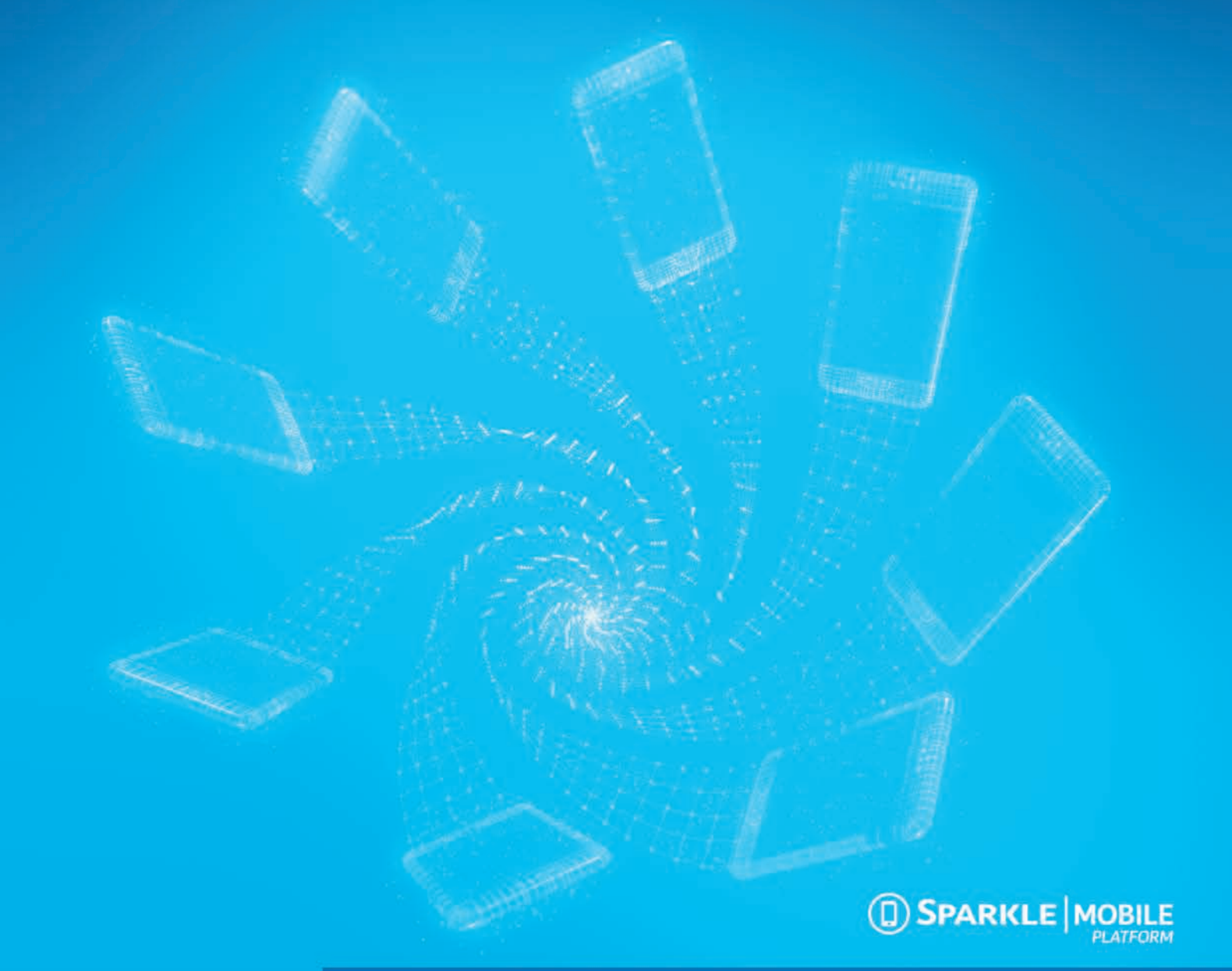

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chapter 1
State of the market

The challenges for African telcos

Stefan Zehle, CEO, Coleago Consulting

Mobile operators are the dominant force in African telecoms and most of the investment action focuses on the mobile sector. The march towards LTE mobile broadband is accelerating, and this is where most telecom investment in Africa is absorbed.

The GSMA notes that mobile broadband connections are set to increase to almost 60 per cent by the end of the decade, by which time the smartphone installed base will total over half a billion.

Although LTE is already deployed in many African countries and some have deployed LTE-A, governments are gearing up to auction new mobile spectrum to achieve digital development goals. 2016 will see several auctions for digital dividend spectrum, namely the 800MHz band, but also 700MHz, the second digital dividend band. In addition, 2600MHz is being made available in a number of countries, including Nigeria and South Africa, two of Africa's largest markets.

The deployment of LTE in new bands requires considerable capital expenditure. While the towers (passive infrastructure) have largely been built and new towers are constructed by tower companies on a build-to-suit basis, the investment in LTE radios and antennas is significant and requires funding. However, larger players generate sufficient cash to fund the development from operating cash flow and will not require additional debt financing.

The dash for mobile broadband also highlights one of the major problems in Africa: the lack of fibre infrastructure. While microwave links were fine for voice and small amounts of data, the data tsunami that will be unleashed on the continent requires considerable investment in fibre backhaul and backbone.

In Africa, LTE will be the primary means of internet access. The lack of fixed internet access means that the monthly traffic per smartphone is likely to be very high. There may therefore be an opportunity for tower companies to build a shared fibre infrastructure, however they are probably keen not to become telecoms operators and may avoid this by deploying dark fibre.

Capital expenditure

Levels of capital expenditure as a proportion of revenue have come down in some markets. For example, in Nigeria the average capex to sales in 2015 is estimated at 14 per cent, but for South Africa it was 20 per cent.

However, in line with global developments, mobile service revenue growth in Africa has slowed down. Many markets now show little increases in nominal terms, i.e. after stripping out the effect of inflation. Therefore, despite the selling of tower assets, in many markets capex to sales ratios are likely to remain in the region of 15-20 per cent.

Management focus will be very much on reigning in capex, but competition for higher spending LTE smartphone customers is likely to drive investment.

In many markets, operators face additional pressure on their capex budgets due to spectrum auctions. Some governments seek to extract unrealistic amounts from license fees. As a result we have seen failed auctions in Mozambique, Senegal and Ghana. For example in Mozambique, on a GDP-adjusted basis, the reserve price for 800MHz spectrum was around 10-times higher than prices paid elsewhere for digital dividend frequencies. Five blocks were on offer and the USD150m price tag amounted to approximately 50 per cent of total mobile industry revenue. None of the spectrum was sold. In Senegal, operators went on a bidder's strike, and in Ghana only the biggest operator, MTN, bought 800MHz spectrum.

Almost all African countries have a very narrow tax base and in many of them mobile networks have become tax collection engines. The mobile industry is facing an escalating tax burden. Furthermore, consumption taxes reduce affordability of mobile services and are likely to have a negative impact on revenue growth and investment. The tax burden also slows down the adoption of mobile broadband.

The uncertainty over spectrum license fees and taxation creates risks for investors which affects the investment climate. In addition, there may be curve balls thrown at operators. For instance in Nigeria, a huge USD3.9bn fine was imposed on MTN for non-compliance with regards to SIM registration. And in Uganda, the regulator commissioned a study which suggested that MTN and Airtel have "joint dominance", a most unusual economic concept. This may have far reaching regulatory consequences, including retail price regulation.

These episodes illustrate that the regulatory risk in African countries remains high, and investors will require appropriate returns to compensate for these risks.

