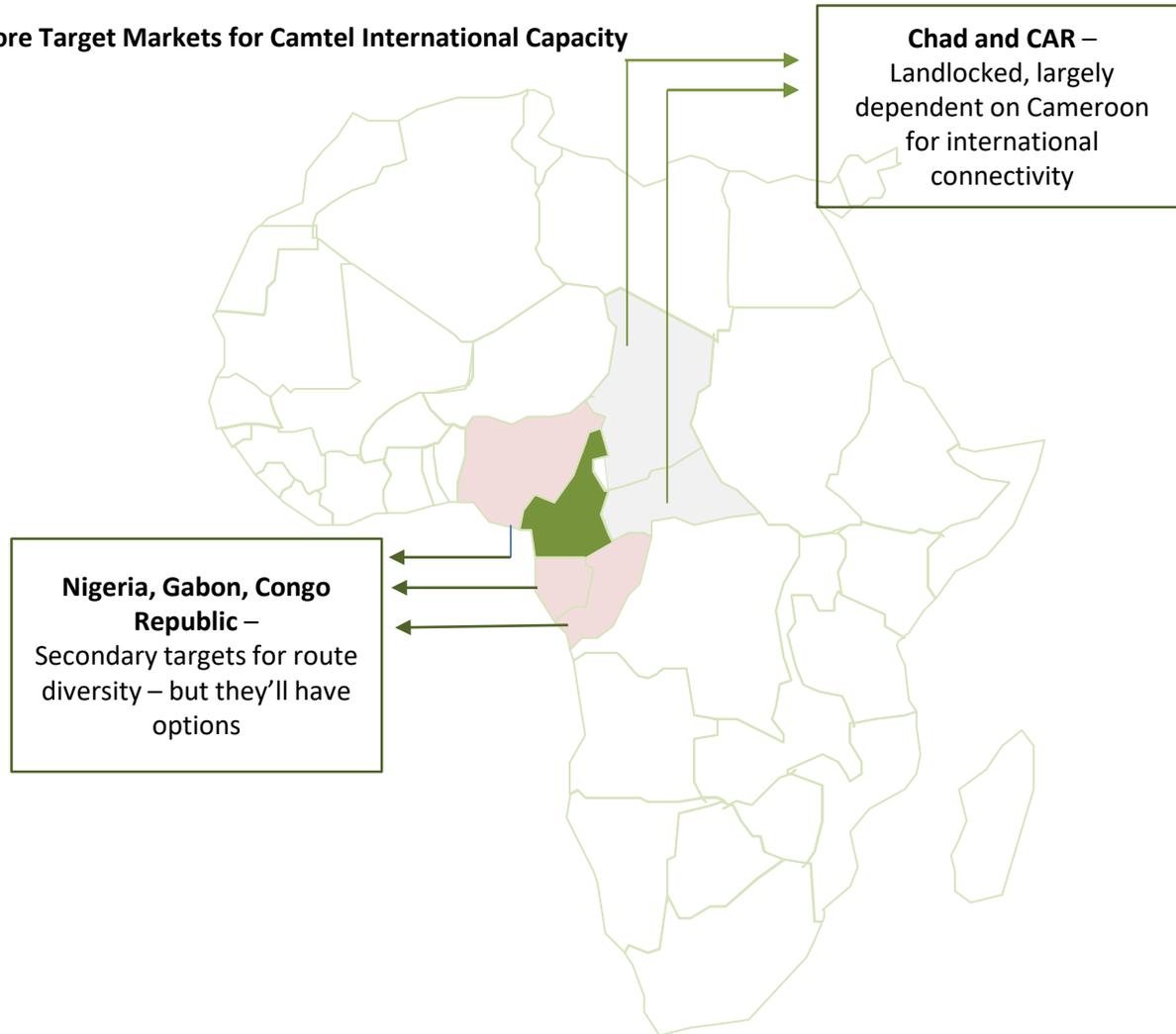
Cameroon Broadband Penetration vs. Sample African Markets* - 2016E



*Only including 3G and 4G connections, ADSL, FTTH, FWA.
Source: Xalam Analytics estimates

The Case for SAIL (or Lack Thereof)

Core Target Markets for Camtel International Capacity



- **Should the SAIL project go through, and subject to how much capacity is initially lit, Camtel would control between 200 Gbps and 600Gbps of international capacity by 2018** (and potentially more). This would be the largest such equipped capacity in the CEMAC region, and would even surpass the entire equipped capacity on such cables as Main One and ACE assuming those do not upgrade capacity over the medium term.
- By our estimates, the combined international capacity requirements of the Cameroon, Chad and CAR markets, under a favorable set of assumptions, would account for only 15%-20% of available capacity, leaving Camtel with 100Gbps to 300Gbps of surplus capacity. The question is what they do with that surplus.
- **There are potentially compelling elements to the Camtel wholesale play.** For one, there is some merit to the objective of becoming a hub for the central African region. Already, Cameroon is a critical international gateway for landlocked Chad and the Central African Republic, though demand from those two markets alone is not enough to sustain the capacity Camtel has been acquiring.
- **Gabon, the Equatorial Guinea and the Republic of Congo are additional targets,** though all have been getting their own direct access to international cables – and for a variety of political reasons, are unlikely to be inclined to be too dependent on Camtel.
- **The neighboring Nigerian market a potential wildcard, due to its size.** Nigeria has five cables of its own, but Camtel could offer a potentially attractive diversity route to the US market (in competition with Angola Cables’ SACS).

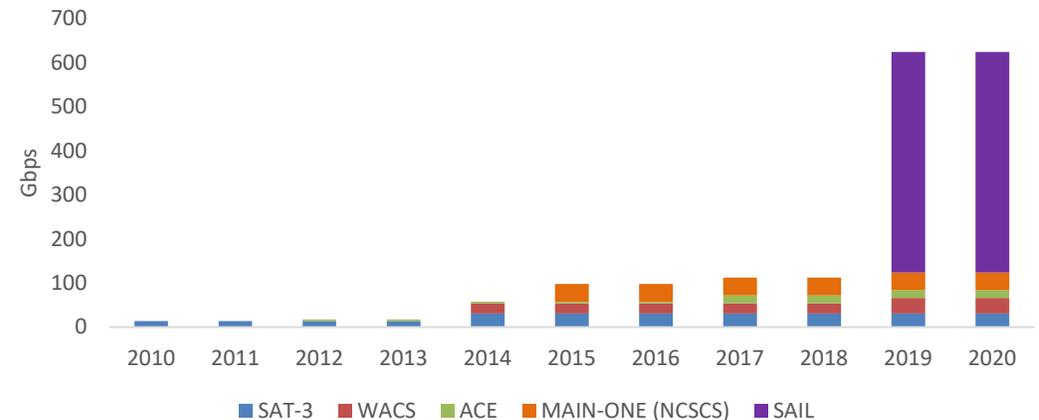
Source: Xalam Analytics Research

Can Camtel Change its DNA – and Pull this Off?

Camtel is the Most Unpredictable of all the Disruptors

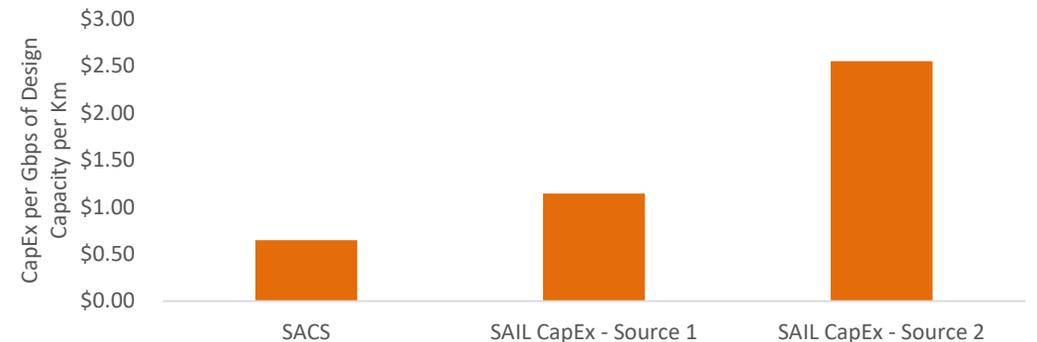
- **All the same, the economic case for SAIL is hardly obvious**. According to unconfirmed target estimates, Camtel hopes to generate \$30m to \$40m a year in revenue from the project. It is not obvious how the company gets to that number.
- **For one, the Cameroon-Brazil route does not build on an established trade route**. Trade between the two countries averaged around \$100m annually between 2000 and 2015. By contrast, Angola’s commercial trade with Brazil reached around \$2.4bn in 2014 alone. For all the official pronouncements around the Cameroon-Brazil relationship, Brazil is not the play – the US market is.
- **Another critical question is whether Camtel has the DNA to truly disrupt the international market** – in effect doing on the international stage what it has not done in its home market. Cameroon’s international capacity prices and Internet retail prices are among the highest in Africa (see our pricing analysis in this report), despite access to three different international cables. Broadband penetration levels are in the lower half of all the markets we examined for the purposes of this report, largely due to Camtel’s hold n the wholesale market.
- **While Cameroonian ISPs have no choice, international capacity buyers do**. And in Angola Cables, Camtel will face a player that is better capitalized, potentially more aggressive, has better Brazilian relationships and owns a high-capacity submarine connection to the US market – while Camtel’s customers will have to buy onward capacity from Brazil (Telefonica is expected to sell the onward capacity to the US). And depending on the CapEx estimate, Angola’s SACS will be 40% to 3x cheaper to build than SAIL., and will come to market earlier.
- **Of all the potential market disruptors we examined, Camtel may be the most unpredictable** – It’s the disruptor whose projects have the weakest economic basis; indeed, they may also have no choice but to disrupt, if the SAIL venture is to have a chance. But Camtel is also the most likely to have substantial amounts of capacity sitting around idly, as has been the case with its current SAT-3, WACS and ACE assets.

Camtel’s Owned International Capacity – 2010 – 2020F



Estimates exclude IRU, leased capacity; SAIL projections are Xalam estimates
Source: Xalam Analytics Research;

SAIL vs. SACS CapEx – Same Route, Same Distance, Different Price



Source: Xalam Analytics Estimates

Djibouti Telecom – From a Uniquely Strategic Position, Building Africa’s Foremost Capacity Hub



Population
~900k

Broadband %
~13%



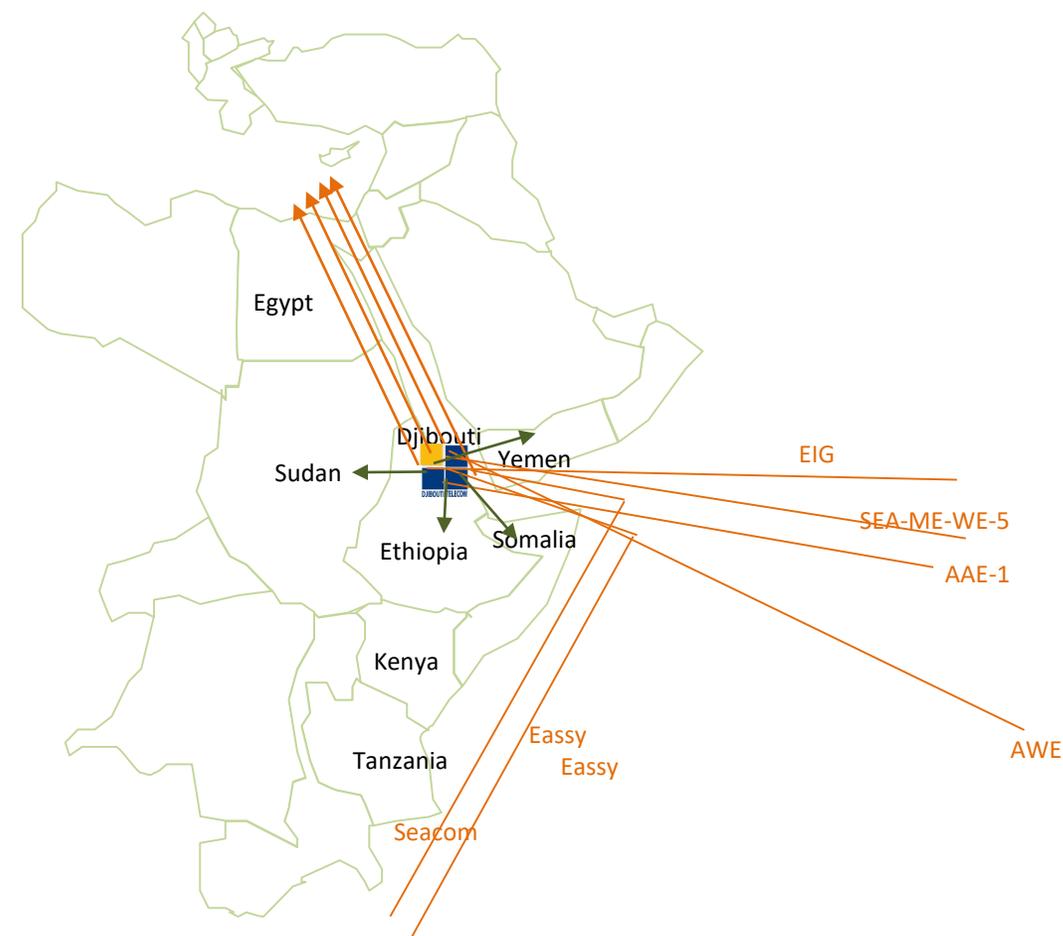
- **Despite its small size, Djibouti has emerged as arguably Africa’s most critical international capacity hub.** As of 2016, 8 international cables were landing in Djibouti, connecting four continents, including some of the most critical to global communications, such as SEA-ME-WE 5 or EIG. This is the highest number of cable landing points in sub-Saharan Africa, and a popular peering exchange point for international cables.
- **Cables landing in Djibouti currently fall into three groups:**
 - International, high-capacity cables connecting Asia to Europe (SEA-ME-WE, EIG, AAE-1)
 - African East coast cables to Europe (Seacom, and Eassy)
 - Regional cables providing an international outlet to neighboring countries, most notably Ethiopia, Somalia and Yemen.
- **The emergence of Djibouti as an international hub is the result of a deliberate, carefully calibrated strategy.** The country’s most important asset is its geographic location, a nexus between Asia, Africa and the Middle East, and a peaceful haven surrounded by larger but more tumultuous neighbors - Ethiopia, Somalia, Eritrea, Sudan, and across the Strait, Yemen. Through Djibouti Telecom, the country’s state-owned carrier, Djibouti has gone about maximizing this position, quickly becoming one of Africa’s most important carriers, despite being one of its smallest.
- But Djibouti is not merely a passive host to cables passing by. **Over the past five years, Djibouti Telecom has made some of the most aggressive bets by an African operator on international capacity markets, building what is now one of Africa’s largest pools of international capacity assets.** The company has invested ~\$100m+ in acquiring stakes in some of the world’s largest cable consortia. Djibouti Telecom is on path to becoming a Top-5 capacity holder in Africa, and a critical player in selling regional and international capacity in the horn of Africa – and across the entire East African coast.

Review of Djibouti Telecom Fibre Assets, From EASSY to AWE

Djibouti Telecom (DT) Key Fibre Assets – 2016 (Ownership Only)*

EASSY	Djibouti Telecom is an investor in the EASSY cable through the WIOCC SPV. But the real value of EASSY for DT is elsewhere; EASSY ends (in practice, if not technically) in Djibouti, and DT’s strategic relationship with WIOCC puts it in prime position to provide onward connectivity to Europe to African customers. In effect, WIOCC helps pull African demand for DT’s Djibouti-to-Europe capacity.
EIG	Currently one of the most critical cables for East Africa to Europe onward connectivity. DT’s stake estimated at ~3%-4%. MTN and Telkom SA are the other African shareholders.
SEA-ME-WE-5	Gigantic transcontinental cable linking Singapore to Marseille, RFS January 2017; 24 Tbps capacity, 18 primary owners; DT is the only sub-Saharan African owner, getting ~500Gbps from commercial launch.
AAE-1	40 Tbps, ~\$800m cable linking Hong Kong to Marseille, RFS 2017; DT is the only sub-Saharan African shareholder, put in ~\$36m. Depending on how much is lit up, will own upwards of 200Gbps on this cable from the start, close to 2Tbps of capacity over time.
AWE	A more recent DT investment in a new, 20 Tbps connecting Australia to Djibouti, and perhaps the best illustration of DT’s strategic acumen. Very similar to DT’s investment in EASSY; a cable from the critical Australian market, with DT acting as the primary provider of onward capacity.
ADEN-Djibouti	Primary international capacity outlet for the Yemeni market
Addis-Djibouti	Ethiopia’s primary international capacity outlet to the Seacom cable
DARE	DT’s plan to build a 60Tbps regional cable pooling capacity from Tanzania all the way to Djibouti – still in project phase, RFS 2018-19.