Competition in African mobile markets also remains intense and we have seen new market entry in some markets from players such as Viettel and Smile Telecom in Mozambique, Tanzania, DRC, and Nigeria. As African markets are maturing, new market entry is surprising and there must be some doubt as to the return on investment generated by these ventures.

Consolidation

When markets mature, consolidation should be the name of the game, and indeed it is in a number of markets, including South Africa. Operators such as Millicom, Bharti Airtel, Orange and MTN recognise that the continued high levels of capex lead them to seek better economies of scale.

Only operators with significant market shares will generate sufficient returns on investment. Many African markets have more than three operators, whereas – depending on the size of country – three or perhaps just two operators are sustainable.

Operators with market share below 15 per cent may seek to exit. Consolidation is seen as particularly likely to take place in countries with four or more operators, such as Côte d'Ivoire, Uganda and Tanzania. As a result, 2016 is likely to see a number of deals driven by in-market consolidation. Perhaps, Telkom's acquisition of Cell C (abandoned in November 2015 over differences in the valuation of Cell C) will be revived in 2016.

The selling of towers to independent companies continues at a fast pace. This could be described as "consolidation lite". The trend is amplified by consolidation among tower cost; for example in March of this year IHS Holding agreed to acquire Helios Towers Nigeria (HTN). This adds further to the expected deal making.

The deal flow is also driven by realignment of portfolios. For example, in 2015 Orange looked into the acquisition of four African mobile businesses from Bharti Airtel.

The growth of mobile broadband creates significant opportunities for investment in digital services. We are all familiar with the success of mobile money in Africa and the role of mobile in the financial sector will grow further.

ICT DEVELOPMENT INDEX 2015 – GLOBAL TOP 20

IDI 2015 RANK	ECONOMY	IDI 2015 VALUE	IDI 2010 RANK	IDI 2010 VALUE	RANK CHANGE
1	Korea (Rep.)	8.93	1	8.64	–
2	Denmark	8.88	4	8.18	▲
3	Iceland	8.86	3	8.19	–
4	United Kingdom	8.75	10	7.62	▲
5	Sweden	8.67	2	8.43	▼
6	Luxembourg	8.59	8	7.82	▲
7	Switzerland	8.56	12	7.60	▲
8	Netherlands	8.53	7	7.82	▼
9	Hong Kong, China	8.52	13	7.41	▲
10	Norway	8.49	5	8.16	▼
11	Japan	8.47	9	7.73	▼
12	Finland	8.36	6	7.96	▼
13	Australia	8.29	15	7.32	▲
14	Germany	8.22	17	7.28	▲
15	United States	8.19	16	7.30	▲
16	New Zealand	8.14	19	7.17	▲
17	France	8.12	18	7.22	▲
18	Monaco	8.10	22	7.01	▲
19	Singapore	8.08	11	7.62	▼
20	Estonia	8.05	25	6.70	▲

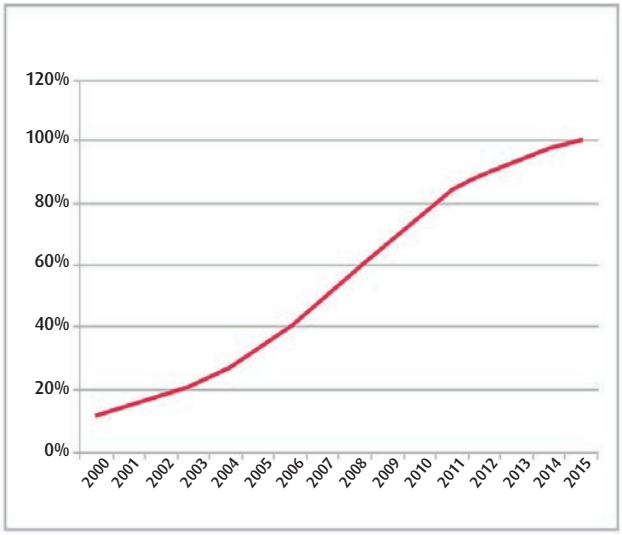
SOURCE: ITU ICT DEVELOPMENT INDEX (IDI) 2015

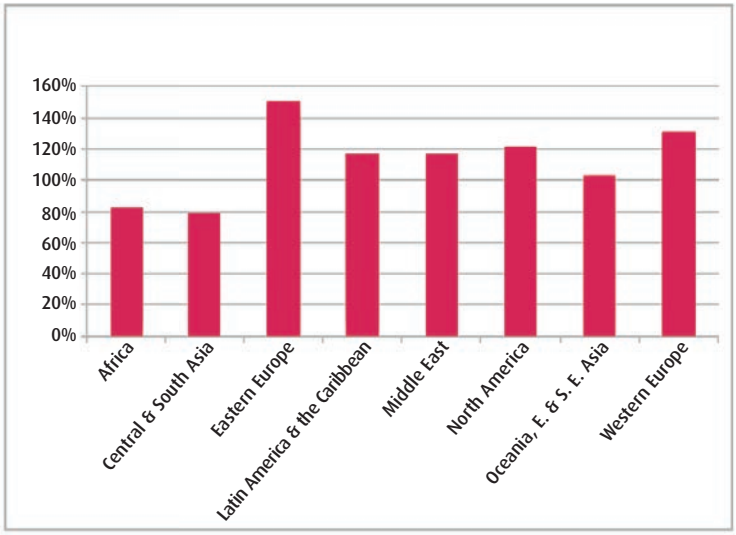
There are other opportunities in consumer markets, such as 'infotainment' and education, as well as in business markets, notably cloud services.

Mobile operators are not only building the access networks over which the information flows, but they also have an unrivalled capability to collect small amounts of cash from almost every person in a country. This positions them well to take advantage of the growth of the digital economy across the region.

Africa is a very diverse continent. Operating and regulatory conditions differ enormously between markets and the investment climate differs between countries. Despite the risks, the opportunity for investors to generate good returns from the fast-growing mobile broadband market remains.

Coleago Consulting is a specialist telecoms management consulting firm. Its highly experienced industry experts advise telecoms operators and regulators around the world. www.coleago.com.





Left: Global mobile penetration from 2000 to 2015. **Right:** global mobile penetration by region as at the end of 2015. SOURCE OVUM

The digital paradox

While all the statistics and indicators for mobile connectivity in emerging markets continue to rise steeply at seemingly breakneck speeds, there are still billions who remain unconnected.

For example, ITU research late last year revealed that more than 95 per cent of the world's population is now covered by a mobile signal. And according to Ovum, mobile penetration reached 100 per cent at the end of 2015, meaning that on average there is one SIM card per person on the planet. Of course, this isn't a reality as multiple SIM ownership by single individuals has to be taken into account, as does a growing number of connected M2M devices.

The ITU estimates that there are still 350 million people worldwide who live outside the reach of a mobile network, and 56 per cent of the global population has yet to experience the internet.

Furthermore, Ovum points out that Africa is still 10 years behind Europe and North America as SIM penetration on the continent is still relatively low at an average 82 per cent. In a *Mobility Report* published in November 2015, Ericsson added that while countries like South Africa and Ghana have long since passed the 100 per cent penetration mark, other large markets such as Nigeria and Kenya are still below 100 per cent.

Ovum believes that the issues of availability and affordability still need to be addressed by the overall mobile industry, and forecasts that Africa as a whole will only approach the 100 per cent penetration mark at the end of this decade.

Each year, the ITU ranks 167 countries according to their level of ICT access, use and skills. In its 2015 ICT Development Index (IDI) published in November, the Republic of Korea, Denmark and Iceland occupy the top three places respectively, as shown above. There are no African countries in the top 50 and only four feature in the top 100. Mauritius is the only African nation with an IDI value above the global average of 5.03, while three others – Seychelles, South Africa and Cape Verde – exceed the average value for developing countries of 4.12.

Altogether, 29 out of 37 African states rank in the bottom quarter of the latest IDI, including the 11 which have the lowest scores of all. The union said the average rise in IDI values in Africa between 2010 and 2015 was 0.65 which is lower compared to other regions in nominal terms. However, it also said that this is from a lower base and is therefore higher in proportion to the benchmark set in 2010.

ICT DEVELOPMENT INDEX 2015 – AFRICA*

IDI 2015 RANK	ECONOMY	IDI 2015 VALUE	IDI 2010 RANK	IDI 2010 VALUE	RANK CHANGE
73	Mauritius	5.41	72	4.31	▼
87	Seychelles	4.96	81	3.98	▼
88	South Africa	4.90	88	3.65	-
93	Tunisia*	4.73	93	3.62	-
96	Cape Verde	4.62	107	3.14	▲
99	Morocco*	4.47	96	3.55	▼
100	Egypt*	4.40	98	3.48	▼
109	Ghana	3.90	130	1.98	▲
111	Botswana	3.82	117	2.86	▲
113	Algeria*	3.71	114	2.99	▲
118	Namibia	3.41	120	2.63	▲
124	Kenya	3.02	126	2.09	▲
126	Sudan*	2.93	127	2.05	▲
127	Zimbabwe	2.90	132	1.97	▲
128	Lesotho	2.81	141	1.74	▲
132	Senegal	2.68	137	1.80	▲
133	Gabon	2.68	122	2.41	▼
134	Nigeria	2.61	133	1.96	▼
135	Gambia	2.60	129	1.99	▼
137	Côte d'Ivoire	2.51	142	1.74	▲
140	Angola	2.32	144	1.68	▲
141	Congo (Rep.)	2.27	136	1.83	▼
145	Mali	2.22	155	1.46	▲
146	Equatorial Guinea	2.21	134	1.96	▼
147	Cameroon	2.19	149	1.60	▲
148	Djibouti*	2.19	143	1.69	▼
149	Uganda	2.14	151	1.57	▲
150	Mauritania*	2.07	146	1.63	▼
151	Benin	2.05	147	1.63	▼
152	Togo	2.04	145	1.64	▼
153	Zambia	2.04	152	1.55	▼
154	Rwanda	2.04	154	1.47	-
155	Liberia	1.86	161	1.24	▲
157	Tanzania	1.82	153	1.54	▼
158	Mozambique	1.82	160	1.28	▲
159	Burkina Faso	1.77	165	1.13	▲
160	Congo (Dem. Rep.)	1.65	162	1.23	▲
161	South Sudan	1.63	N/A	N/A	-
162	Guinea-Bissau	1.61	158	1.33	▼
163	Malawi	1.61	159	1.33	▼
164	Madagascar	1.51	157	1.34	▼
165	Ethiopia	1.45	166	1.07	▲
166	Eritrea	1.22	164	1.14	▼
167	Chad	1.17	167	0.88	-

SOURCE: ITU ICT DEVELOPMENT INDEX (IDI) 2015

Indices for African ITU member states. The region's top-ranking nations are listed at the top. (*Note while we have added Algeria, Djibouti, Egypt, Mauritania, Morocco, Sudan and Tunisia to the table above, the ITU does not include them in its Africa region and instead categorises them as Arab states.)

ITU AFRICAN COUNTRY REPORTS 2015											
	POPULATION				SUBSCRIPTIONS PER 100 INHABITANTS				PERCENTAGE OF		
COUNTRY	TOTAL	DENSITY	GNI PER CAPITA	INTERNATIONAL INTERNET BANDWIDTH PER INTERNET USER (BPS)	FIXED-TELEPHONE	MOBILE-CELLULAR TELEPHONE	FIXED (WIRED)-BROADBAND	ACTIVE MOBILE-BROADBAND	HOUSEHOLDS WITH A COMPUTER	HOUSE-HOLDS WITH INTERNET ACCESS	INDIVIDUALS USING THE INTERNET
Mauritius	1,249,151	621.15	9,710	32,990	29.80	132.25	14.57	31.78	51.27	47.53	41.44
Seychelles	93,306	198.97	13,990	28,945	22.73	162.19	12.67	12.67	61.82	55.02	54.26
South Africa	53,139,528	44.52	6,800	149,542	8.10	149.68	3.21	46.70	28.05	37.30	49.00
Tunisia	11,116,899	70.78	4,210	25,972	8.54	128.49	4.44	47.56	33.10	28.80	46.16
Cape Verde	503,637	127.52	3,450	12,330	11.62	121.79	3.79	51.26	32.23	24.80	40.26
Morocco	33,492,909	76.01	2,980	10,768	7.43	131.71	2.96	26.82	52.50	50.40	56.80
Egypt	83,386,739	89.99	3,050	9,302	7.57	114.31	3.68	43.49	45.08	36.78	31.70
Ghana	26,442,178	117.72	1,600	3,602	0.98	114.82	0.26	59.77	39.90	29.00	18.90
Botswana	2,038,587	3.92	7,240	16,437	8.30	167.30	1.63	49.74	14.75	12.05	18.50
Algeria	39,928,947	16.35	5,480	12,460	7.74	93.31	4.01	20.79	28.21	25.94	18.09
Namibia	2,347,988	2.92	5,680	8,162	7.78	113.76	1.75	35.46	16.53	17.27	14.84
Kenya	45,545,980	78.83	1,290	25,200	0.39	73.84	0.19	9.09	12.27	16.90	43.40
Sudan	38,500,000	21.57	1,710	2,499	1.08	72.20	0.05	27.24	16.62	32.20	24.64
Zimbabwe	14,599,325	39.41	830	3,939	2.26	80.82	1.04	39.23	7.55	5.76	19.89
Lesotho	2,097,511	69.47	1,340	2,410	2.44	101.90	0.11	32.80	6.88	6.50	11.00
Senegal	14,548,171	76.21	1,040	8,349	2.14	98.84	0.71	23.74	11.59	12.60	17.70
Gabon	1,711,294	6.55	9,450	19,657	1.00	210.37	0.63	0.00	12.50	9.69	9.81
Nigeria	178,516,904	194.86	2,970	3,150	0.10	77.84	0.01	11.71	9.12	8.48	42.68
Gambia	1,908,954	190.53	440	10,928	2.92	119.63	0.12	8.04	8.26	8.54	15.56
Cote d'Ivoire	20,804,774	69.68	1,460	5,163	1.17	106.25	0.28	24.55	7.20	12.20	14.60
Angola	22,137,261	19.43	4,850	4,250	1.27	63.48	0.41	16.41	9.90	8.62	21.26
Congo (Rep)	4,558,594	13.19	2,710	185	0.36	108.15	0.01	10.81	4.92	1.93	7.11
Mali	15,768,227	14.00	660	1,879	1.00	149.02	0.02	11.30	8.20	6.74	7.00
Equatorial Guinea	778,061	29.27	12,640	1,452	1.94	66.39	0.50	0.00	18.00	8.50	18.86
Cameroon	22,818,632	48.18	1,360	1,796	4.61	75.68	0.07	0.00	9.63	6.50	11.00
Djibouti	886,313	37.80	null	8,955	2.47	32.39	2.27	3.24	17.97	7.08	10.71
Uganda	38,844,624	189.09	680	4,002	0.83	52.43	0.29	14.66	5.80	6.20	17.71
Mauritania	3,984,457	3.85	1,270	1,454	1.29	94.20	0.20	14.42	4.35	6.20	10.70
Benin	10,599,510	93.99	810	2,839	1.85	101.71	0.40	2.84	4.80	3.51	5.30
Togo	6,993,244	130.82	570	6,523	0.90	68.96	0.11	4.14	3.20	3.34	5.70
Zambia	15,021,002	21.15	1,680	4,223	0.76	67.34	0.14	1.00	6.64	6.89	17.34
Rwanda	12,100,049	459.73	700	8,517	0.41	64.02	0.11	11.12	3.38	3.80	10.60
Liberia	4,396,873	45.65	370	6,306	0.23	73.35	0.14	7.63	2.20	2.50	5.41
Tanzania	50,757,459	58.50	930	6,081	0.30	62.77	0.17	3.04	3.80	4.10	4.86
Mozambique	26,472,977	34.61	620	7,755	0.26	69.67	0.05	2.98	7.33	6.22	5.94
Burkino Faso	17,419,615	64.29	710	2,860	0.71	71.74	0.03	9.55	4.60	8.30	9.40
Congo (Dem Rep)	69,360,118	33.03	380	384	0.00	53.49	0.00	7.94	1.93	2.00	3.00
South Sudan	11,738,718	null	940	27	0.00	24.50	0.00	1.28	10.00	9.60	15.90
Guinea-Bissau	1,745,798	64.03	550	2,674	0.29	63.48	0.08	0.00	2.46	1.91	3.32
Malawi	16,829,144	177.08	250	4,237	0.38	30.50	0.05	4.09	5.19	6.23	5.83
Madagascar	23,571,962	40.52	440	267	1.06	38.22	0.10	6.09	4.52	4.68	3.70
Ethiopia	96,506,031	96.96	550	5,002	0.85	31.59	0.49	7.55	2.80	2.85	2.90
Eritrea	6,536,176	50.60	680	1,391	0.98	6.39	0.00	0.00	2.34	1.50	0.99
Chad	13,211,146	10.79	980	733	0.18	39.75	0.08	0.00	2.92	2.73	2.50