How to Build a Hub – Key Connections to and From Djibouti

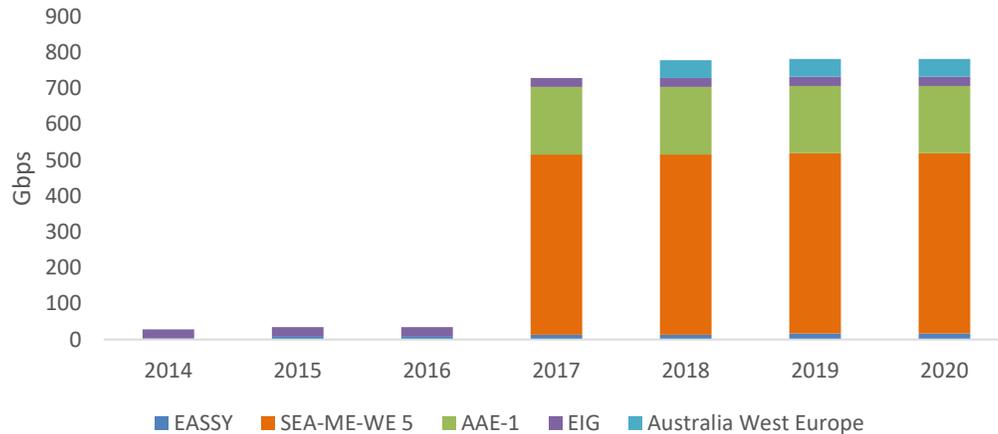


Ownership only; DT also believed to have IRUs in a number of cables, notably Seacom, SEA-ME-WE-3
Sources: Djibouti Telecom, Djibouti MCPT, Xalam Analytics Research

Sources: Djibouti Telecom, Djibouti MCPT, Xalam Analytics Research

Djibouti Telecom Outlook – Likely a Top 3 African Wholesale Player Within 2 Years

Djibouti Telecom Owned Capacity – 2010 – 2020F



Estimates exclude IRU, leased capacity; 2017-2020 are Xalam projections based on lit capacity assumptions, DT stake; estimates exclude DARE capacity (which we treat as regional) and Aden to Djibouti – which we treat more as a Yemen cable. Source: Xalam Analytics Research;

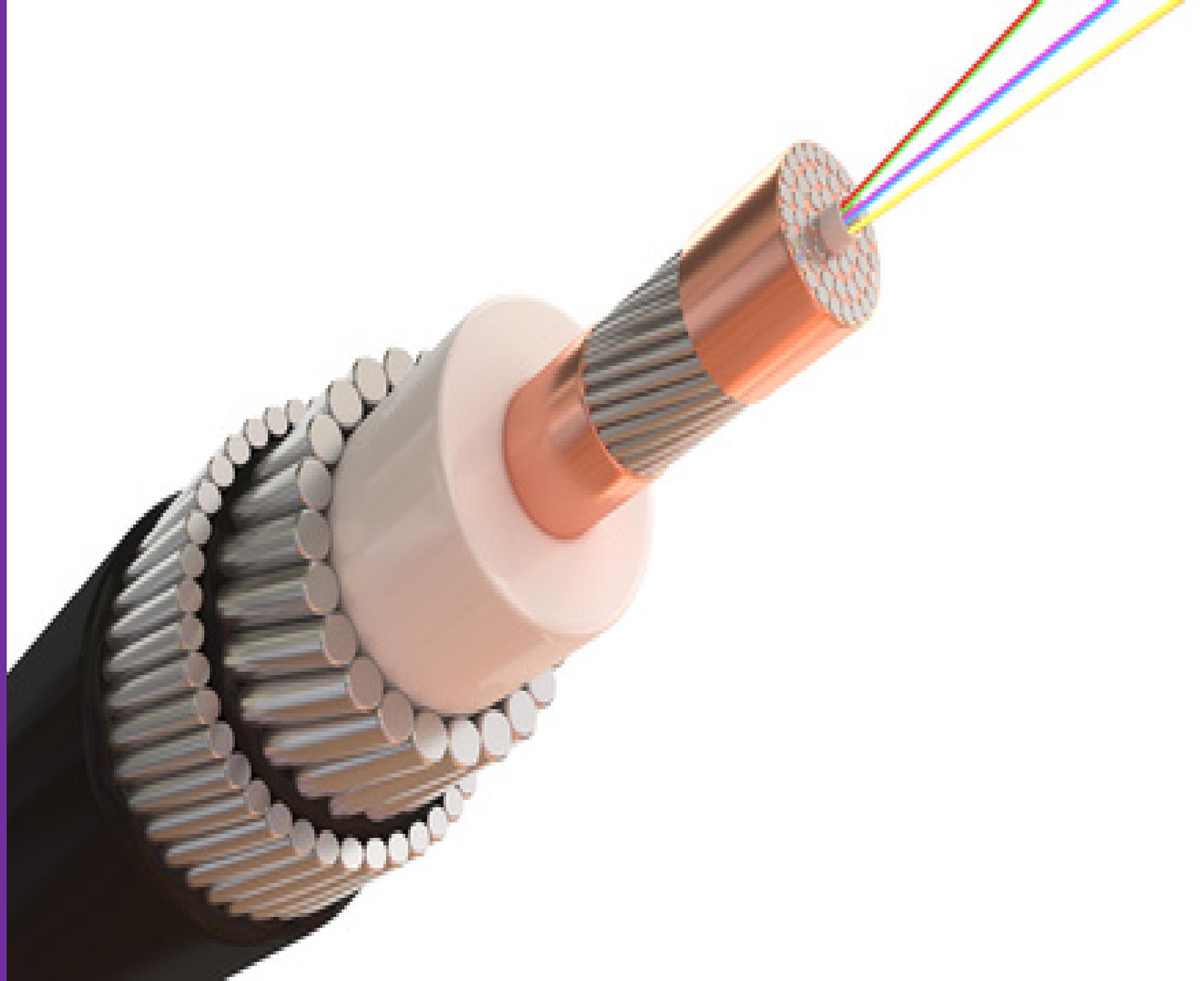
Djibouti Telecom’s Regional DARE – DARE Project Specifications

	(Djibouti Africa Regional Express (DARE))
RFS	2018
CapEx (Initial Only)	~\$100m
Length	5500 km
Landing Points (Proposed)	Dar es Salaam, Mombasa, Mogadishu, Bossaso, Berbera, Mocha and Djibouti
Design Capacity	60 Tbps
Cable Owner (s)	Djibouti Telecom, Africa Marine Express, TeleYemen, Telesom Company, Hormuud Telecom Somalia, Golis Telecom, Somtel Group. (actual stakes unclear)

Source: Djibouti Telecom, Xalam Analytics Research

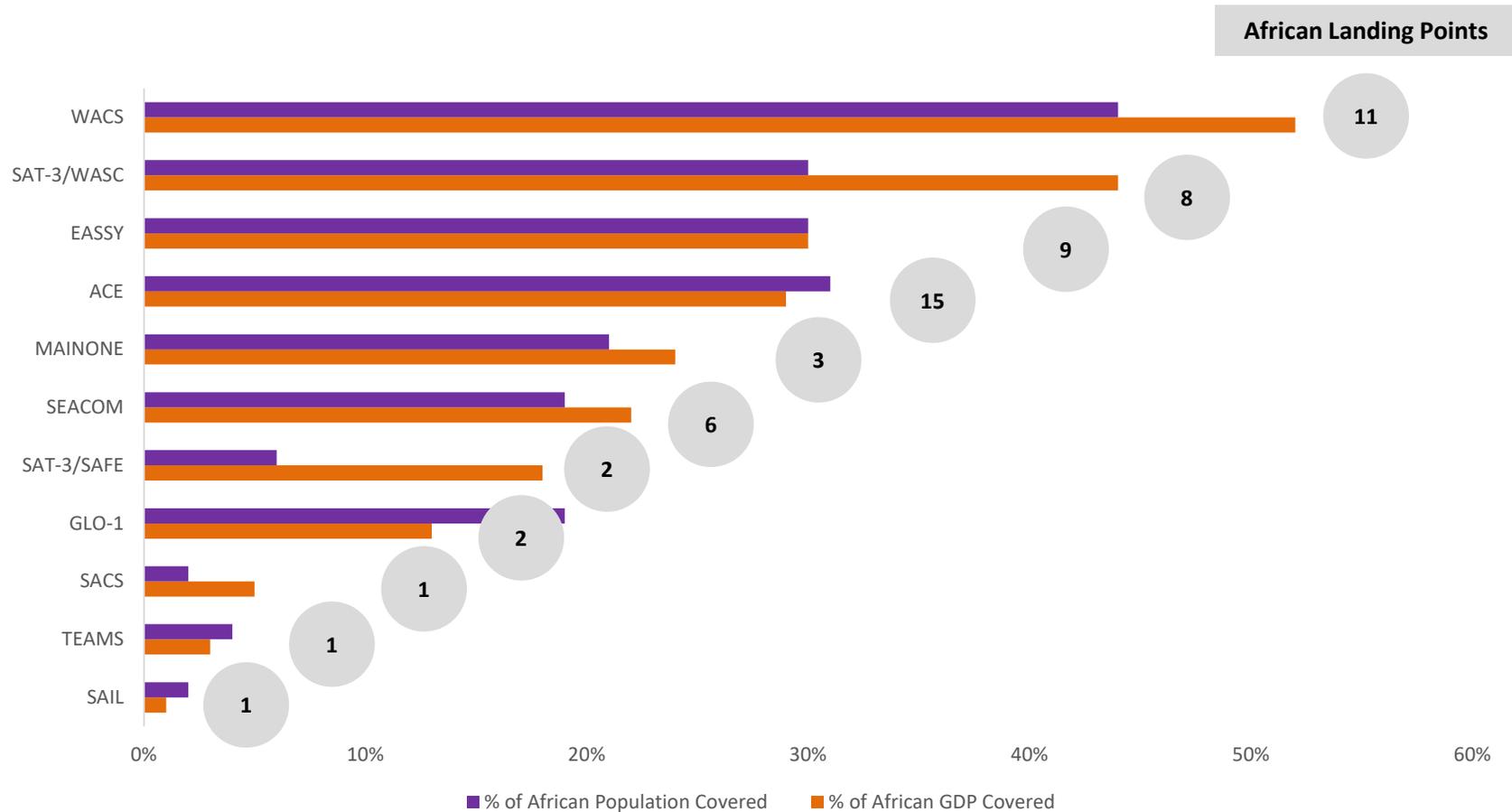
- Djibouti Telecom (DT) has been performing what in our estimation is one of the smartest wholesale plays we’ve seen from an African telco in a long time.** It’s a two level play; 1) build up as many diverse routes from Djibouti to Europe as possible, then 2) pool rising regional demand to feed that onward capacity supply to Europe. That this is coming from a state telco, and with the state’s blessing shows perhaps the importance of a strategy whose underpinnings are likely more than commercial.
- So long as DT can be extremely competitive on Djibouti to Europe pricing and customize its offering to African demand, it will be a tough competitor for international players (for whom the African market is a secondary consideration – at best) and regional players (who lack the onward capability, or if they have it, will find it difficult to compete on price).**
- A critical consideration in making this work will be to improve the sourcing of regional traffic, which is currently being brought in by the likes of Seacom and Eassy.** This is the likely objective of the DARE cable system, a regional project led by DT, in partnership with a number of Somalian telcos, and designed to offer a 60 Tbps subsea connection from Mombasa to Djibouti. Should DT be able to pull this off, the company would emerge as the biggest challenger to the East African capacity business of Eassy, Teams and Seacom.
- This all makes for a solid outlook for DT. Under our capacity projections – and depending on various set of assumptions, Djibouti will emerge as a top-3 holder of African international capacity by 2018.** The only blip, in our estimation, is a below-par retail broadband offering in its home market. Djibouti (where DT holds a monopoly) has one of the lowest broadband penetration among all the markets we examined (~13%), a performance that is surprisingly below the standard that DT’s international performance would lead one to anticipate.

Who Controls
African Internet
Capacity? A Key
Player Chart
Analysis



Africa Submarine Cable Coverage

Proportion of African GDP and Population Directly Covered by Submarine Cables – 2016E



WACS is the only African cable to cover more than half of sub-Saharan Africa's GDP

Most existing and planned cables cover less than 30% of Africa's population and GDP

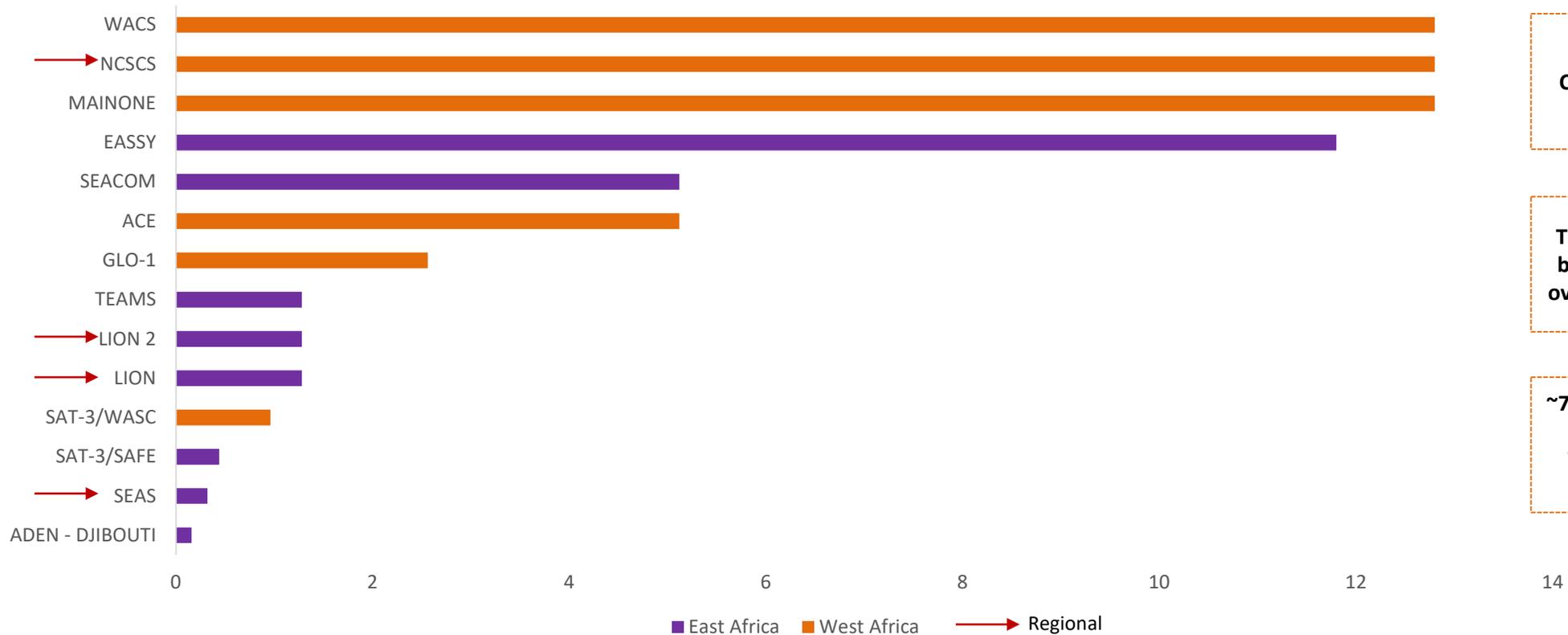
The upcoming SACS and SAIL cables directly cover less than 5% of African GDP

*Based on countries covered by landing station + those that have direct investment in capacity on the system (excl. IRUs and leases); excluding onward resale of capacity to landlocked markets; based on operational landing points as of 2016; Population and GDP based on World Bank data (2012E, total Africa).

Source: Xalam Analytics Estimates

Africa Submarine Cable by Design Capacity - 2016

Africa Submarine Cable by Design Capacity – 2016 - Tbps



The Top 3 Largest Capacity Cables are in West Africa

The Top 4 Cables were built and/or upgraded over the 2014-16 period

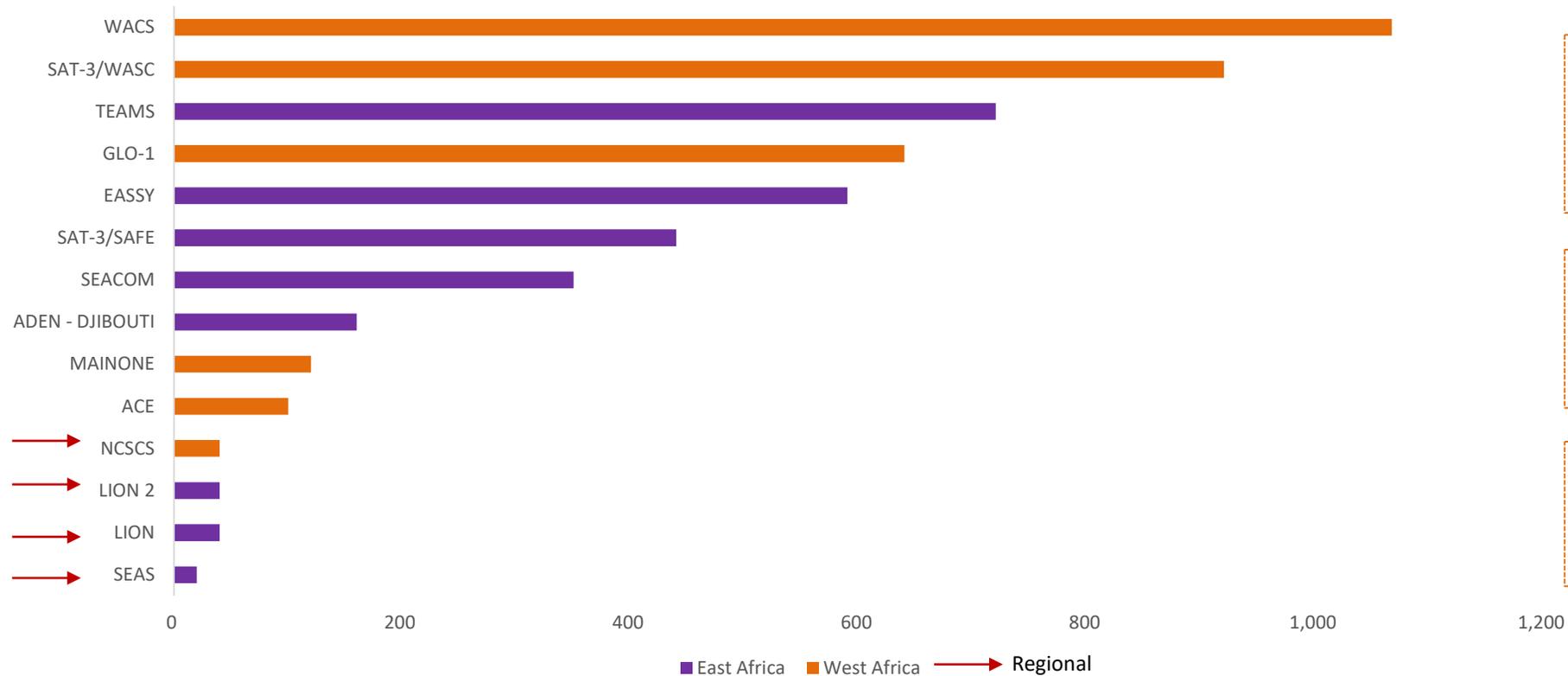
~70 Tbps of Total Design Capacity, ~55Tbps Trans-Oceanic (excl. Regional Cables)

*Submarine cables only; including regional cables, but excluding International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, EIG, AAE-1, etc.). Regional cables both originate and land in an African country.

Source: The Companies, Xalam Analytics Research

Africa Submarine Cable by Lit Capacity – 2016E

Africa Submarine Cable by Lit Capacity – 2016 - Gbps



~5.25 Tbps of Total Equipped Capacity, o/w ~5.1Tbps is Trans-Oceanic

The Venerable SAT-3 (~15 Years) Still Has Africa's Second Largest Equipped Capacity

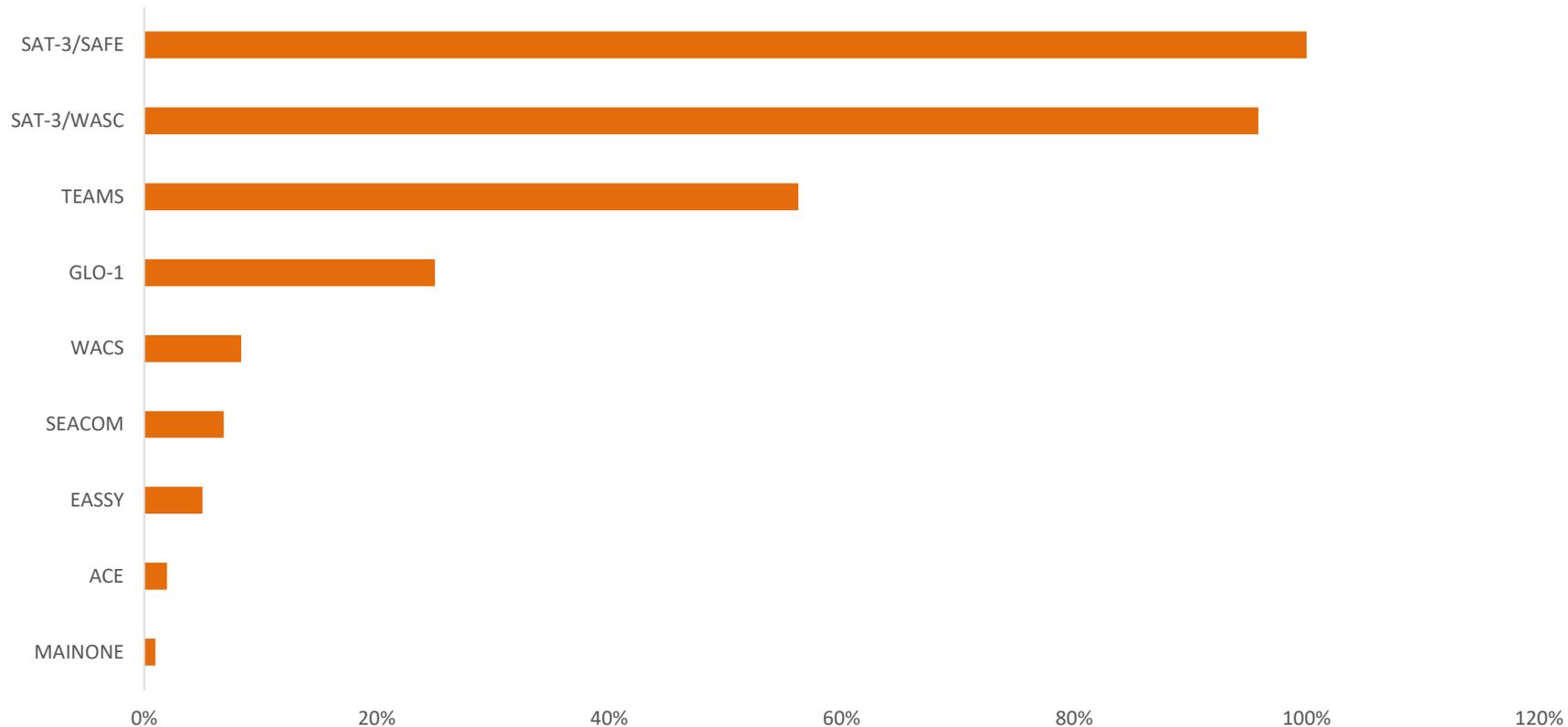
Regional Cables Have the Lowest Lit Capacities

*Submarine cables only; including regional cables, but excluding International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, EIG, AAE-1, etc.). Regional cables both originate and land in an African country.