SOURCE: ITU ICT DEVELOPMENT INDEX (IDI) 2015

The ITU's ICT Development Index measures ICT access, use and skills. The above table shows some of the indicators for selected African countries.

The most significant improvement achieved by an African country was shown by Ghana. It increased its IDI value by 1.92 points and rose 21 places in the global rankings. The ITU said Lesotho, Cape Verde and Mali also substantially improved their rankings.

Growth prospects

Ericsson's *Mobility Report* said that with a population of 830 million people, sub-Saharan Africa (SSA) has been experiencing "strong economic growth driven by improved political stability, a global commodity boom and greater regional integration".

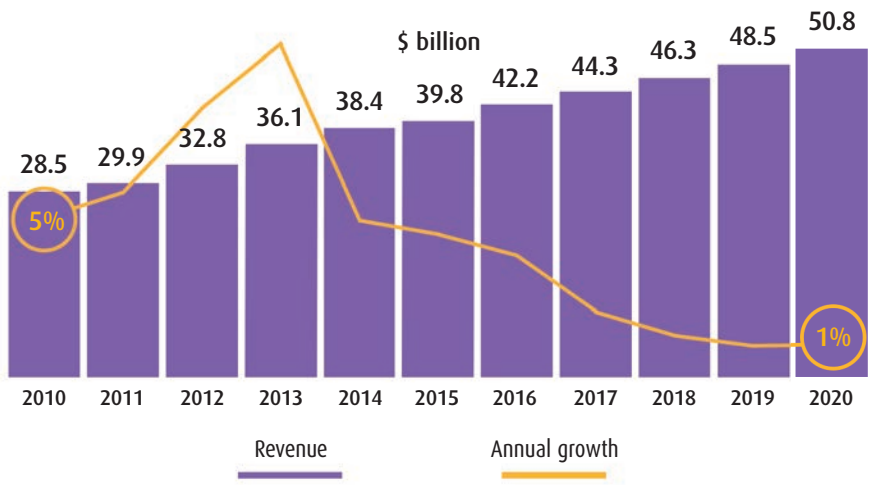
Citing the World Bank's *Global Economic Prospects* report (June 2015), it forecasts annual GDP growth of 4-6 per cent for the region between 2015 and 2018. This is said to be lower than earlier forecasts because of slower recovery in the Eurozone, as well as economic stutters in China which is not only a major destination for commodities from SSA but also a source of foreign investment.

The GSM Association (GSMA) adds that mobile operators' revenue growth is also slowing across the region because of the impact of external factors such as growing competitive pressures and regulatory action. In *The Mobile Economy, Sub-Saharan Africa 2015* report released last year, the association said that from a CAGR of almost seven per cent for 2010-2015, growth is set to slow to five per cent over the next four years.

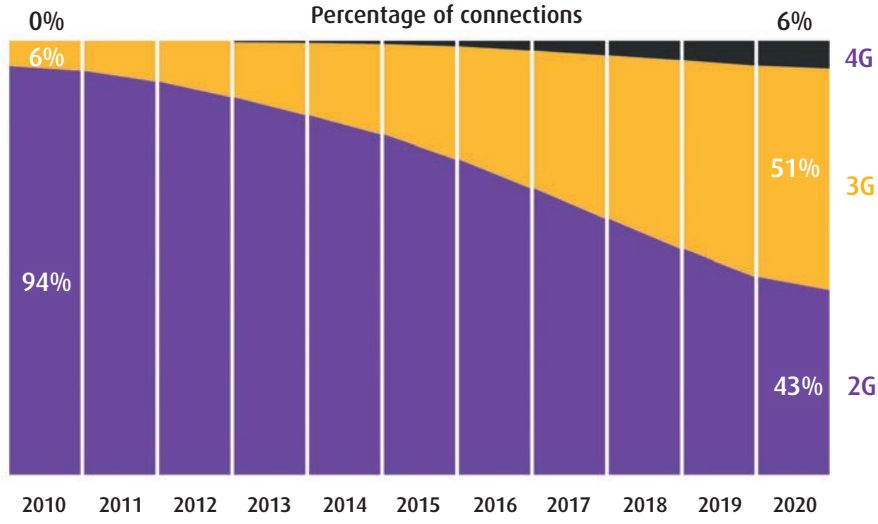
According to the GSMA, the broader mobile ecosystem generated 5.7 per cent of SSA's GDP in 2014, a contribution of just over USD100bn in economic value. During the same year, it supported 4.4 million jobs in the region and raised around USD15bn in government revenues in the form of general taxation *(see top graph, right).*

Ericsson said SSA had reached 500 million mobile subscriptions by the end of 2015, of which 70 per cent are GSM/EDGE-only. It expects this to change by 2021 when WCDMA/HSPA combined with LTE will account for almost 80 per cent of subscriptions (*see middle graph, right*).