Source: The Companies, Xalam Analytics Research

Proportion of African Design Capacity that is Lit

Africa Submarine Cables - % of Design Capacity that is Lit – 2016E



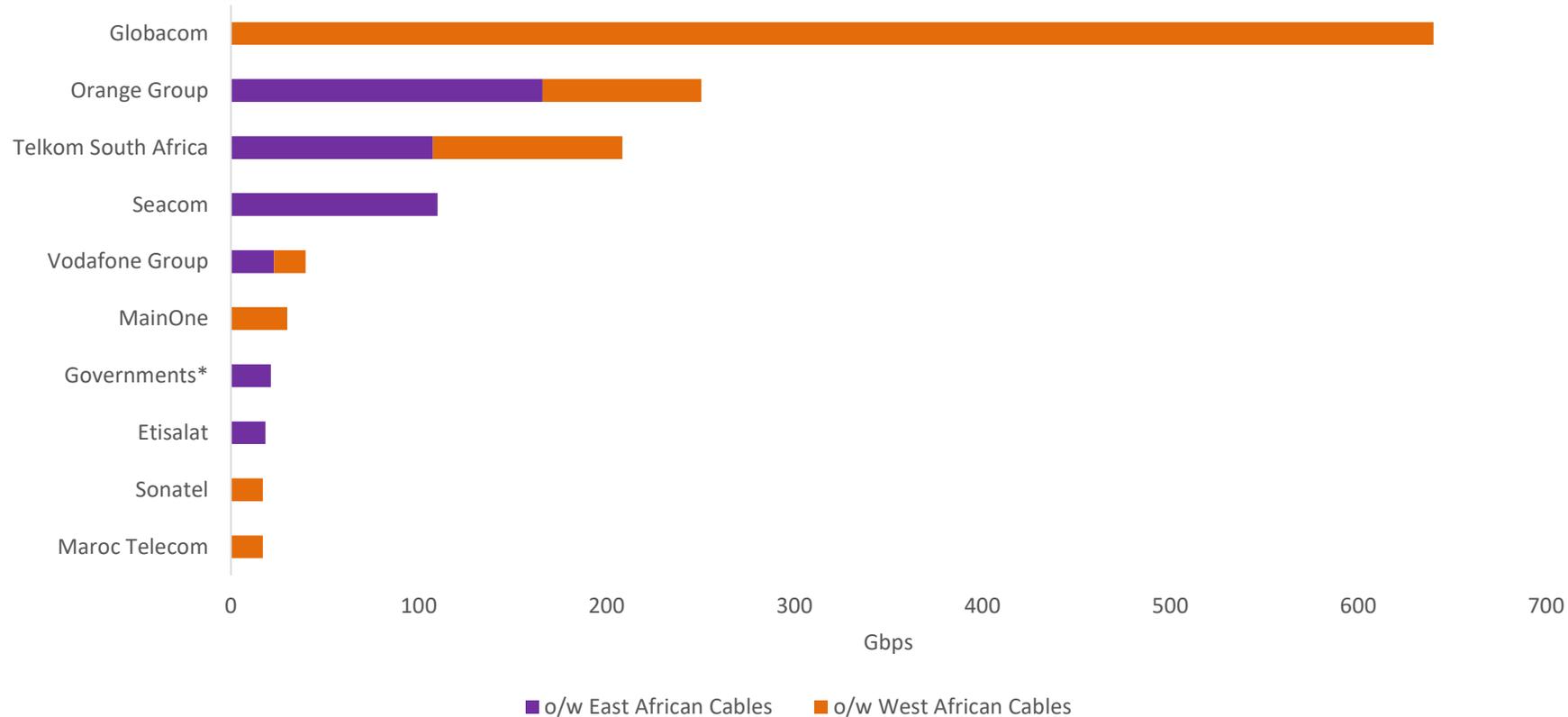
SAT-3 – Fully Lit, Has Likely Maximized its Capacity Capabilities – Approaching End of Life

Other than Glo-1 and TEAMS, all Recent (<~5 Years) Trans-Oceanic Cables Have Lit Less than 10% of their Design Capabilities

Sources: The Companies, Xalam Analytics Research

Who Controls African International Capacity? – A 2010 View

Top 10 of Pan-African Carriers' Ownership of Africa Submarine Cable Lit Capacity – 2010 - Gbps



Globacom Was (and Still is) an Outlier – A Large Capacity Player Focused on 2 Countries Only

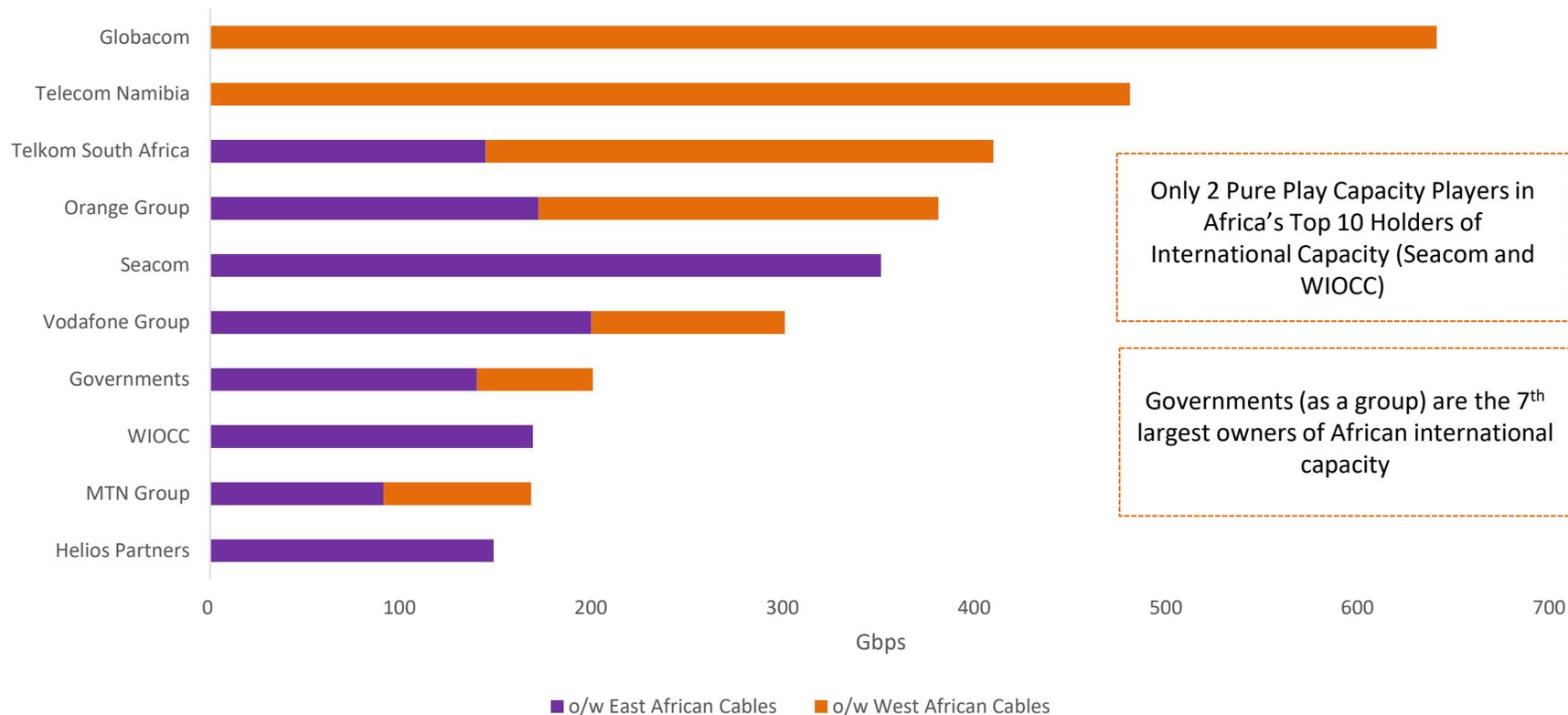
Seacom, Globacom and MainOne Entered the Top 10 in 2010

The Top 10 Players Controlled Around 75% of Africa's Lit Capacity in 2010

*Based on on-net lit capacity only (excluding IRUs and leased assets); Numbers aggregate capacity owned directly and by country subsidiaries; Sonatel considered as a group separate from Orange for the purposes of this chart; Governments refer to capacity held directly (or through non-telco assets) by governments; Submarine cables only; Based on African Trans-oceanic Cables only; Excluding regional and International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, EIG, AAE-1, etc.).
Sources: The Companies, Xalam Analytics Research

Who Controls African International Capacity? – A 2016 View

Top 10 of Pan-African Carriers' Ownership of Africa Submarine Cable Lit Capacity – 2016 - Gbps



Globacom - Large Capacity Holdings – but Not a True Pan-African Wholesale Play (Nigeria and Ghana Only)

Only 2 Pure Play Capacity Players in Africa's Top 10 Holders of International Capacity (Seacom and WIOCC)

Telecom Namibia – Vaulted to Top 3 with Increased Stake in WACS

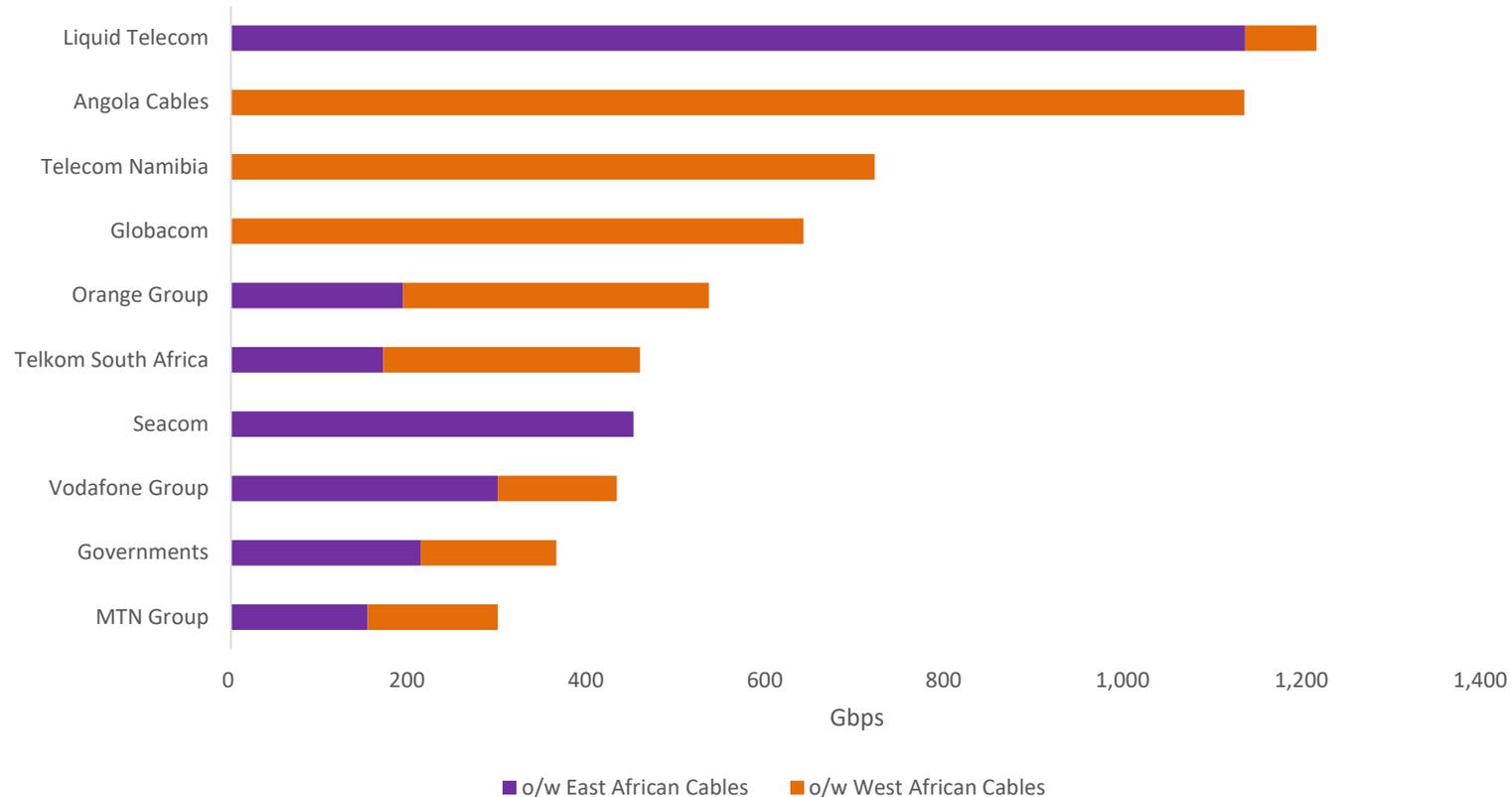
Governments (as a group) are the 7th largest owners of African international capacity

This chart, in our view, highlights the strategic impetus in Liquid Telecom building out its own subsea cable

*Based on on-net lit capacity only (excluding IRUs and leased assets); Numbers aggregate capacity owned directly and by country subsidiaries; Sonatel considered as a group separate from Orange for the purposes of this chart; Governments refer to capacity held directly (or through non-telco assets) by governments; Submarine cables only; Based on African Trans-oceanic Cables only; Excluding regional and International cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-3, EIG, AAE-1, etc.).
Sources: The Companies, Xalam Analytics Research

Who Will Control African International Capacity? A 2020 View

Top 10 of Pan-African Carriers' Ownership of Africa Submarine Cable Lit Capacity – 2020 – Gbps



Rolling out Liquid Sea (along with picking up Neotel's assets) would likely make Liquid the largest holder of African capacity

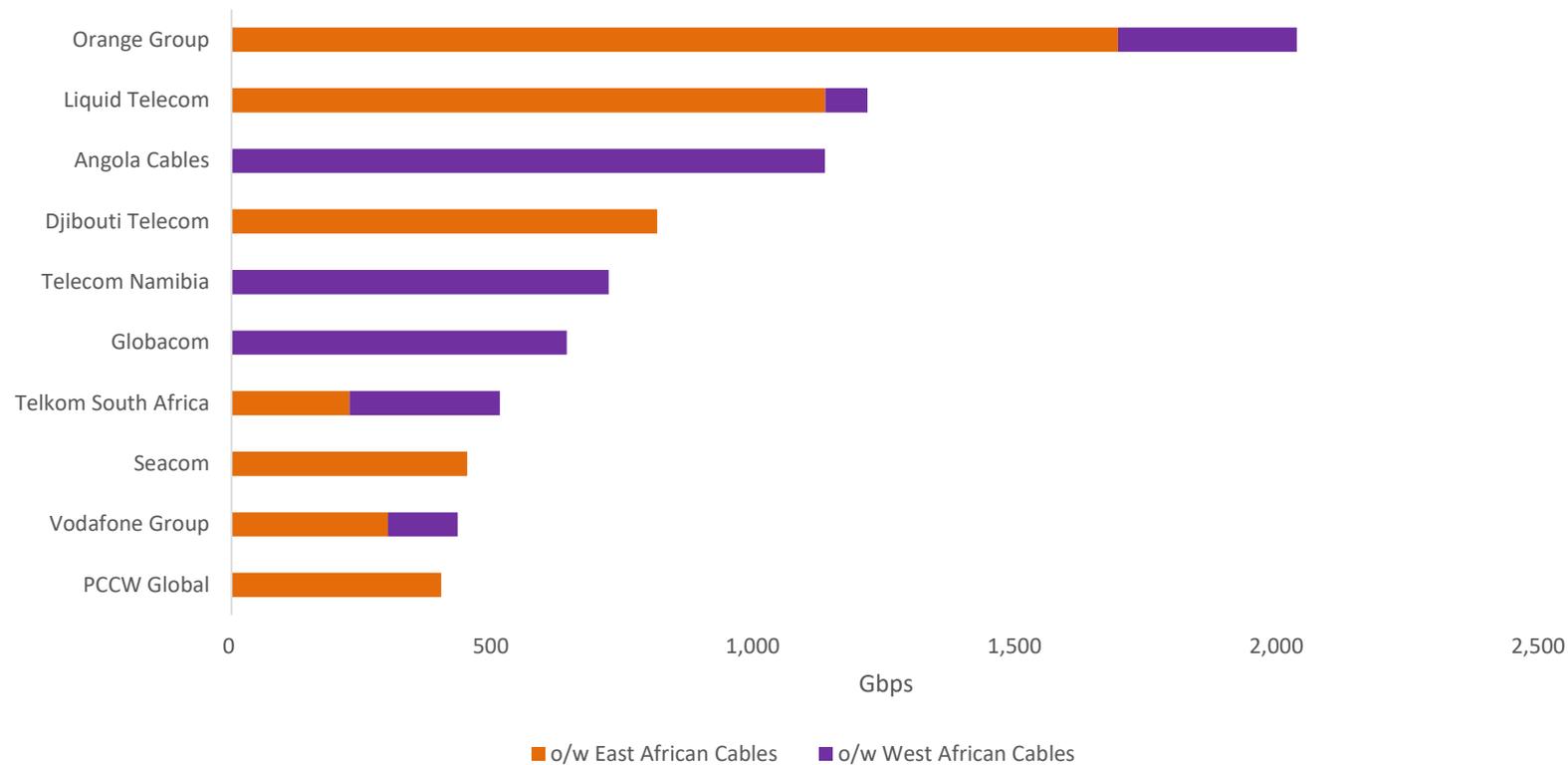
The impact of 100Gbps technology will be notable – 4 of the Top-5 capacity holders will be on 100Gbps systems

African governments are significant holders of African capacity – directly and indirectly

*Projections assume capacity upgrades on existing cables, as well as extension of ACE to South Africa, along with the launch of Liquid Sea (but not Africa-1), with a low lit-to-design ratio. Based on on-net lit capacity only (excluding IRUs and leased assets); Numbers aggregate capacity owned directly and by country subsidiaries; Governments refer to capacity held directly (or through non-telco assets) by governments; Submarine cables only; Based on African Trans-oceanic Cables only, i.e. excluding regional cables, and excluding international cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-5, EIG, AAE-1, etc.). Sources: The Companies, Xalam Analytics Research

Who Will Control African International Capacity? – An Alternate 2020 View

Top 10 of Pan-African Carriers' Ownership of Africa Submarine Cable Lit Capacity – 2020 – Gbps – Including International Cables



3 of Africa's Top 5 will be potential capacity market disrupters

If international cable capacity holdings are included, Orange becomes Africa's largest capacity holder – and by far

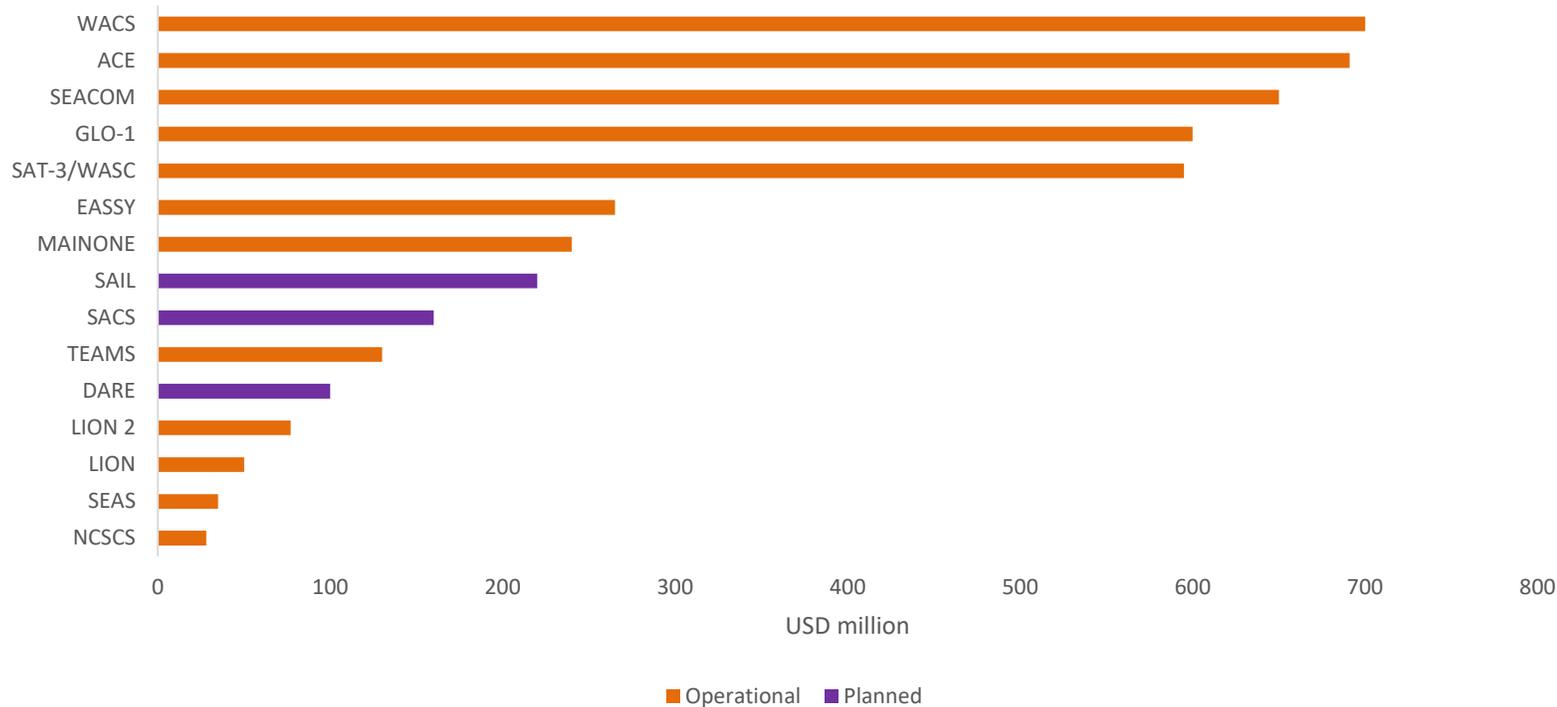
The rise of Djibouti Telecom will be primarily driven by its international cable capacity holdings

*Projections assume capacity upgrades on existing cables, as well as extension of ACE to South Africa, along with the launch of Liquid Sea (but not Africa-1), with a low lit-to-design ratio. Scale of upgrades may be higher or lower than projected, changing the order of the ranking, and/or bringing in other players in the top 10 (e.g. MainOne). Based on on-net lit capacity only (excluding IRUs and leased assets); Numbers aggregate capacity owned directly and by country units; Submarine cables only; this excludes regional cables, but includes international cables – cables passing through an African landing point (typically on the African East Coast), but not dedicated to, nor targeting African markets (e.g. SE-ME-WE-5, EIG, AAE-1, etc.).

Source: The Companies, Xalam Analytics Research

Africa Submarine Cable CapEx - ~\$4bn So Far

Africa Submarine Cable CapEx – As 2016, excl. System Upgrades – USD Million*



~\$4bn spent on African international submarine cable buildout - ~85% of which after 2009 (excl. upgrades)

Another ~\$500m to \$1bn in planned new cables and system upgrades between 2016 and 2020

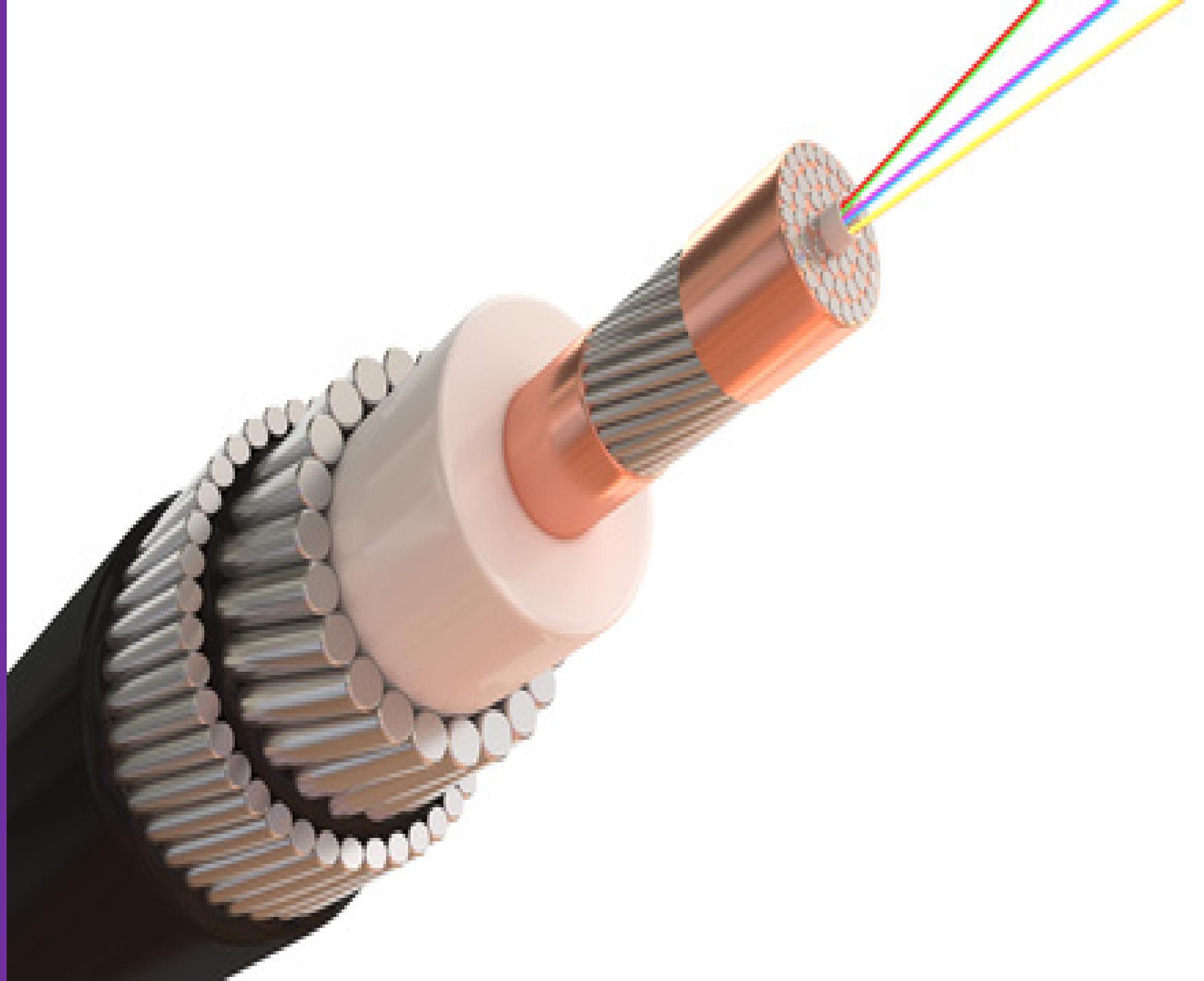
4 of Africa's top 5 most expensive cables are on Africa's West Coast

*Also see Page 26 for Cable CapEx per Gbps per km

"Planned" cables excluding Liquid Sea and Africa-1, for which we have no available estimates; numbers are proximate values; there are inconsistencies on reported SAIL CapEx, which we were not able to resolve by publication time.

Source: The Companies, Xalam Analytics Research

From EASSY to
WACS - Sample
Africa Cable Systems
Snapshot Profiles



Africa Coast to Europe (ACE) – Bringing Connectivity Where There Wasn't Much Before



Sources: Orange – Map as of December 2015

Cable Key Specs (2016)

	Africa Coast to Europe - ACE
Organization Type	PPP Consortium
RFS	2012
CapEx (Initial Only)	~\$690m
Builder	Alcatel Submarine Networks
Length	17,000km (After completion of Phase 2 to South Africa)
Starting & Ending Points	Sao Tome & Principe to Penmarch (France) – Ext. to SA ongoing
Design Capacity (as of 2016)	5.12 Tbps
Capacity per Fibre Pair / Wavelength Technology (as of December 2016)	40 Gbps – Plans to upgrade to 100Gbps
Lit Capacity	~100 Gbps
Largest Individual Capacity Holder	Orange Group
Number of Landing Points	17 (in service); Phase 2 RFS 2017
Number of Members in Consortium	~20 direct shareholders ~52 members including indirect Shareholders
% of African GDP Covered	~30%-35%

Sources: Consortium members, press reports, Xalam Analytics Estimates

ACE – Ownership Structure Has Been Excellent for Penetration, Tough on Upgrades

ACE Cable – A Significant Disrupter of the Leased Capacity Market on the West Coast

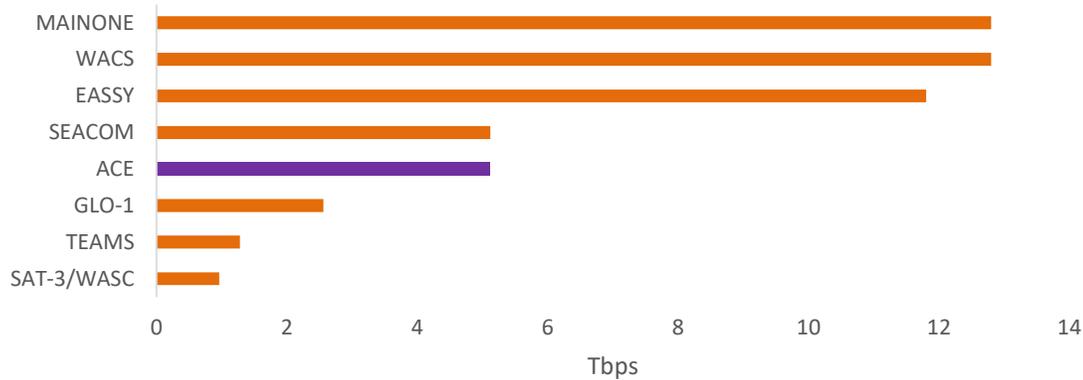
- **The Orange-led ACE cable has been one of the largest cable projects in Africa (only WACS cost more).** It is Africa's largest subsea cable consortium, with more than 50 direct and indirect investors.
- At the time of its launch (2012), the ACE cable offered the largest design capacity in Africa (along with WACS) – it has since been overtaken by a few others as more providers move to 100Gbps wavelength technology.
- **Few African submarine cables have been as impactful;** ACE was the very first direct access to an international cable for 7 of the countries hosting its landing points. It provided first-time subsea redundancy to 4 others, directly impacting Internet access prices.
- **The ACE cable has also been one of the most significant disrupter of the leased capacity market along the West African coast.** Many providers that typically would lease international capacity from third parties were suddenly able to self-provision, with many ending up with more international capacity than they could use.

Wide + Diverse Ownership Base = Limited Flexibility

- **While mostly a benefit, the nature, size and diversity of the ACE consortium also carry the seeds of its weaknesses.**
- The consortium includes about 4 SPVs and 8 governments. **About 20% of the capacity is directly owned by governments, the highest such proportion among sizeable African subsea cable projects.**
- Most of the governments were only able to invest thanks to World Bank funding.
- **In turn, capacity upgrades have been more difficult to execute;** markets at different levels of development, carriers with materially different requirements, slow government decision-making, and at times shareholder disputes within the SPVs as some want to move forward, others do not (or cannot) but do not want to get diluted.
- **Mostly as a result, ACE has one of the lowest lit to design ratio amongst African submarine cables** – but in fairness, this is really only a challenge for upper-tier shareholders who may want to increase capacity but are held back by others.
- An ACE upgrade is highly likely in 2017, coinciding with the launch of the Sao Tome to South Africa Southern leg.

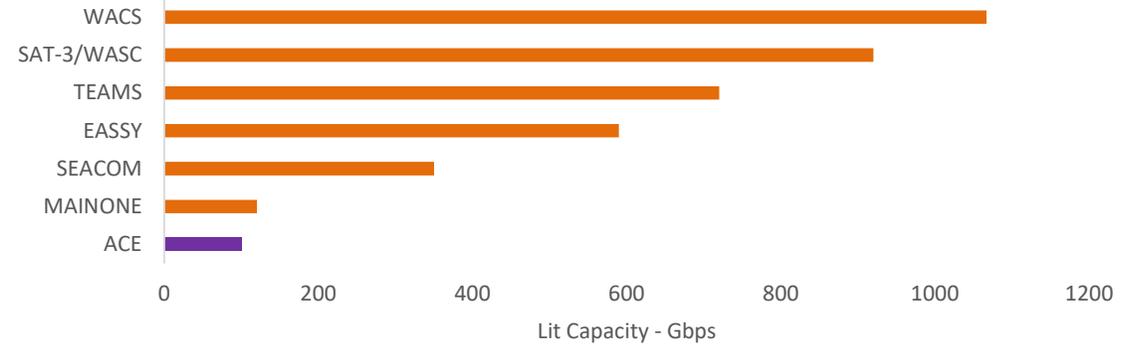
ACE Cable Key Charts – Shareholders Base, Design & Equipped Capacity

Design Capacity: ACE Cable vs. Sample African Cables – 2016



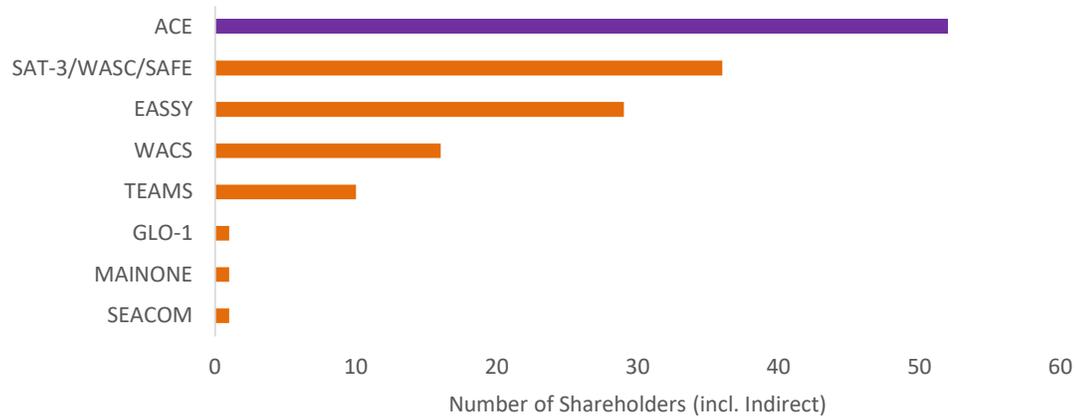
Sources: The companies; Xalam Analytics research.

Lit Capacity: ACE Cable vs. Sample African Cables – 2016



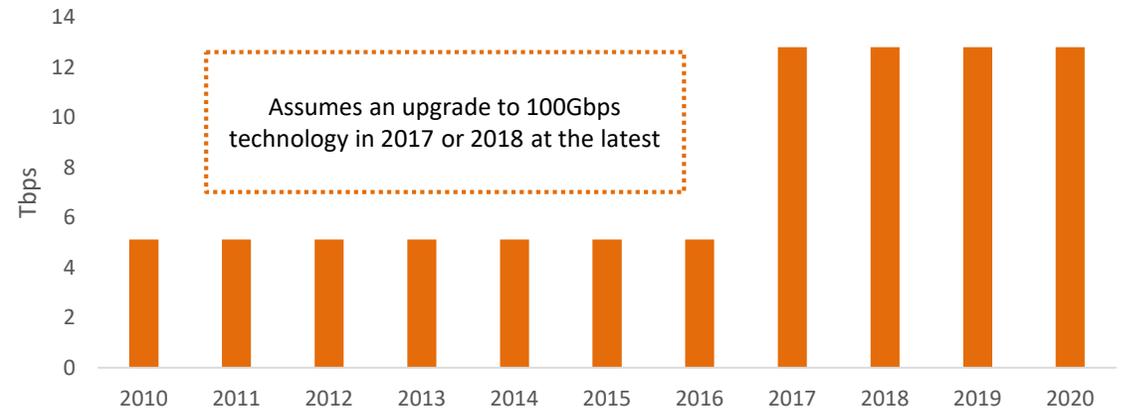
Sources: The companies; Xalam Analytics research.

Shareholder Base: ACE Cable vs. Sample African Cables – 2016



Sources: The companies; Xalam Analytics research.