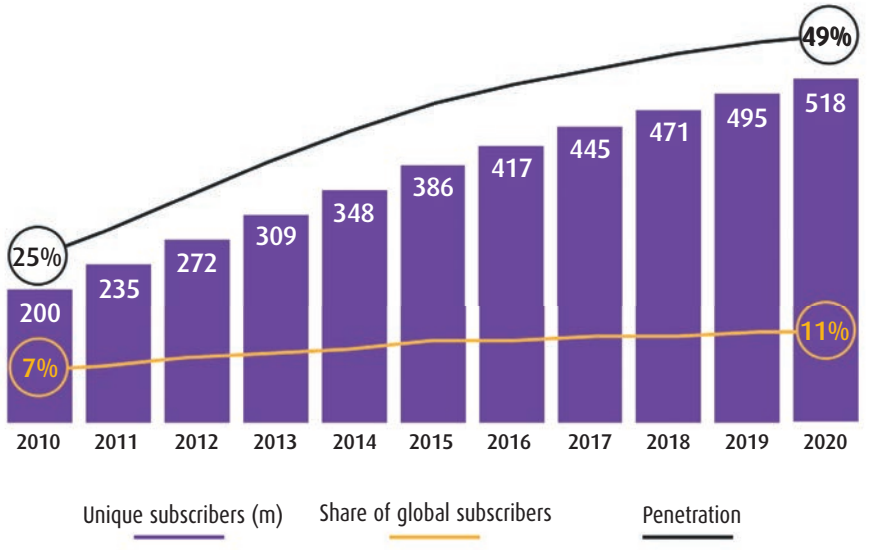
The GSMA reckons a migration to mobile broadband and the growth of new services will result in a regional GDP rise to 8.2 per cent by 2020. It predicts 982 million unique SIM connections (excluding M2M) over the next four years. Ethiopia and Nigeria – two of SSA's most populous countries with penetration rates of around 23 and 31 per cent respectively – will account for 40 per cent of these new subscribers. Cameroon, Kenya, Mozambique, Tanzania and Uganda are also expected to record strong subscriber growth during this period *(see bottom graph, right).*



Mobile revenue growth in sub-Saharan Africa. SOURCE: THE MOBILE ECONOMY, SUB-SAHARAN AFRICA 2015 – GSMA INTELLIGENCE



Africa's ongoing technology shift. SOURCE: THE MOBILE ECONOMY, SUB-SAHARAN AFRICA 2015 – GSMA INTELLIGENCE



Unique subscriber growth in sub-Saharan Africa. SOURCE: THE MOBILE ECONOMY, SUB-SAHARAN AFRICA 2015 – GSMA INTELLIGENCE

But the association believes that even with the predicted growth, a little more than 50 per cent of SSA's population will still not have subscribed to a mobile service by 2020. It also warned that growth rates will "slow sharply" over the next few years, coming in at around six per cent compared to 13 per cent during 2010-2015.

Mobile broadband

In March 2016, the Global mobile Suppliers Association (GSA) confirmed that the milestone of a billion LTE subscriptions worldwide had been passed during the fourth quarter of last year. It said 552.2 million users were added in 2015, meaning a 107 per cent year-on-year growth. The GSA forecasts there will be 3.8 billion LTE subscriptions globally by the end of 2020.

While APAC leads the growth, the GSMA said that it's still very early days for LTE in SSA as the technology only accounts for just under one per cent of current mobile subscriptions in the region. However, the association said 4G is "gaining traction" in several early-adopter markets, especially Angola, Mauritius, Namibia and South Africa. It said 4G adoption for the region as a whole will rise to 400 million new smartphone connections by 2020, representing six per cent of all connections.

Recent figures from GfK revealed that global smartphone sales hit a quarterly high in Q4 2015, with 368 million units purchased during the period, a rise of 14 per cent quarter-on-quarter and six per cent year-on-year. But despite a record fourth quarter and a strong performance in 2015 in general, the market-watcher said there are mixed results across countries.

"Local factors, rather than regional and industry trends, are increasingly driving markets," said Kevin Walsh, director of trends and forecasting, GfK. "Diverging economic trends, device saturation, mass market adoption, politics, social change and even sport have an impact on smartphone demand and prices at country level."

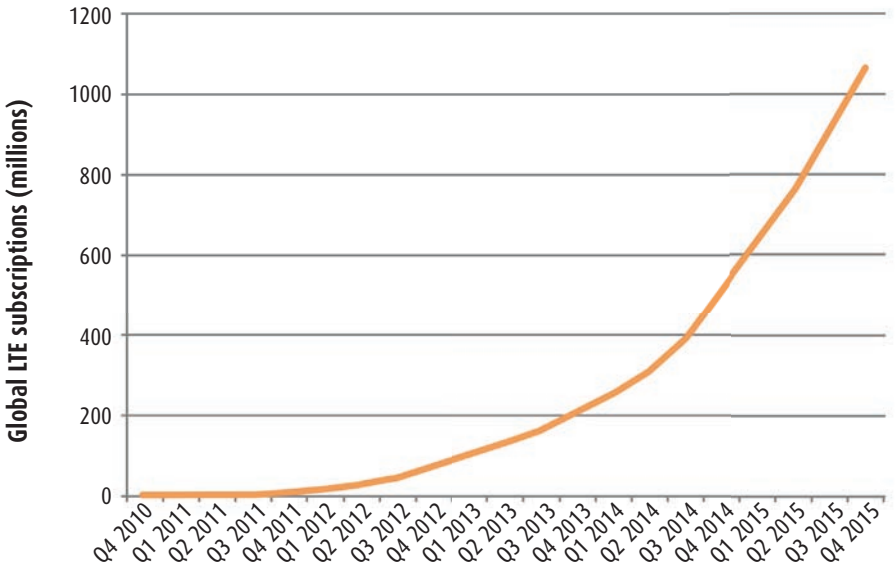
According to the firm, emerging regions such as MEA and APAC continue as "growth powerhouses", and it forecasts global smartphone demand to increase seven per cent in 2016.

Despite a slight slowdown in growth in the Middle East and Africa, GfK said smartphone unit demand in the region grew 12 per cent year-on-year in Q4 2015. Most countries saw increases but Egypt stood out with demand growing 27 per cent year-on-year.

Naturally, given APAC's increasing adoption of LTE as detailed above, the region remains the primary growth driver in the global smartphone market, with 21 per cent year-on-year unit growth in Q4 2015 (*also see tables on p.15*).

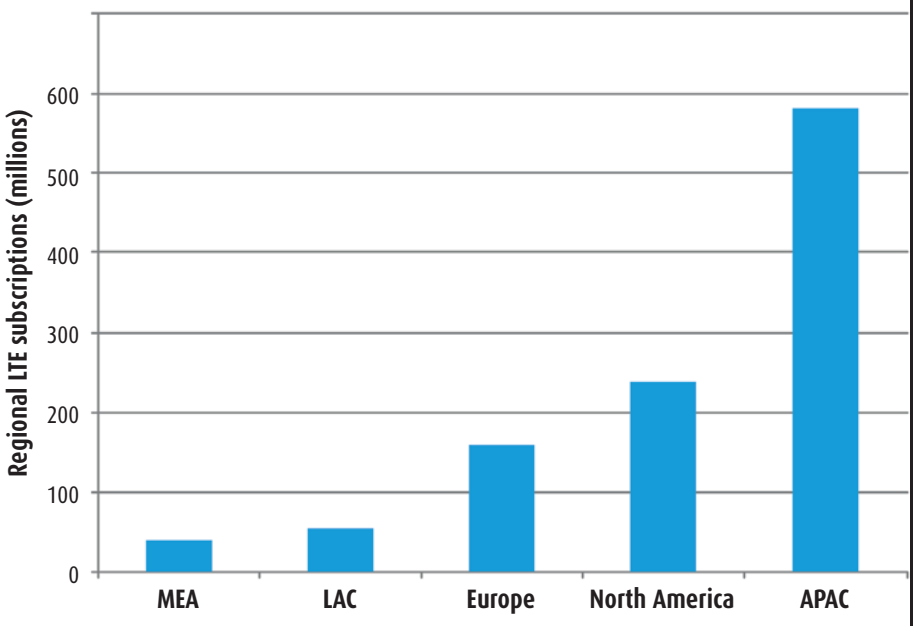
Cisco is also predicting huge rises in smart mobile device adoption and connections over the next four years. In its 10th annual Visual Networking Index (VNI) released earlier this year in February, the company said these will represent 72 per cent of total mobile devices and connections by 2020 – up from 36 per cent in 2015. Smartphones are expected to account for 81 per cent of total mobile traffic by 2020, an increase of 76 per cent in 2015. Cisco said the proliferation of mobile phones, including so-called 'phablets', is rising so rapidly that by 2020 more people will have mobile phones (5.4 billion) than electricity (5.3 billion), running water (3.5 billion) and cars (2.8 billion).

Globally, 4G connectivity share is projected to surpass 2G by 2018 and 3G by 2020. Cisco said 4G will represent more than 70 per cent of all mobile traffic, and 4G connections will



LTE subscriptions are now 14.55 per cent of the global mobile base as at Q4 2015. The GSA said they increased 155.9 million in Q4 2015, 75% per cent higher than 3G/WCDMA-HSPA subscriptions which grew 89.2 million. GSM subscriptions fell by more than 141 million in the same period

SOURCE: OVUM WCIS/GLOBAL MOBILE SUPPLIERS ASSOCIATION/WWW.GSACOM.COM



LTE subscriptions regional shares for Q4 2015. APAC leads the way with a 54.3 per cent share of global subs – China alone added 83.8 million during the period. The Middle East and Africa bring up the rear, trailing way behind North America, Europe, Latin America and the Caribbean.

SOURCE: OVUM WCIS/GLOBAL MOBILE SUPPLIERS ASSOCIATION/WWW.GSACOM.COM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generate nearly six times more traffic per month than non-4G connections by 2020. It said the adoption of devices, increased coverage, and demand for content are driving user growth two times faster than the global population over the next four years."This surge of mobile users, smart devices, mobile video and 4G networks will increase mobile data traffic eight-fold over the next five years," said Cisco.

Mobile usage in MEA

Like Ericsson's annual *Mobility Report*, Cisco's VNI is often cited throughout the industry for its indicators of future mobile trends. Its global mobile data traffic forecasts rely upon independent analyst predictions and real-world mobile data usage studies. Cisco then uses this information as a foundation for its own estimates for mobile application adoption, minutes of use, and transmission speeds. Key enablers such as mobile broadband speed and device computing power are also factored into the projections and findings.

The latest report predicts there will be 5.5 billion mobile users on the planet by 2020 – that's 70 per cent of the world's population.

In Middle East and Africa, there were 708.9 million mobile users in 2015. That's 49 per cent of the region's population and represents a rise of six per cent from the previous year. According to the VNI, there will be 878.7m mobile users in MEA by 2020, a CAGR rise of 4.4 per cent.

124.1 million net new devices and connections were added to mobile networks in MEA during 2015. These included 89.3m smartphones, a rise of 45 per cent meaning that there are now around 286 million smartphone users in the region. Cisco reckons the number of smartphones in MEA will grow three-fold to reach 848 million in 2020.

4G connections in MEA are predicted to grow at a CAGR of 53 per cent over the next four years, accounting for 17.2 per cent of total mobile connections by 2020, compared to 2.9 per cent in 2015.

Meanwhile, 3G will be 59.7 per cent of total mobile connections by 2020, compared to 24.3 per cent in 2015. Third generation connections are expected to surpass 2G in the region by 2018. Cisco said 2G will make up 22.3 per cent of total connections by 2020, compared to 72.8 per cent in 2015.

In MEA, mobile data traffic grew 117 per cent and was 294.5PB per month in 2015. That's said to be the same as 74 million DVDs each month or 811 million text messages each second. Cisco predicts consumer mobile traffic in MEA will reach 4EB per month by 2020.

SMARTPHONE SALES Q4 2014 VERSUS Q4 2015

	UNITS SOLD (MILLIONS)			VALUE (USD BILLIONS)		
	Q414	Q415	YOY % CHANGE	Q414	Q415	YOY % CHANGE
Latin America	36.1	31.5	-12.7%	9.6	7.4	-23.3%
Central & Eastern Europe	21.4	22.2	3.6%	5.1	4.5	-10.8%
North America	57.0	56.4	-1.1%	25.6	23.9	-6.5%
Emerging APAC	41.5	50.0	20.5%	7.5	8.1	8.0%
Middle East & Africa	37.7	42.1	11.7%	10.8	10.2	-4.8%
Western Europe	40.0	42.1	5.2%	17.2	17.0	-0.9%
China	95.1	106.6	12.0%	28.8	33.5	16.3%
Developed APAC	17.3	17.4	0.3%	11.0	10.6	-3.8%
Global	346.1	368.1	6.4%	115.5	115.2	-0.2%

SOURCE: GFK POINT OF SALES MEASUREMENT DATA IN 90+ MARKETS, JANUARY 2016

SMARTPHONES: 2015 SALES VERSUS 2016 FORECAST

	UNITS SOLD (MILLIONS)			SALES VALUE (USD BILLIONS)		
	2015 SALES	2016 FORECAST	YOY % CHANGE	2015 SALES	2016 FORECAST	YOY % CHANGE
Latin America	109.7	108.8	-0.8%	27.0	25.5	-5.7%
Central & Eastern Europe	73.2	77.9	6.5%	14.8	14.5	-1.5%
North America	190.7	193.7	1.6%	77.9	77.2	-0.9%
Emerging APAC	185.2	227.0	22.6%	30.7	33.1	7.9%
Middle East & Africa	162.4	187.7	15.6%	42.0	43.3	3.0%
Western Europe	137.1	142.3	3.8%	53.6	52.7	-1.6%
China	385.3	397.2	3.1%	115.8	117.8	1.7%
Developed APAC	64.8	65.5	1.1%	37.5	37.2	-0.7%
Global	1,308.5	1,400.2	7.0%	399.2	401.3	0.5%

SOURCE: GFK POINT OF SALES (MEASUREMENT DATA IN 90+ MARKETS FOR CALENDAR YEAR 2015 PLUS GFK FORECASTS FOR CALENDAR YEAR 2016, AS AT JANUARY 2016.

REGIONAL MOBILE DATA TRAFFIC GROWTH RATES 2015–2020

REGION	PREDICTED GROWTH
Middle East & Africa	15x
Asia-Pacific	9x
Central & Eastern Europe	8x
Latin America	8x
Western Europe	6x
North America	6x

SOURCE: CISCO VNI 2016

Last year, mobile data traffic in MEA grew 2.6 times faster than the region's fixed IP traffic. The average mobile-connected end-user device generated 231Mb of data traffic per month, up 98 per cent from 117Mb per month in 2014. In terms of business mobile data traffic in the region, the VNI said this grew 107 per cent in 2015 to reach 31.9PB per month. It is expected to increase at a CAGR of 60 per cent over the next four years to reach 330.8PB per month by 2020.

In some of its other forecasts, Cisco predicts video will account for 72 per cent of mobile data traffic in MEA by 2020, compared to 46 per cent at the end of 2015. It also said total public Wi-Fi hotspots will grow from 776,800 in 2015 to 4.2 million by 2020.