ACE Cable – Design Capacity Projections



Sources: Projections are Xalam Analytics research estimates; not confirmed nor endorsed by the consortium

ACE – Shareholders and Landing Points

ACE Cable – Key Shareholders (Direct Only)

- Bénin ACE GIE
- Cable Consortium of Liberia Inc.
- Canalink Africa SL
- Côte d'Ivoire Telecom
- Dolphin Telecom JLT
- MEO -Serviços de Comunicações e Multimedia SA
- Gambia Submarine Cable Company Ltd
- Guineenne de la Large Bande SA
- International Mauritania Telecom
- MTN Group
- Orange S.A.
- Orange Cameroun S.A.
- Orange Mali
- Orange Niger S.A.
- Government of Equatorial Guinea
- Government of Cameroon
- SPIN – (Government of Gabon)
- Sierra Leone Cable Ltd
- Sonatel Senegal
- STP Cabo - Sao Tome

Sources: ACE Consortium

ACE Cable – Landing Points

COUNTRY	LANDING POINT	RESPONSIBLE PARTY
Benin	Cotonou	Benin Telecoms
Cameroon	Kribi	Camtel*
Cote-d'Ivoire	Abidjan	Orange Cote-d'Ivoire
Equatorial Guinea	Bata	
France	Penmarch	Orange
Gabon	Libreville	SPIN Gabon
Ghana	Accra	Dolphin Telecom
Guinea	Conakry	GUILAB
Liberia	Monrovia	Cable Consortium
Mauritania	Nouakchott	IMT
Nigeria	Lagos	Dolphin Telecom
Portugal	Lisbon	
Sao Tome & Principe	Santana	STP Cabo
Senegal	Dakar	Sonatel
Sierra Leone	Freetown	Sierra Leone Cable
Spain	Tenerife	
The Gambia	Banjul	GSC
PHASE 2 – RFS 2017		
Angola	Luanda	
DRC	Muanda	
Namibia	Swapkomund	
South Africa	Cape Town	MTN

*Initially Orange Cameroon, but taken over by Cameroon government
Sources: ACE Consortium

West Africa Cable System (WACS) – Africa’s Largest Pure Telco Subsea Cable



Cable Key Specs (2016)

	West Africa Cable System - WACS
Organization Type	Telco Consortium
RFS	2012
CapEx (Initial Only)	~\$700m
Builder	Huawei Marine Networks
Length	14,530 km
Starting & Ending Points	South Africa to Portugal
Design Capacity (as of 2016)	12.80 Tbps**
Capacity per Fibre Pair / Wavelength Technology (as of December 2016)	100 Gbps
Lit Capacity (as of December 2016)	~570 Gbps*
Largest Individual Capacity Holder	Telecom Namibia*
Number of Landing Points	14
Number of Members in Consortium	~13 direct shareholders ~16 members including indirect Shareholders
% of African GDP Covered	~52%

*Xalam estimate

**Other sources suggest 14.5Tbps

Sources: Consortium members, press reports, Xalam Analytics Estimates

Sources: WACS Cable

WACS – A Cable for the West African Telco Elite

WACS Cable – Landing Points

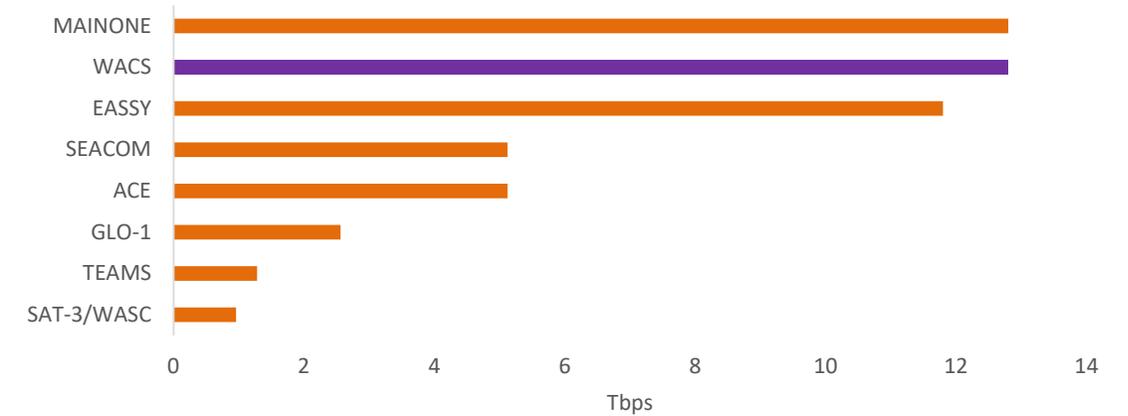
- South Africa
- Namibia
- Angola
- DRC
- Congo-B
- Cameroon
- Nigeria
- Togo
- Ghana
- Cote-d'Ivoire
- Cape Verde
- Canary Islands
- Portugal
- UK

WACS Cable – Key Shareholders (Direct Only)

- Angola Cables
- Broadband Infracore
- Cable & Wireless
- MTN Group
- Portugal Telecom
- Congo Telecom
- Tata Communications
- Telecom Namibia
- Telkom South Africa
- Togo Telecom
- Vodacom South Africa
- Government of DRC
- Government of Cameroon

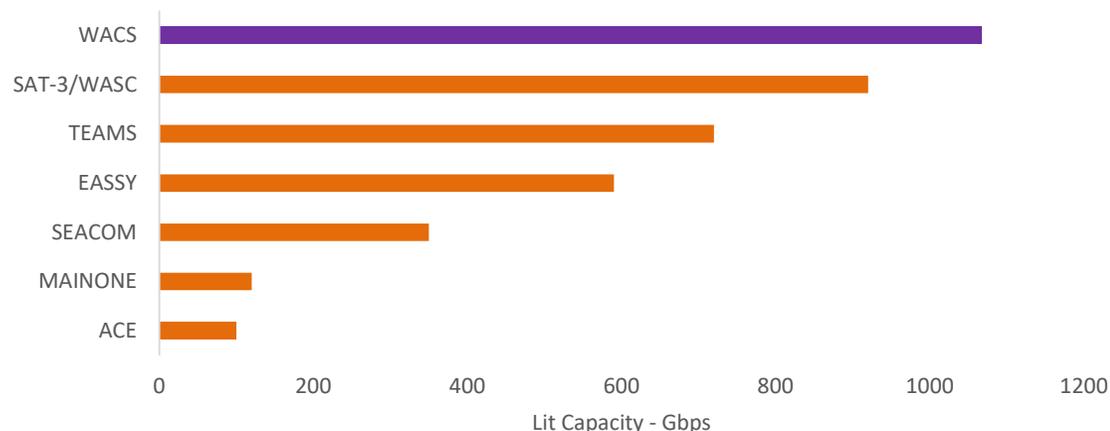
Sources: The companies; Xalam Analytics research.

Design Capacity: WACS Cable vs. Sample African Cables - 2016



WACS – A Cable for the West African Telco Elite

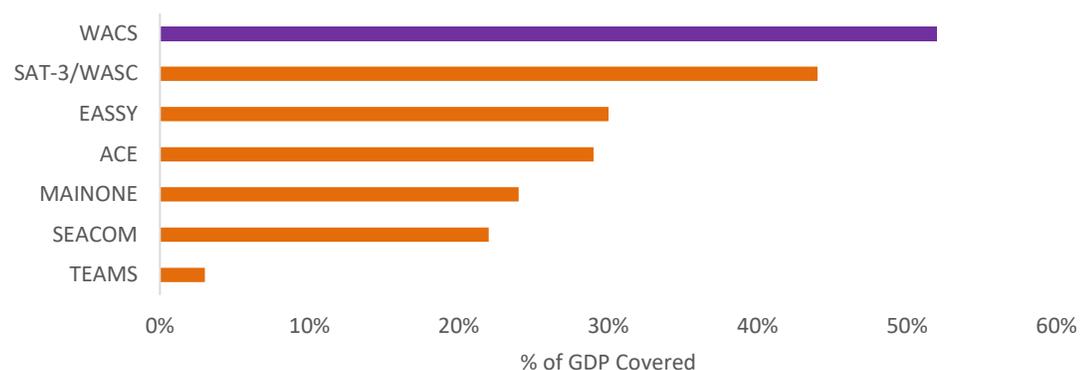
Lit Capacity: WACS Cable vs. Sample African Cables – 2016



Lit Capacity: WACS Cable vs. Sample African Cables – 2016

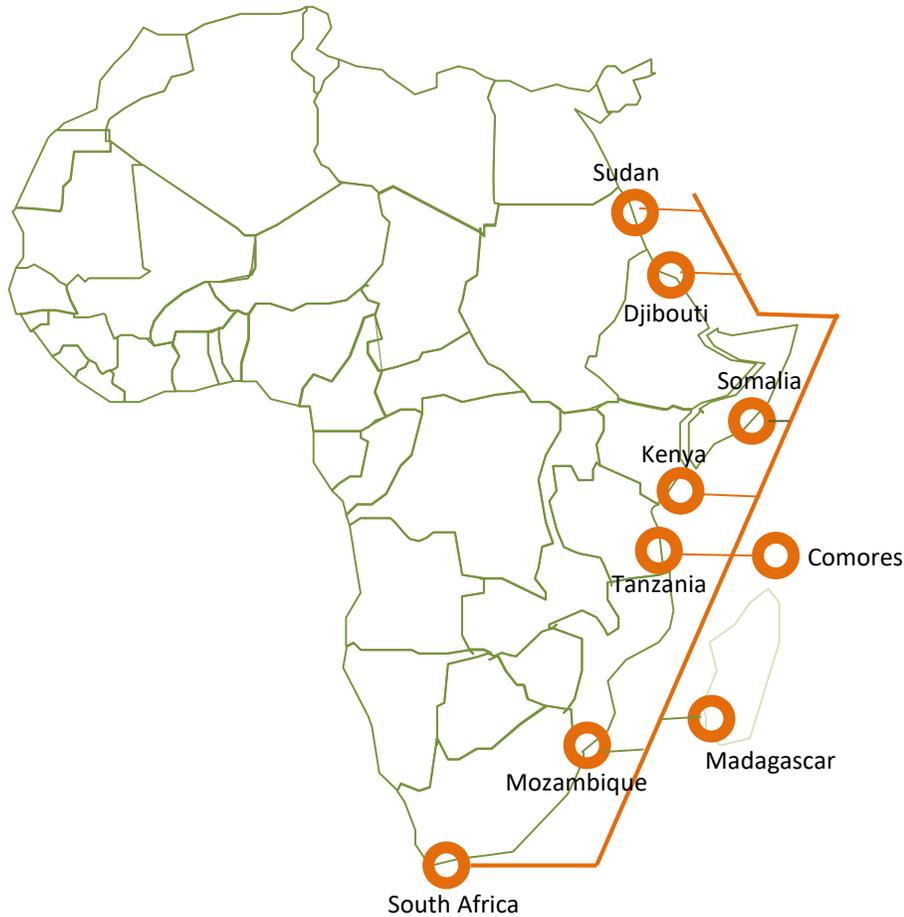
- **The WACS cable boasts Africa’s largest lit capacity, with slightly more than 1Tbps**, ahead of SAT-3. Already among the largest, the WACS cable was upgraded in 2015 from 40Gbps technology to 100Gbps technology.
- **The WACS cable’s coverage is the best in Africa**, with the cable landing in markets that represent about 55% of Africa’s GDP and around half of the continent’s population.
- **The WACS cable was built primarily for self-provisioning purposes**, by players such as MTN and Vodafone seeking to escape their dependency on the venerable but state telco-dominated SAT-3. Today, it is the primary West African cable for several of Africa’s largest broadband retail providers, outside of Orange Group (which primarily uses ACE and SAT-3).
- **WACS is also critical to the Southern Africa region**, with providers in Zimbabwe, Zambia or Botswana accessing primary or redundant capacity through South Africa and Namibia.
- **An intriguing evolution in the structure of the cable has been the role of Telecom Namibia.** Looking well beyond its own country international capacity requirements – which are fairly small, less than 30 Gbps in 2016- the company has emerged as the largest holder of capacity in WACS, with between 40% and 45% of the cable’s available capacity, part of a strategy to build a southern African capacity hub business.
- Another notable in this consortium is the addition of the government of Cameroon, which imposed itself in the structure as a condition for allowing the cable to land. We explore Cameroon’s international capacity strategy elsewhere in this report.
- **Overall, this is the African system (other than EASSY) most likely to continuously add capacity over the next five years**, due to the profile of its shareholders and their high capacity requirements.

Coverage of African GDP: WACS Cable vs. Sample African Cables - 2016



Sources: The companies; Xalam Analytics research.

The Eastern Africa Submarine Cable System (EASSY)



Cable Key Specs (2016)

	Eastern Africa Submarine Cable System - EASSY
Organization Type	PPP Consortium
RFS	2010
CapEx (Initial Only)	~\$265m
Builder	Alcatel Submarine Networks
Length	10,800 km
Starting & Ending Points	South Africa to Djibouti and Sudan
Design Capacity (as of 2016)	11.80 Tbps*
Capacity per Fibre Pair / Wavelength Technology (as of December 2016)	100 Gbps
Lit Capacity (as of December 2016)	~590 Gbps*
Largest Individual Capacity Holders	WIOCC, MTN
Number of Landing Points	9
Number of Members in Consortium	~16 direct shareholders ~29 members including indirect Shareholders
% of African GDP Covered	~35%

*Xalam Analytics estimate

Sources: Consortium members, press reports, Xalam Analytics Estimates

Sources: Eassy Cable

EASSY – A Broad Ownership Base

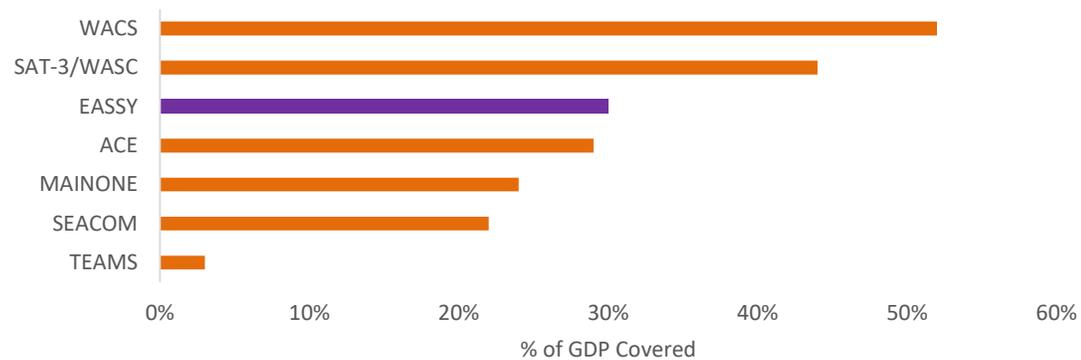
EASSY Cable – Key Shareholders (Direct)

- Bharti Airtel
- BoFiNet Botswana
- British Telecom - BTGNS
- Comores Telecom
- Etisalat
- Orange Group
- Mauritius Telecom
- MTN
- Neotel
- STC
- SPV 2 - Telkom SA / Vodacom SA
- Sudatel
- TTCL
- Telma
- WIOCC (largest with 28%)

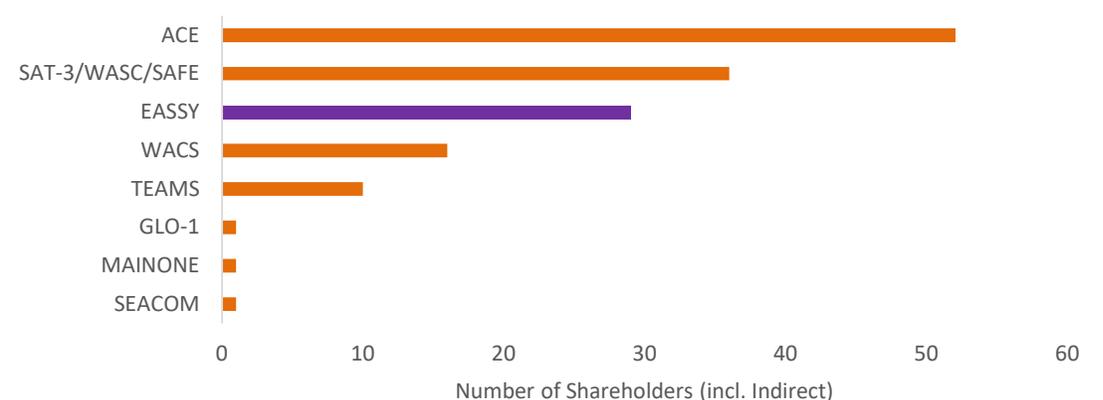
EASSY Cable Indirect Shareholders (Through WIOCC)

- Zantel Zambia
- BoFiNet Botswana
- UCOM Burundi
- Onatel Burundi
- Djibouti Telecom
- Orange Kenya
- Lesotho LTA
- Libya LPTC
- TDM Mozambique
- Gilat Satcom Nigeria
- Seychelles Cable System Company
- Dalkom Somalia
- Uganda telecom
- Tel-One Zim
- Zantel

Coverage of African GDP: EASSY Cable vs. Sample African Cables - 2016



Shareholder Base: EASSY Cable vs. Sample African Cables – 2016



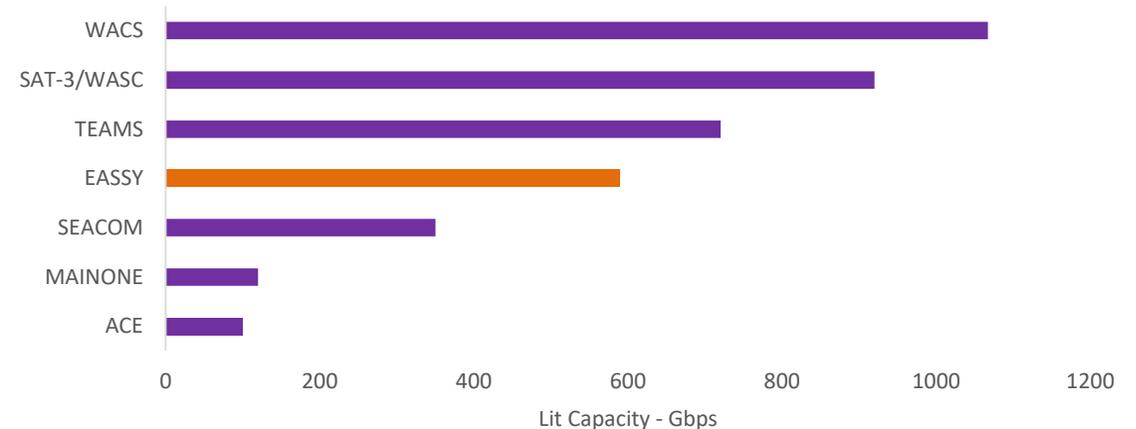
Sources: The companies, Xalam Analytics Research

EASSY – The Largest (Non-Kenyan) Cable in East Africa – and Arguably the Most Dynamic

The Primary Challenger to Seacom

- **Eassy is the largest cable along East Africa’s coastline;** it has the highest design capacity in the region (~11.80Tbps) and its lit equipped capacity is second only to that of the Kenya-focused TEAMS cable (as of 2016). Eassy is the primary challenger to the Seacom private cable, and a key factor behind the sharp uptick in connectivity in the region over the past six years.
- The cable is a reference system for service providers in the region. At least 25 providers are connected to it through consortium membership and more through IRUs and capacity leases. **By our estimates, at least half of the Internet service providers on Africa’s East Coast and in neighboring landlocked countries (South of Kenya and North of South Africa) get their primary or redundant international capacity from the Eassy cable.**
- As a PPP consortium, Eassy faces challenges that are relatively similar to those faced by the West African ACE cable. **But Eassy has been more nimble and more reactive to market change.** The consortium has upgraded its equipped capacity at least twice over the past six years and was the first large scale African subsea cable to move to 100 Gbps wavelength technology.
- This is likely due to its structure, at the heart of which is a wholesale-focused vehicle, WIOCC, the consortium’s largest shareholder. **WIOCC’s presence has been dynamic, bringing an atypical (for these parts) commercial, open-access focus on capacity sales** – often in direct competition with other members of the broader EASSY consortium.

Lit Capacity: EASSY Cable vs. Sample African Cables – 2016



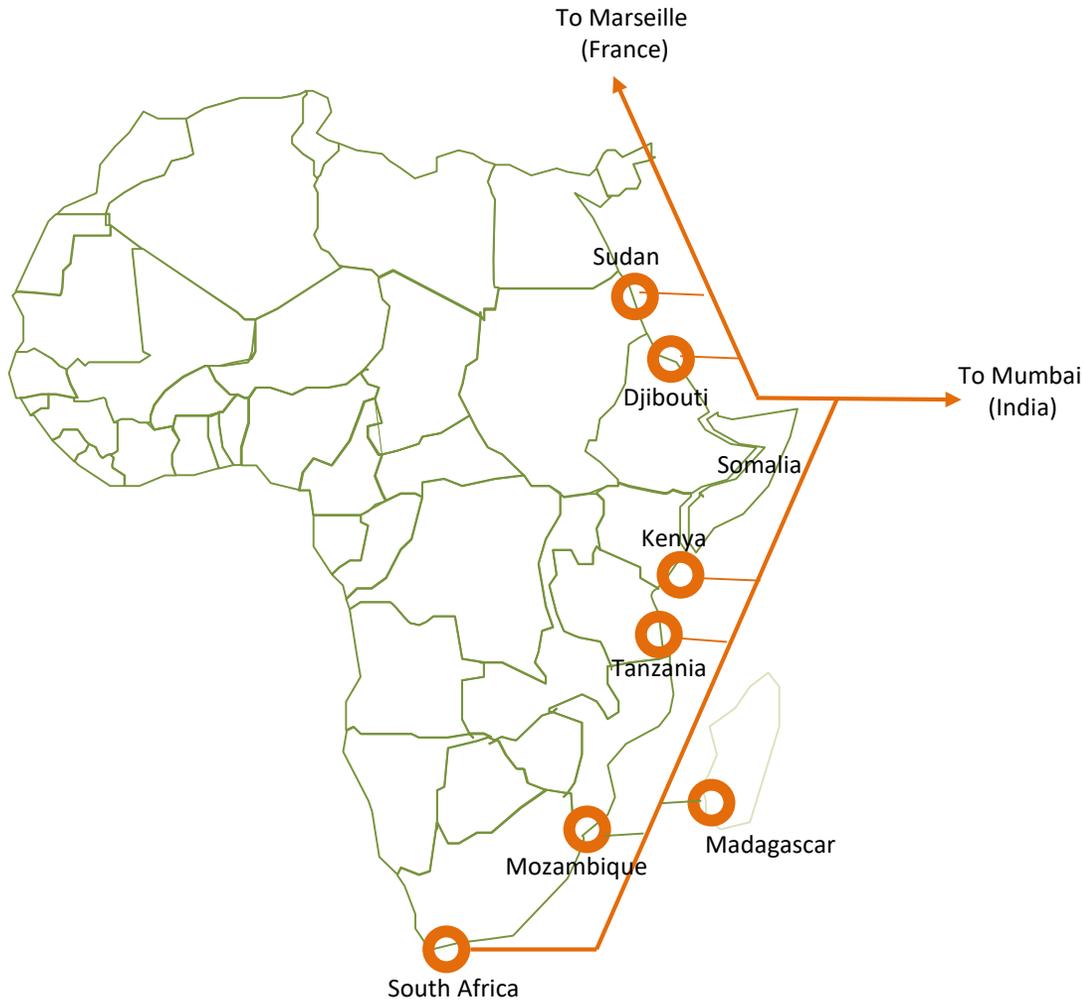
Sources: The companies; Xalam Analytics research.