The number of mobile-connected M2M modules grew 1.4-fold or 38 per cent in 2015 to reach 39 million in MEA. Cisco expects the number of M2M modules in the region to increase 4.8-fold over the next four years to

reach 186 million in 2020. The VNI forecasts M2M traffic in MEA to grow 25-fold from 2015 to 2020, a CAGR of 90 per cent. M2M traffic will reach 104.9PB per month by 2020 by which time it will account for two per cent of total mobile data traffic, compared to one per cent at the end of 2015. The average M2M module in the region will generate 563Mb of mobile data traffic per month by 2020, an increase from 110Mb per month in 2015.

Tower sharing

According to the GSMA, tower sharing is now a "major feature" of SSA's mobile industry. In *The Mobile Economy, Sub-Saharan Africa 2015* report, it said this is driven by license obligations and the MNOs' need to cut opex and capex.

Citing documented examples from Asia and Europe, the association said tower sharing could lead to capex savings of around 40-50 per cent and opex savings of 20-30 per cent. Despite revenue and margin pressures, the GSMA noted that operators across SSA continue to invest heavily in order to expand coverage and implement mobile broadband networks. It said capital investment in 2014 came in at USD9 billion and is likely to hit USD13.6 billion or 24 per cent of total operator revenues by 2020.

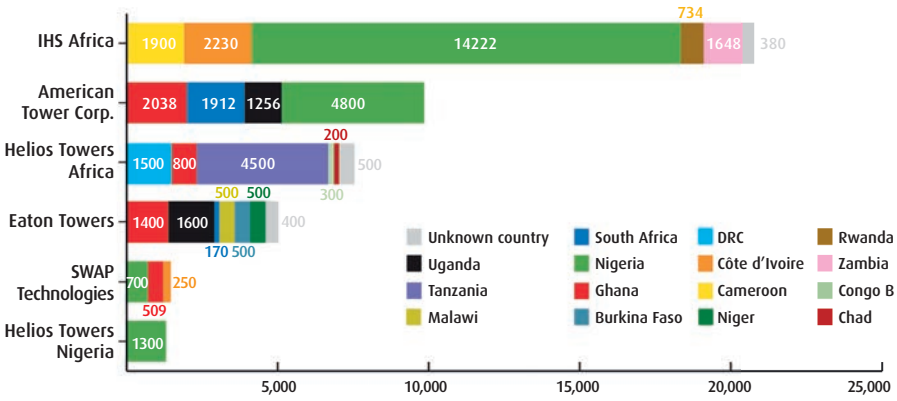
"Funds realised from the sale of tower assets are usually deployed in other priority areas that can improve service quality and operational efficiency, such as investing in next-generation technology and deleveraging through debt reduction," said the report.

A definitive figure for the number of telecoms towers in Africa is difficult to find. The two most authoritative sources differ somewhat. Industry forum TowerXchange estimates there are approximately 165,000 towers on the whole continent. Meanwhile, the GSMA said there are 240,000 towers in SSA and estimated 70,000 in MENA.

Last year, TowerXchange reported that between 2010 and 2014, tower companies in sub-Saharan Africa spent more than USD4bn to buy around 47,500 towers from MNOs. It pointed out that this is equivalent to 33 per cent of the total number of towers in the region.

Some of the towercos with a significant number of estates on the continent include: American Tower Corporation (approximately 10,000); Eaton Towers (about 5,000); Helios Towers Africa (1,300); IHS Africa (more than 20,000); and SWAP Technologies (more than 1,500).

Among MNOs, the company that has certainly been the most active in recent years is Airtel. By the end of 2014, it had sold almost 12,000 of the 15,000 towers it owned across 17 countries in Africa. Three large deals accounted for the bulk of the sales: 3,100 went to Helios Towers; 3,500 to Eaton Towers; and 4,800 to American Tower Corporation (ATC). Airtel's plan was to sell all of its remaining towers and exit the infrastructure business altogether.



Between them, the 'Big Four' towercos own more than 42,500 towers in Africa, with the next two owning fewer than 3,000 between them. The country with the most number of telecoms towers on the continent is Nigeria – it has around 22,000. SOURCE: TOWERXCHANGE

At the end of 2014, ATC paid more than a billion dollars to Airtel for its towers in Nigeria, and has now leased them back to the operator for 10 years. Also in Nigeria, MTN entered into a joint ownership agreement with IHS Towers on 9,151 of its towers in the country. IHS paid around USD2 billion for the assets in what was believed at the time to be the largest tower deal to date in Africa. Etisalat has also offloaded 2,136 of its towers in Nigeria to IHS.

Meanwhile at the end of 2014, fixed-line operator Telecom Egypt signed a USD2bn contract with MNOs Mobinil (now Orange) and Vodafone. Under the terms of the agreement, the MNOs will utilise Telecom Egypt's infrastructure instead of constructing their own.

In May 2015, Egypt also saw its first independent tower deal when Eaton Towers used some of the USD350 million it had raised in new finance for the purchase, leaseback and management of Mobinil's towers. Eaton said the agreement consisted of the purchase of around 2,000 towers with a 15-year leaseback contract for the operation and maintenance, and additional build-out of new sites.

All these deals resulted in the size of Africa's tower industry doubling in two quarters to the end of 2014, according to TowerXchange. It said that following the completion of the Airtel and Mobinil deals, independent towercos now own and share 30 per cent of Africa's towers, up from just 4.7 per cent five years ago. It went on to predict that towerco penetration will rise above 45 per cent in 2015.

The 'Big Four' towercos include IHS Africa, ATC, Helios Towers Africa and Eaton Towers. While they concentrate on achieving economies of scale, colocation sales, greater efficiency and more profitability, smaller and more nimble new companies have now entered the market and can perhaps win in deals considered too small or too risky for the big players. It is estimated these smaller firms owned or operated a total of around 2,000 towers at the end of 2014, with most of the money for their ventures provided by private equity investors.

These relative newcomers include: Atlas Towers (South Africa); BCTEK (Nigeria); Communications Towers Nigeria; Frontier Tower Solutions (targeting Burundi); Hotspot Network (Nigeria); Infratel (South Africa); Pro High Site Communication (South Africa); Shared Networks Tanzania (active infrastructure sharing); Square1 Infrastructure (Nigeria and South Africa); TASC (targeting MENA); TowerCo of Madagascar; and Tower Share (targeting MENA).

According to TowerXchange, another opportunity for newcomers is Africa's urgent need for a viable proposition to build single-tenant towers. It believes this is possible even in markets where the 'Big Four' are active, particularly in low ARPU, off-grid areas. It said these represent "a tough combination of economics which attracts a unique breed of telecoms entrepreneur".

TowerXchange predicted that 50 per cent of towers in Africa will be owned by independents by the end of 2015, which is a year-on-year increase of nearly 100 per cent. It could therefore be argued that within two years, the number of towers remaining in the hands of MNOs will be statistically insignificant.

A more conservative forecast comes from researchers at Statplan Energy. In its *Global Market for Telecoms Towers 2014-2020* report, the energy analyst forecasts that 30 per cent of all towers in Africa could be independently operated by the end of the decade.

Satcoms

In *Prospects for Satellite Communications and Broadcasting in Africa 2015* published in April 2015, Euroconsult reported that usage for satellite capacity in SSA increased at an 11 per cent CAGR over 2009-2014. This was despite the spread of terrestrial fibre networks and the decrease of international trunking.