Lit Capacity: EASSY Cable vs. Sample African Cables – 2016

- The company has extended its reach beyond its own subsea network, leveraging terrestrial networks from its shareholders and IRUs on other systems to cobble together one of the most extensive IP capacity wholesale offerings available in the Southern and East African regions.
- **Its primary downside, in our estimation, has been a trans-oceanic reach that ends in Djibouti*;** from there, customers have to pick up onward connectivity through other cable systems to Europe or Asia (which Eassy facilitates and can itself provide).

*Eassy really ends in Port Sudan (Sudan), but most customers pick up onward connectivity from better-connected Djibouti.

Seacom – The Pioneer Subsea Cable Disrupter



Cable Key Specs (2016)

	SEACOM
Organization Type	Private
RFS	2009
CapEx (Initial Only)	~\$650m
Builder	TE Subcom
Length	17000 km
Starting & Ending Points	South Africa to France (Marseille)
Design Capacity (as of 2016)	5.12 Tbps*
Capacity per Fibre Pair / Wavelength Technology (as of December 2016)	40 Gbps
Lit Capacity (as of December 2016)	~350 Gbps*
Largest Individual Capacity Holders	NA
Number of Landing Points	7
Number of Members in Consortium	NA
% of African GDP Covered	~25%

*Xalam Analytics estimate
Sources: Seacom, Press reports, Xalam Analytics Estimates

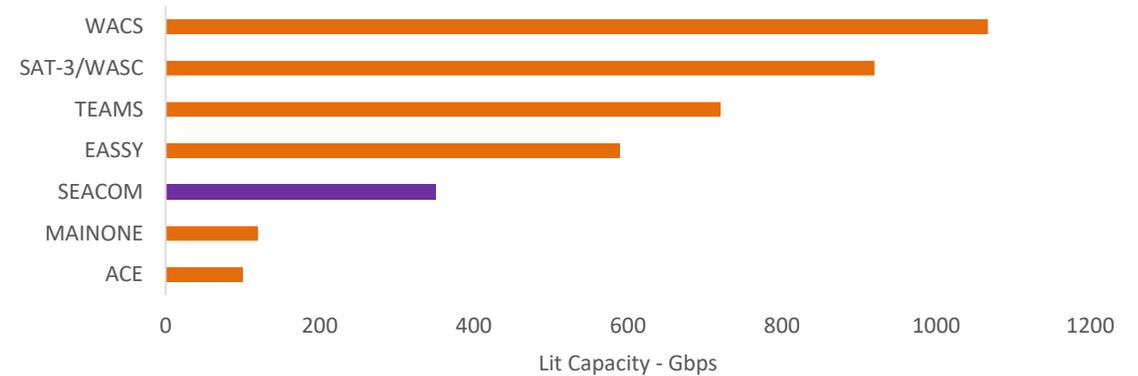
Source: seacom.mu

Seacom – A South African Focus, and the Need to Evolve its Model

SEACOM - When Fibre Economics Matter

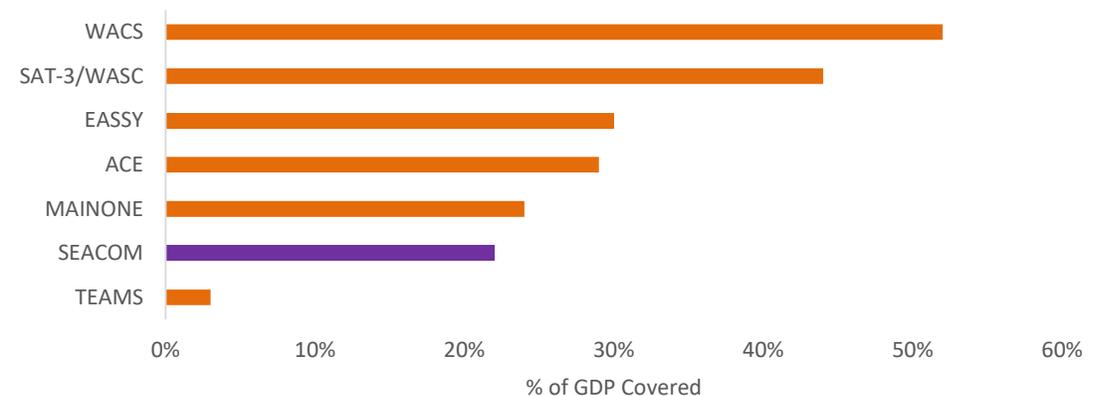
- **Seacom was Africa’s first fully-private submarine cable system, the first disrupter to the established SAT-3 cable in the South African market.** The company built substantial share and goodwill in its initial years, bringing much-needed competition to SAT-3 in South Africa, but also connecting markets on the African East Coast that up to that point, relied primarily on satellite.
- Over the past few years, Seacom’s position has been challenged by Eassy – the two cables are the primary systems for the “non-elite” – mostly alternative telcos and ISPs with limited cash to invest directly in cable system ownership. **They are also South Africa’s most commercially-driven cables, with a near-existential impact on South Africa’s Internet infrastructure.**
- **Few African wholesale capacity players understand the need and challenge of transforming their model as much as Seacom.** As a fully private player -with shareholders that include equity management funds- profitability, payback periods and returns matter. This means that the company is more vulnerable than most to the continuous erosion of value in the international capacity market as described in this report.
- Seacom revenue and profitability data is not available (nor is EASSY’s); we make a rough estimate of revenue between \$75m and \$125m based on available shareholder data. The company is EBITDA positive.
- **Seacom has been taking steps to evolve its model,** most notably targeted investments in terrestrial infrastructure and a push into the enterprise business. Over time, however, its outlook will likely have to include mergers and acquisitions*.

Lit Capacity: SEACOM Cable vs. Sample African Cables – 2016



Sources: The companies; Xalam Analytics research.

Coverage of African GDP: SEACOM Cable vs. Sample African Cables - 2016



Sources: The companies; Xalam Analytics research.

*We developed a more elaborate view of Seacom and MainOne’s strategic position in a separate report - The African Fiberco “Big Three”: a Strategic Analysis Of Seacom, Mainone And Liquid Telecom & The Case For Africa Fiber Consolidation – January 2016

Other African Cable Systems – A Summary

Cable Systems	RFS	Lit Capacity (est. as of 2016)	Starting & Ending Points	Primary Target Markets	Organization Type	Largest Individual Capacity Holder	Summary Observations
GLO-1	2010	~640 Gbps	Nigeria to Portugal	Nigeria, Ghana	Private Telco	Globacom Nigeria	Has the third largest equipped capacity in Africa; still largely opaque, its primary focus has been on the Nigerian market. Mostly built for Globacom self-provisioning, ultimate impact has been less notable than had been anticipated at launch.
MAINONE	2010	~120 Gbps	Nigeria to Portugal	Nigeria, Ghana, Cameroon, with secondary focus on ECOWAS region (Benin, Burkina Faso)	Private	MainOne	West Africa's pre-eminent fully private subsea system; of all the West African cables, MainOne has had arguably the most significant impact to date in the Nigerian capacity market; exposure to Nigeria remains a challenge, but company has sustained performance by adapting strategically; geographically across the West African region, and by expanding business lines to include data center colocation services, metro fibre and cloud services.
SAT-3/WASC	2002	~920 Gbps	South Africa to Portugal	West Africa coastline	Telco Consortium	Telkom SA	Africa's longstanding, venerable cable; over the 2002-2010 period, a symbol of all the excesses in African bandwidth rationing. Facing new competition, SAT-3 has been surprisingly resilient; still the primary source of capacity in more than half of the West African markets where it lands. Approaching end of life.
TEAMS	~1250 Gbps		Kenya to UAE	Kenya	Telco & Government consortium (PPP)	Safaricom Kenya	Kenya's primary source of international capacity; primarily a self-provisioning cable; nearly all of Kenya's main service providers are shareholders, helping tamp down the leased capacity market; main downside is ending point in the UAE, which is less competitive for onward connectivity pricing vs. Djibouti (EASSY) or SEACOM (direct connectivity to Europe).

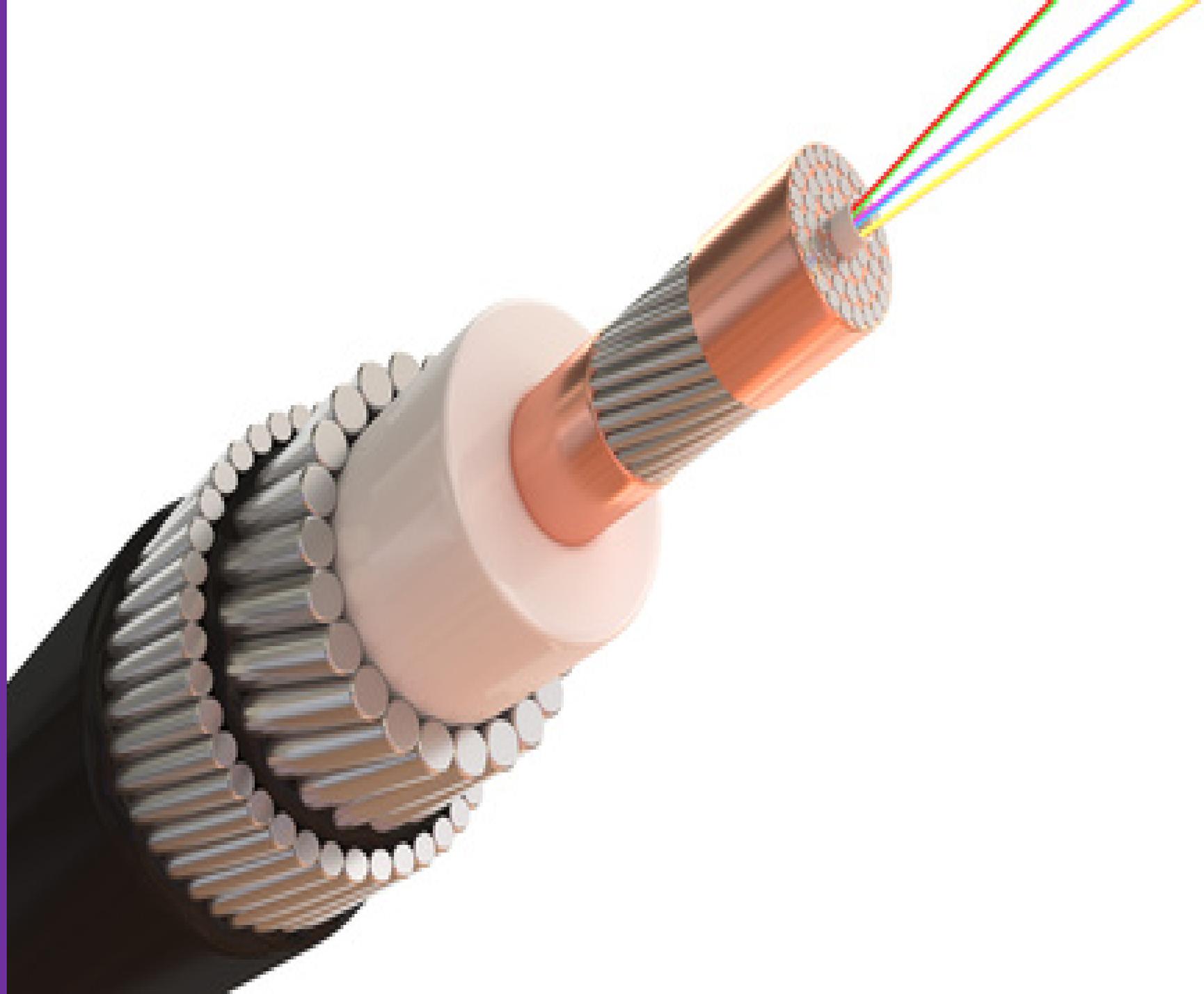
Sources: The companies; Xalam Analytics research.

Other African Cable Projects – Whatever Happened to SAEx, WASACE, Africa-1?

Cable Systems	Proposed RFS	Organization Type	Project Lead Promoter	What was the Plan?	Verdict/Probability
SAEx	~2015-2016	Private	eFive Telecoms	Initially announced in 2011 by South African firm eFive Telecoms, and later Simplcom; initial plan was to connect South Africa and Brazil, with landing points in Namibia and Brazil. Project has faced material funding challenges; Telecom Namibia has moved forward to increase its investment in WACS, and SAIL and SACS project now make SAEx largely moot.	Dead
WASACE	~2014	Private	WASACE Cable Company	Ambitious plan announced in 2011, including links between Nigeria and South Africa, South Africa and Brazil, and Brazil to North America. Gradually phased out in the face of funding challenges. As with SAEx, initial footprint largely being executed by Angola Cables' SACS and MONET projects.	Dead
Africa-1	2018-19	Telco Consortium	PCCW Global	MoU initially announced in April 2016, including PCCW Global, STC, Telkom SA, MTN; some of the proposed stakeholders later played down their participation, and most have since gone silent on the project. Still under evaluation, but new cables will complicate the business case further.	Alive, but uncertain
Liquid Sea	2018-19	Private	Liquid Telecom	Initially announced in late 2015 by Liquid Telecom; 100Gbps-wavelength cable to run on the African East Coast. Liquid Telecom has since gone relatively silent since, but strategically, few African telcos need their own international cable as much – which is why we believe Liquid Sea is still more likely than not. The forecasts developed for the purposes of this report assume that at least one of Liquid Sea or Africa-1 will be available by 2019.	Likely

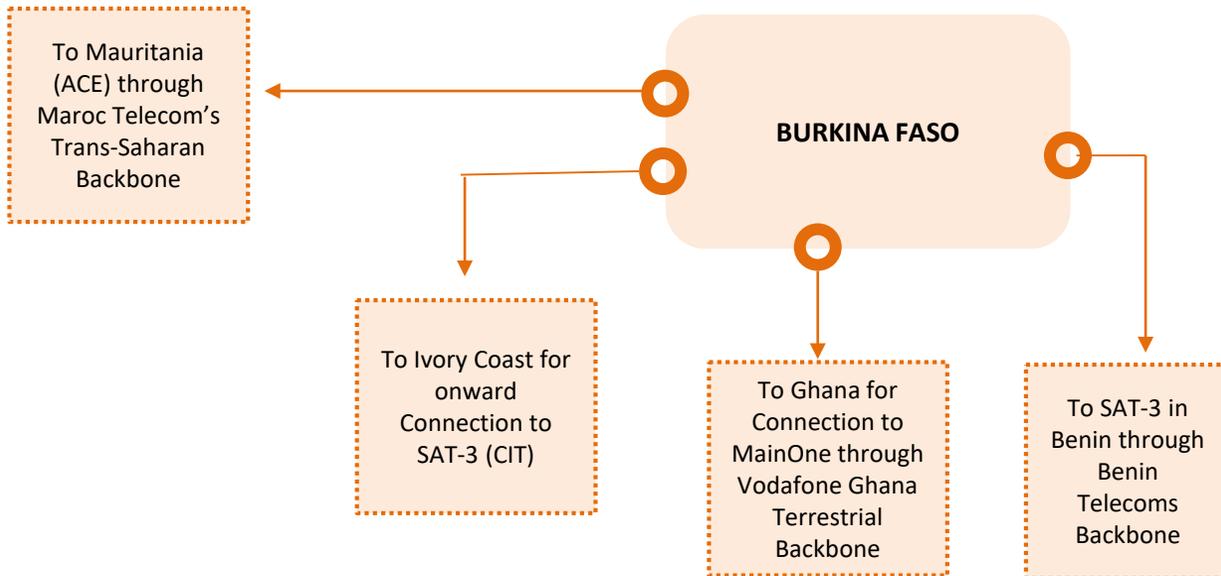
Sources: Press reports; Xalam Analytics research.

From Burkina to
Zimbabwe - Country
International
Capacity Snapshot
Profiles



International Capacity Country Snapshot: Burkina Faso

Burkina Faso – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- Burkina Faso has a substantial bandwidth deficit - broadband potential has long been hampered by its landlocked status, and high transit cross-connect prices in West Africa
- Onatel – Burkina’s main gateway carrier- has long been dependent on connections to the SAT-3 cable, through the Ivory Coast and Benin
- Primary international connections through SAT-3 (Ivory Coast) and MainOne cable in Ghana
- Pan-African player strategies are impacting capacity market – Onatel owner Maroc Telecom will shift a portion of its capacity to its newly built Trans-Saharan terrestrial backbone
- The acquisition of Airtel BF by Orange will likely shift the new acquisition’s traffic to Cote-d’Ivoire primarily
- We’re projecting the country’s international capacity to grow ~2x-3x by 2020 – but much of it of the on-net variety

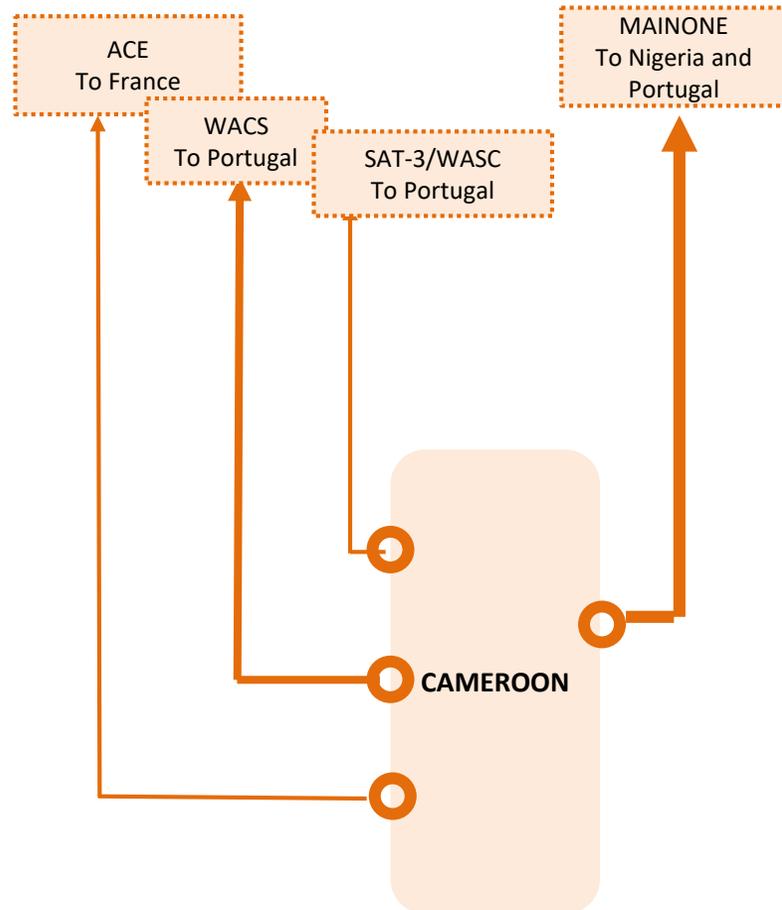
Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	NA - Landlocked	NA
Country Broadband Penetration	~6%	20th
International Capacity Supply (Gbps)*	~8 Gbps	20th
International Capacity per BB Connection*	~7 (Kbps)	15th
Bandwidth Demand vs. Supply Context	Bandwidth Deficit	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

International Capacity Country Snapshot: Cameroon

Cameroon – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- **The largest economy and largest telecoms market in Central Africa**
- **Excellent bandwidth supply** – Access to four separate international cables, average bandwidth per connection is in Africa’s top 10**
- **Market structure is the primary impediment to more dynamic growth** – the wholesale capacity market is a monopoly of state-owned Camtel (see our analysis in the Disrupter Analysis” section of this report)
- **Very low utilization** - Actual leased capacity is less than 3% of available/equipped bandwidth
- **Direct market impact** – Cameroon is a market where average FTTH is < 2Mbps
- **New cable planned (SAIL) should bring more capacity** – without material effect on the domestic market
- **Overall outlook is mixed; strong increase in available capacity, but quality of Internet will lag**

Country International Bandwidth Indicators

	Indicator (2016 E)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	4	NA
Country Broadband Penetration	~21%	12th
International Capacity Supply (Gbps)*	~100 Gbps	5th
International Capacity per BB Connection*	~21 (Kbps)**	7 th **
Bandwidth Demand vs. Supply Context	Bandwidth Rationing	NA

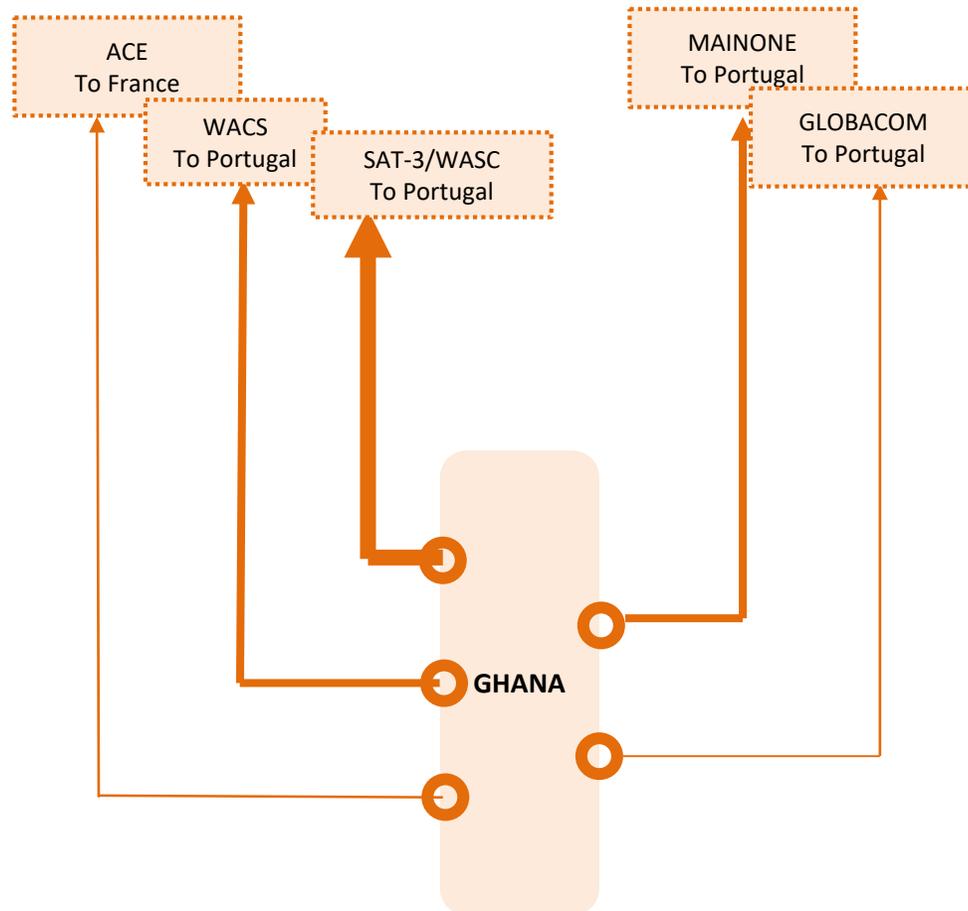
*International lit bandwidth owned and leased by local providers and allocated to the market

**Ratio is misleading (based on capacity owned); if based on capacity used/leased, Cameroon’s ratio is ~2kbps, in the bottom quartile of our sample.

Source: Xalam Analytics research.

International Capacity Country Snapshot: Ghana

Ghana – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- Arguably the most dynamic wholesale capacity market in West Africa – even more so than Nigeria
- Five international cables in active contribution – have contributed to bringing down average international capacity prices to the lowest level in West Africa (on par with Senegal)
- Rollout of Google Project link in the metro has boosted demand for international capacity
- One of the few African markets to have a reliably robust leased capacity market – altnets and lower-tier mobile players control ~30% of retail broadband
- Excellent outlook – projected capacity in the 120Gbps-150Gbps range by 2020; leased proportion higher than African median.

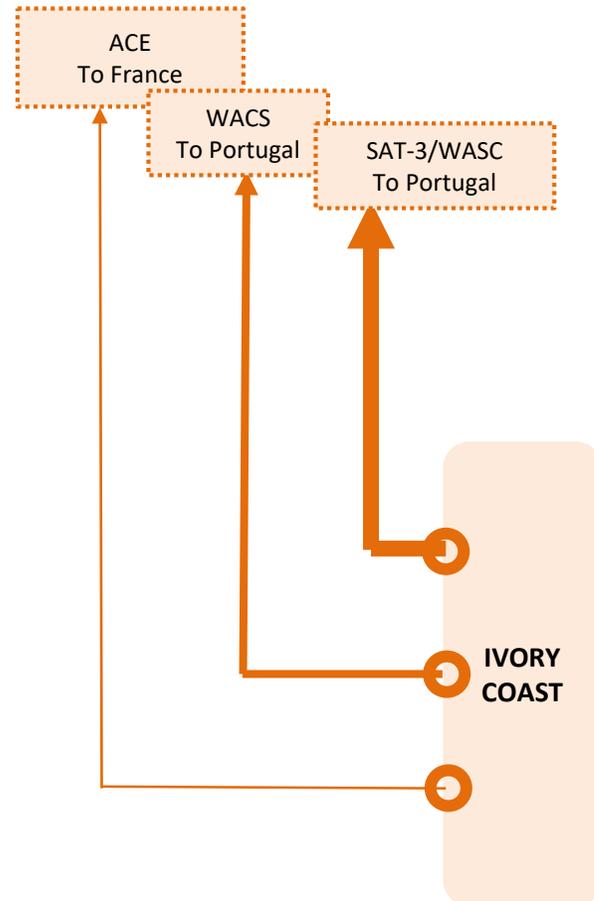
Country International Bandwidth Indicators

	Indicator (2016 E)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	5	NA
Country Broadband Penetration	~22%	10th
International Capacity Supply (Gbps)*	~95 Gbps	6th
International Capacity per BB Connection*	~11 (Kbps)	13th
Bandwidth Demand vs. Supply Context	Bandwidth Oversupply	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

International Capacity Country Snapshot: Ivory Coast

Ivory Coast – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- **French-speaking West Africa’s largest economy** – but not quite its largest BB market in terms of connections
- **Three main international cables**, on which the market’s two largest players (Orange and MTN) have direct ownership and resell capacity
- **A relatively constrained market still** – demand potential under optimal conditions is higher than current usage – but market structure doesn’t favor lower capacity prices
- **~90%+ of international capacity requirements are still largely self-provisioned** – international leased capacity market estimated at less than 5Gbps
- **A critical value as an international capacity outlet for landlocked countries** – primarily Mali, Burkina Faso
- Example of market in which an effective IXP would be critical in driving increased access

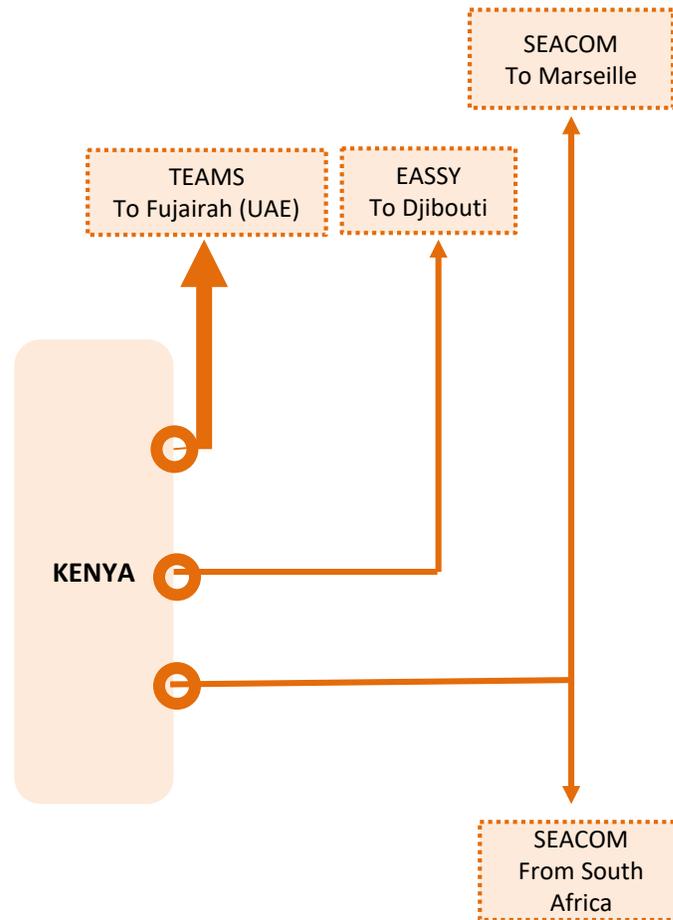
Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	3	NA
Country Broadband Penetration	~16%	16th
International Capacity Supply (Gbps)*	~40 Gbps	10th
International Capacity per BB Connection*	~12 (Kbps)	12th
Bandwidth Demand vs. Supply Context	Bandwidth Rationing	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

International Capacity Country Snapshot: Kenya

Kenya – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- **Three submarine cables – with ~900Gbps owned by Kenyan operators and ISPs**
- Carriers have to purchase onward capacity to Europe, from the UAE or Djibouti
- **TEAMS is the primary cable** - ~720Gbps of Kenyan-owned lit capacity
- **A tight leased capacity market** – Carriers and customers accounting for ~70%+ of Kenya’s capacity needs have strong self-provisioning capability – through TEAMS, primarily, and through part-ownership in EASSY
- **Kenya is a regional hub – a critical outlet for a number of markets on the East coast;** Uganda, Rwanda, Ethiopia, Mayotte (French territory)
- **A broadly positive outlook** – excellent demand base, enough capacity to meet demand, and Liquid Telecom cable should bring even more capacity

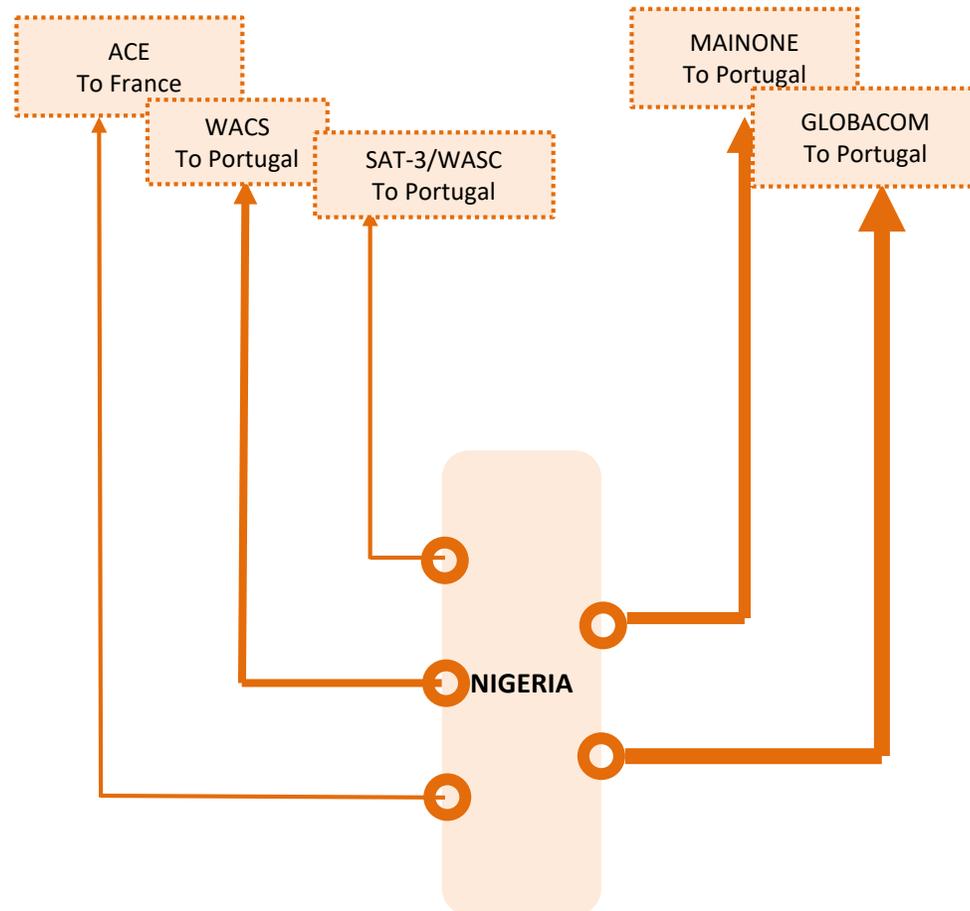
Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	3 (excl. 1 regional cable (LION))	
Country Broadband Penetration	~26%	9 th
International Capacity Supply (Gbps)*	~850 Gbps	2 nd
International Capacity per BB Connection*	~70 (Kbps)	2 nd
Bandwidth Demand vs. Supply Context	Bandwidth Oversupply	

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

International Capacity Country Snapshot: Nigeria

Nigeria – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- **Sub-Saharan Africa’s largest retail broadband market**, with ~27m connections (2016E)
- West Africa’s largest international capacity market - ~5%-10% of equipped capacity is leased
- **Tough short term outlook** - a sharp economic recession and foreign exchange limitations
- **Operating below real potential** - the biggest roadblock for increased capacity usage is an ineffectual terrestrial bandwidth market
- ~80%+ of available international capacity belongs to a single, still somewhat unpredictable player – Globacom; other providers have capability for more, but keep capacity levels closer to usage levels
- Prices appear to have largely stabilized, as has leased capacity market
- **Outlook still positive – but tied to an economic recovery**
- **The range of performance is wide** - ~10% annual growth to ~30%+ annual growth depending on regulatory decisions and economic climate

Country International Bandwidth Indicators

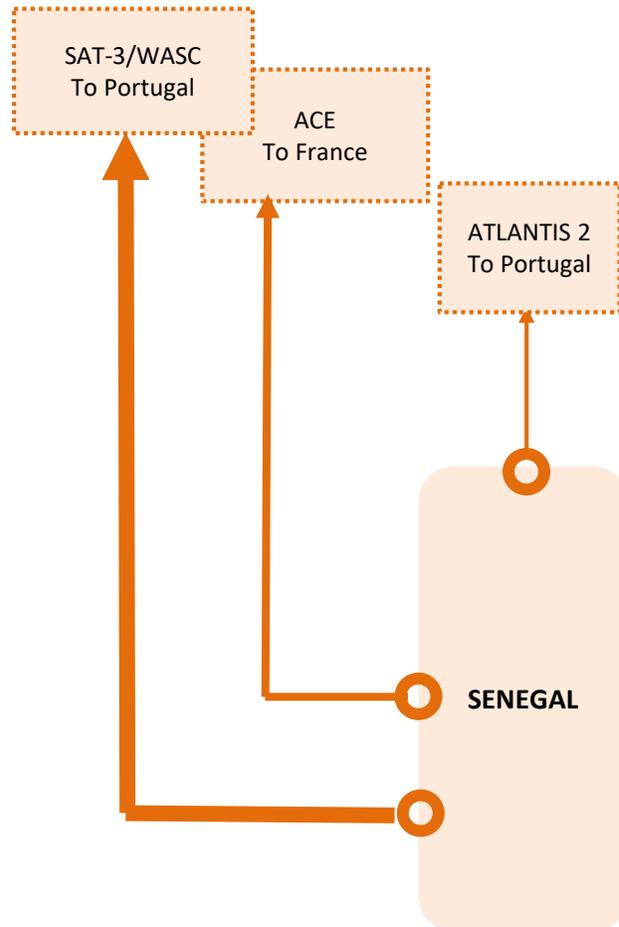
	Indicator (2016 E)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	5	NA
Country Broadband Penetration	~27%	8 th
International Capacity Supply (Gbps)*	~700 Gbps	3rd
International Capacity per BB Connection*	~14 (Kbps)	11th
Bandwidth Demand vs. Supply Context	Bandwidth Rationing/Oversupply**	NA

*International lit bandwidth owned and leased by local providers and allocated to the market

**Nigeria could fall in either group; market has excess capacity, but lacks dynamism (though that’s mostly due to inadequate terrestrial fibre supply).

Source: Xalam Analytics research.

Senegal – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

- **French-speaking West Africa’s second largest economy** – and its largest broadband market in terms of connections
- **Two main international cables**, on which market leader Sonatel is a key shareholder
- **A highly concentrated wholesale market** – Sonatel has significant market power in the provision of domestic and international capacity
- **An African paradox – while competition is limited, Senegal has some of the lowest bandwidth capacity prices in Africa**
- **A relatively soft leased capacity market** – capacity requirements outside of Sonatel are relatively limited
- **Senegal is still a critical international capacity outlet for landlocked countries** – though that role has diminished as some countries got direct access through the ACE cable, or the networks of their parent companies

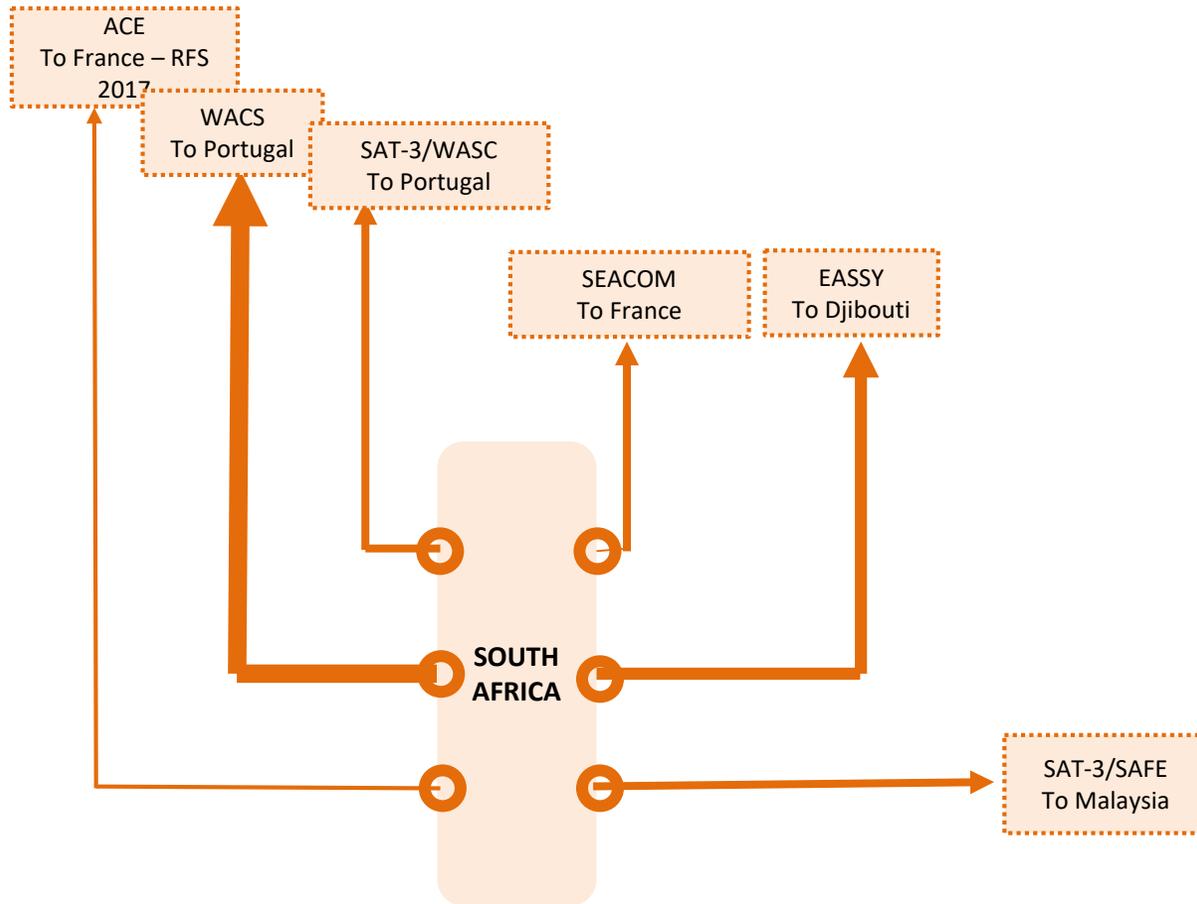
Country International Bandwidth Indicators

	Indicator (2016 E)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	3	NA
Country Broadband Penetration	~34%	6th
International Capacity Supply (Gbps)*	~45 Gbps	9th
International Capacity per BB Connection*	~9 (Kbps)	14th
Bandwidth Demand vs. Supply Context	Bandwidth Oversupply	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

International Capacity Country Snapshot: South Africa

South Africa – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

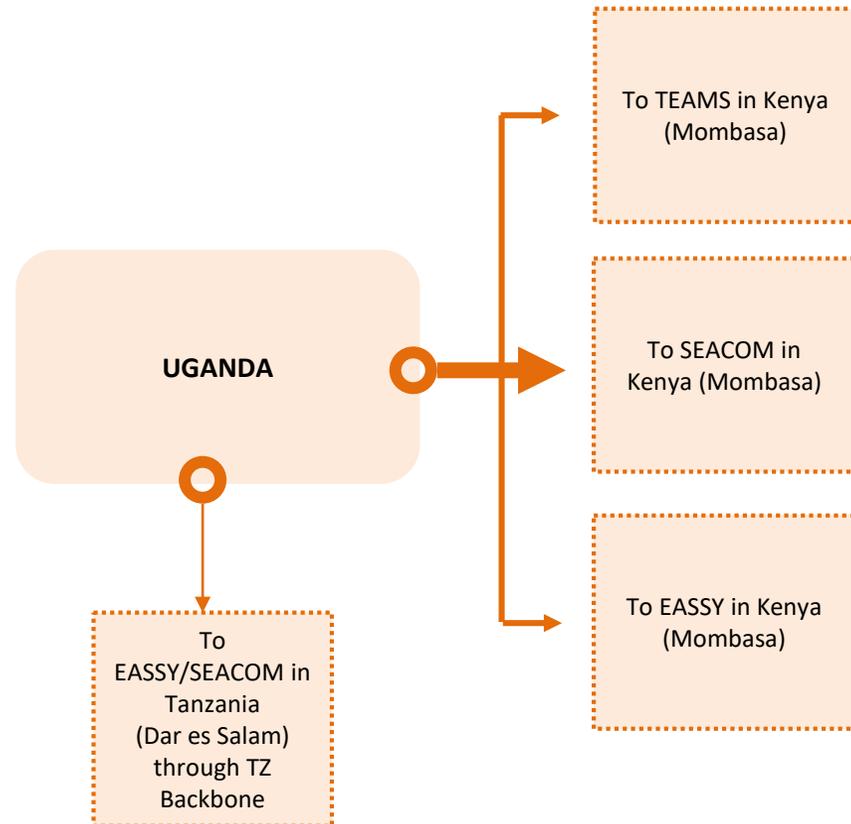
- Africa’s largest, and most dynamic international capacity market
- 5 international cables, a sixth likely in 2017 (ACE), and potentially another cable in 2018-19 (Liquid Sea or Africa-1)
- SA has a bandwidth glut – persistent capacity surplus combined with continuous declines in capacity prices; the glut will intensify with new cables coming onshore
- Projected available capacity in the 2000-2500Gbps range, depending on scale of upgrades, equipped capacity on new cables
- Market is highly sensitive to impact of disruptors – e.g. Angola Cables
- For the most part, real potential for value accretion has moved to domestic metro/long haul transport segment

Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	5	NA
Country Broadband Penetration	~53%	4th
International Capacity Supply (Gbps)*	~1600 Gbps	1st
International Capacity per BB Connection*	~50 (Kbps)	3rd
Bandwidth Demand vs. Supply Context	Bandwidth Glut	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

Uganda – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

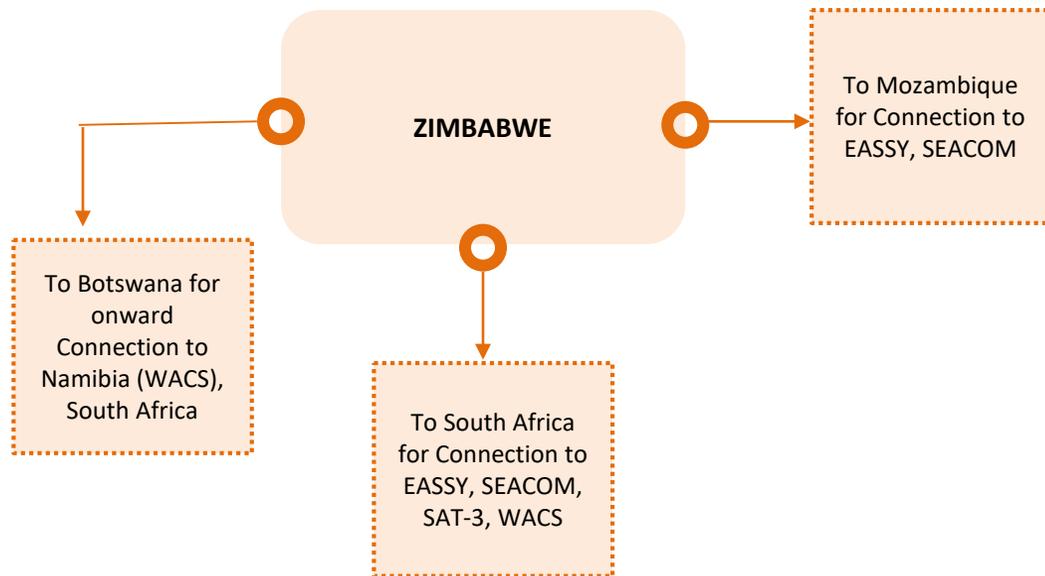
- **Uganda is the most dynamic of all landlocked markets in Africa**
- More international capacity than many coastal countries with access to 2+ cables
- **Uganda has indirect access to three cables** – SEACOM, EASSY, TEAMS – with the first generally preferred due to direct access to Europe
- **Highly dependent on Kenya backbone**, and terrestrial cable from Liquid Telecom for cross-country connectivity.
- **This hasn't been a major roadblock to capacity adoption** due to competitive intensity of Kenyan terrestrial fibre market (unlike in West Africa – and a key factor in the variation between Uganda and Burkina Faso for example)
- **This is arguably the most attractive international leased capacity market in East Africa** – a broad addressable market of ISPs needing capacity and lacking enough capital to self-provision
- **Outlook is solid** – we're projecting capacity volumes to at least double from current levels

Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	NA - Landlocked	NA
Country Broadband Penetration	~22%	11th
International Capacity Supply (Gbps)*	~45 Gbps	8th
International Capacity per BB Connection*	~6 (Kbps)	17th
Bandwidth Demand vs. Supply Context	Bandwidth Oversupply	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

Zimbabwe – Key International Links



Line thickness represents estimated lit bandwidth owned and leased by local providers and allocated to the market
Sources: The Companies, Xalam Analytics research.

International Capacity Market Snapshot

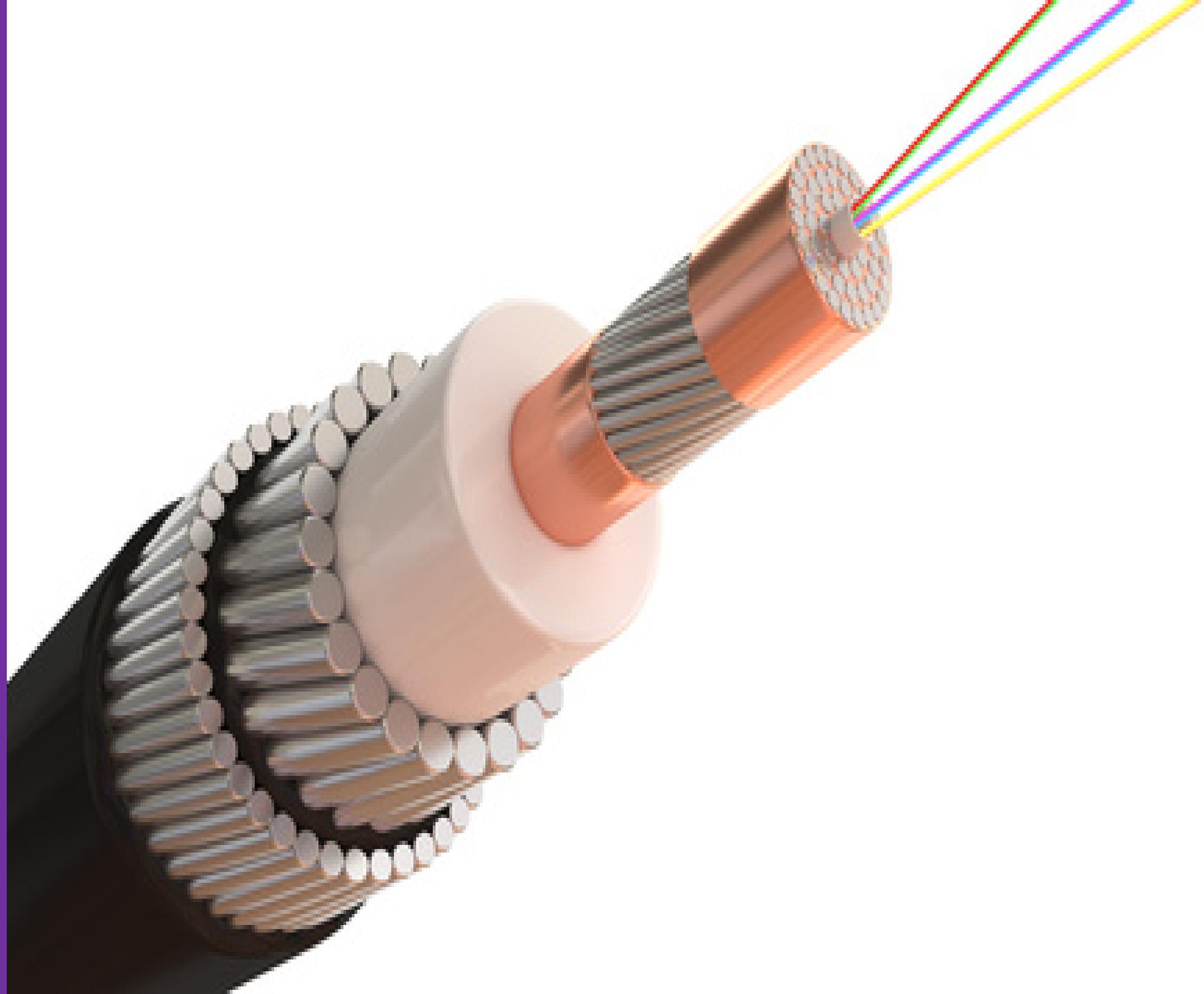
- The Zimbabwe paradox – a strong retail broadband market, and yet, one of Africa’s most constrained international capacity markets;
- Potential under optimal conditions is ~2x-4x current international capacity levels; but political and economic uncertainty means conditions are not optimal;
- **Landlocked** – connections to Seacom, EASSY, WACS, SAT-3 through Namibia, Botswana, Mozambique, South Africa;
- Few other markets are as hit by terrestrial cross-country transit fees
- **One of the largest leased capacity markets in sub-Saharan Africa (~10Gbps+)** – and a key target market for all wholesale providers in the SADC region.

Country International Bandwidth Indicators

	Indicator (2016)	Ranking vs. SSA Sample (Out of 22 Countries)
Number of Subsea Cables Landing in the Country	NA - Landlocked	NA
Country Broadband Penetration	~68%	2
International Capacity Supply (Gbps)*	~20 Gbps	14th
International Capacity per BB Connection*	~2 (Kbps)	19th
Bandwidth Demand vs. Supply Context	Bandwidth Deficit	NA

*International lit bandwidth owned and leased by local providers and allocated to the market
Source: Xalam Analytics research.

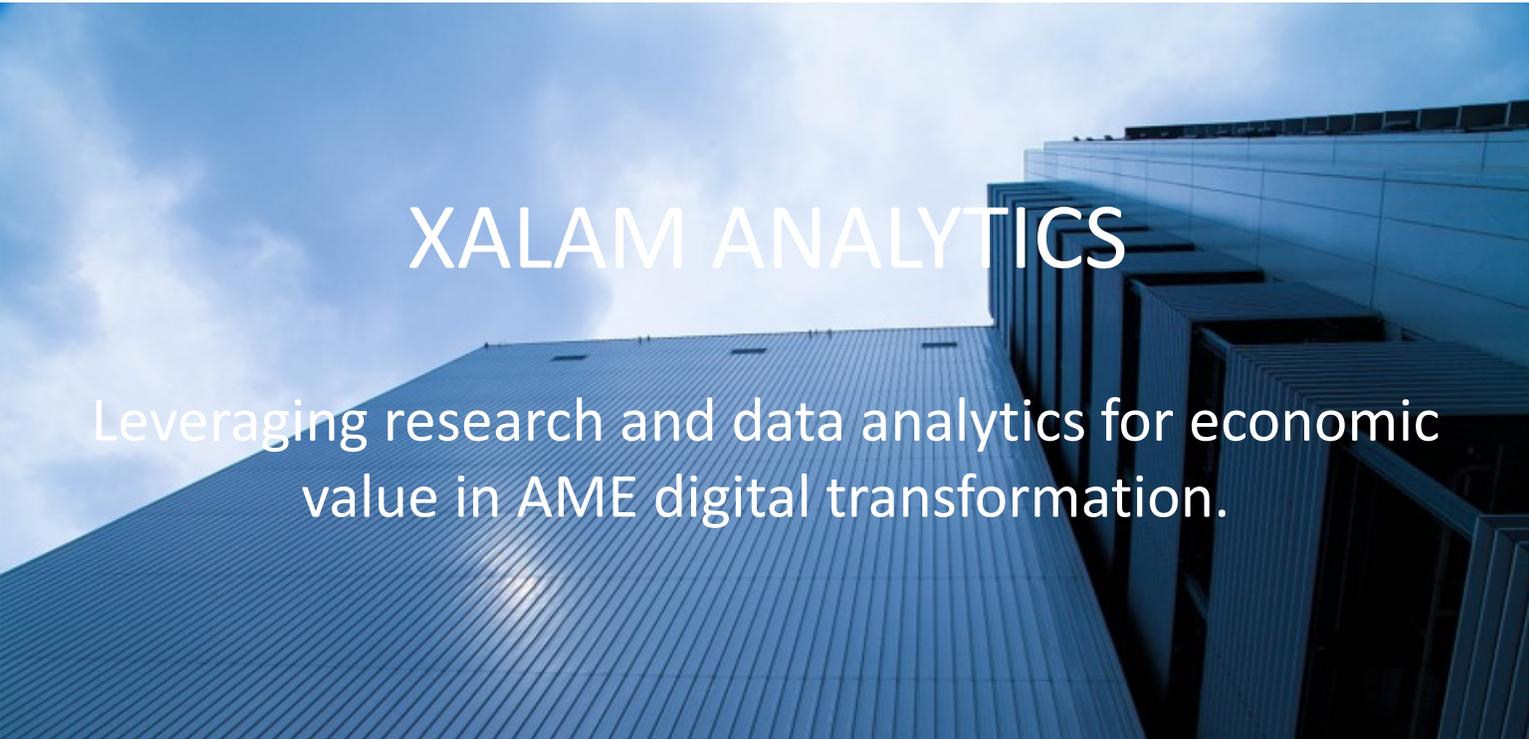
APPENDIX - TABLES



Africa International Bandwidth Table (Gbps)*

	2010	2011	2012	2013	2014	2015	2016	2017F	2018F	2019F	2020F	CAGR - 2010 -2015	CAGR - 2015-2020
Angola	17	17	81	81	101	101	101	101	1,101	1,133	1,133	43%	62%
Benin	20	20	20	30	40	45	45	45	65	85	105	18%	18%
Botswana	1	1	22	30	30	49	126	136	136	146	146	103%	25%
Burkina Faso	0	1	1	2	4	6	8	18	23	28	33	81%	41%
Cameroon	3	20	20	20	43	88	98	108	118	128	138	104%	9%
Djibouti	29	47	47	49	61	70	70	764	814	817	817	20%	63%
Ethiopia	3	3	3	9	27	27	32	32	37	37	42	55%	9%
Gabon	10	10	16	16	16	16	16	29	29	29	29	10%	13%
Ghana	26	36	64	64	93	93	93	101	109	121	121	29%	5%
Guinea	0	1	5	5	5	5	5	23	23	23	23	74%	36%
Ivory Coast	17	17	33	33	41	41	41	64	64	72	72	19%	12%
Kenya	131	142	208	214	224	829	836	838	840	842	844	45%	0%
Mauritius	10	10	10	10	14	15	27	27	33	33	39	9%	21%
Namibia	2	3	5	12	11	16	21	26	31	36	41	51%	21%
Nigeria	31	661	689	689	710	725	725	744	776	786	786	88%	2%
Rwanda	3	6	10	11	12	13	14	15	16	17	18	30%	7%
Senegal	17	17	23	23	44	44	44	67	67	67	67	21%	9%
South Africa	343	473	712	855	975	1,506	1,506	1,720	1,820	2,148	2,148	34%	7%
Tanzania	6	8	10	12	14	16	20	24	28	32	36	22%	18%
Uganda	5	16	23	26	27	36	46	61	76	91	106	47%	24%
Zambia	2	3	4	9	10	10	12	14	16	18	20	42%	14%
Zimbabwe	2	2	7	9	11	15	20	24	29	33	38	43%	20%

*International lit bandwidth owned and leased by local providers and allocated to the market
Sources: Operators, regulators, Xalam Analytics estimates.



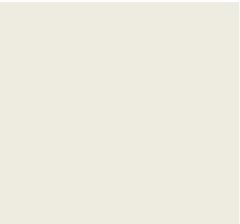
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