The company said it anticipated a further 11 per cent CAGR for capacity leased over the next decade, resulting in a total of close to 200Gbps of traffic flowing over satellite. It believes the region's satcoms services market is being driven by multiple factors:

- Digital TV growth is still only in its early phase and the transition process to DTT has only started in many countries. In parallel, despite the signing of more than 10 million subscribers in the last ten years, satellite pay-TV is only beginning to penetrate the market.
- Mobile penetration continues to increase along with universal access requirements, while 3G and potentially 4G expansion will create new connectivity requirements.
- A variety of segments, such as oil and gas, banking, mining, and government networks will require more connectivity as operations either diversify or expand geographically.
- A number of new enterprise hotspot markets are evolving, particularly in East and West Africa, in addition to historically strong VSAT markets such as South Africa, Nigeria, Angola, Kenya and Tanzania. This should contribute to overall market growth across SSA.

Euroconsult added that the ability for operators to create new differentiators will be vital against the backdrop of large capacity supply. It also expects the introduction of "more sophisticated" solutions and a potential consolidation of service providers to contribute to market growth.

In the Q1 2016 edition of its Satellite Capacity Pricing Index (SCPI) published in February 2016, Northern Sky Research (NSR) revealed that satellite bandwidth costs have been declining in Africa and the Middle East. The analyst said there has been region-wide competition from GEO-HTS offerings that have brought down average data pricing to just over USD2,000 per MHz per month for Ku-band, and just under USD2,500 per MHz per month for C-band.

"These figures have been brought down over the previous years by new entrants, and to some extent an oversupply in sub-Saharan Africa that has come about due to relatively slow-to-develop demand over the previous decade," said NSR.

The firm said that overall, its figure of around USD2,200 per MHz for Ku-band data in SSA, for example, corresponds to just under USD1m per transponder equivalent per year. This is still comparatively far from what NSR believes to be the "breaking point" for fixed satellite services operators, but also considerably lower than previous years.

NSR believes the satcoms industry is going through a rapid change as GEO-HTS and eventually non-GEO-HTS continue to pour "unfathomable amounts of capacity" into regions that often do not have sufficient demand to soak up the supply.

It said this has so far resulted in generally slow and stable downward pressure on pricing up to 2016, but warned that the trend will continue to gather momentum. "While this outcome will certainly accelerate the creation of winners and losers in the industry, the alternative is for satellite to remain relatively costly and see its addressable market continue to shrink in an age of bandwidth commoditisation," said NSR.

Broadband, backhaul and broadcast

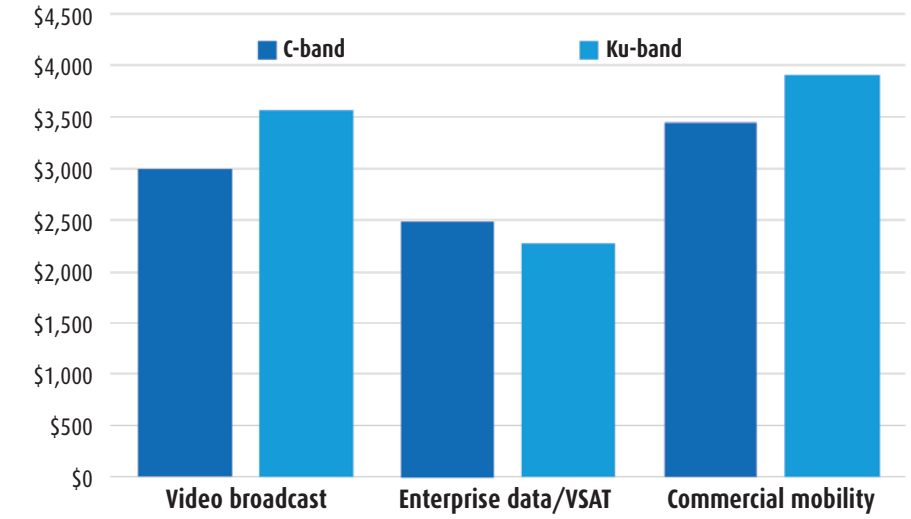
In a separate study, NSR predicts that VSAT, consumer broadband, and trunking/backhaul will generate USD13.6 billion in global revenue by 2024. In the 14th edition of its *VSAT and Broadband Satellite Markets* report released last October, it said the entire broadband satellite market will add 8.4 million new sites during this period. Despite "congested beams" in developed markets and CPE costs in developing ones, NSR said broadband access via satellite added more than 300,000 net new subscribers globally in 2014. "Capacity expansion through next generation HTS will not only grow mature markets, but will also improve reach in Africa, Asia, and Latin America, with impact for the latter coming in the 2016 to 2018 time frame," said NSR senior analyst and report co-author Prashant Butani.

While satellite trunking sites are predicted to decline between 2014 and 2024, NSR said backhaul will show steady growth for in-service units. "More importantly, revenues will increase even faster given the new markets, HTS supply growth and technology shifts towards bandwidth hungry 3G and 4G sites," added Jose del Rosario, research director and report co-author.

The analysts forecast more than 1.4Tbps of demand for non-GEO constellations across all broadband markets, but only if the various technical, regulatory, and business challenges are overcome.

Broadcast continues to be a lucrative application for the major global satellite operators. For example, Eutelsat has been targeting Africa's DTH markets, and launched a new satellite last year for coverage in a video neighbourhood which it described as the "most dynamic in the global satellite TV market". Launched to 8°W in August 2015, *EUTELSAT 8 West B* joined others from Eutelsat and Egyptian operator Nilesat that are already orbiting at the adjacent 7°W position.

The 7/8°W video neighbourhood comprises three Eutelsat satellites plus two from Nilesat which broadcast more than 1,000 TV channels to households from Morocco to the Gulf.



Middle East & Africa traditional FSS spot pricing per MHz per month for Q1 2016. SOURCE: NSR

Eutelsat regularly carries out market research to monitor the number of homes receiving TV channels broadcast by eight of its flagship video neighbourhoods serving North Africa, the Middle East and Europe. As part of its *TV Observatory* report published at the start of 2015, it said all eight continue to experience audience growth, including the 7/8°W neighbourhood shared with Nilesat whose DTH base in MENA grew from 27 million homes in 2010 to 52 million in 2014.

In earlier research carried out in 2014, Eutelsat found that out of a population base of 77.1 million TV homes across 14 countries (which included Algeria, Egypt, Libya, Morocco and Tunisia, amongst others), 92 per cent favour satellite reception for pay-TV or free-to-air viewing.

In 2010, satellite reception accounted for 67 per cent of TV homes in the region, and by 2013 penetration had increased by 25 percentage points. During the same period, Eutelsat found that the number of homes receiving analogue terrestrial TV slumped from 18.2 million in 2010 to 4.1 million in 2013.

Other satellite markets

Machine-to-machine is usually seen as an application in cellular networks but satellite technology also has a vital role to play when it comes to connecting remote devices.

MarketsandMarkets expects the M2M satellite communication market to grow from USD3.36 billion in 2015 to USD5.91 billion by 2020, a CAGR of 11.9 per cent.

The research firm said this will be driven by an increasing need for enriched data communication and expansive applications of M2M.

It added that there are also various factors, such as the conjunction of satellite and terrestrial mobile technology, and the emergence of cloud-based platform providers in the market, that are creating opportunities for vendors such as Orbcomm, Kore Telematics (which announced the acquisition of Wyless Group Holdings in March 2016), Hughes Network Systems, Orange, ViaSat, amongst others.

In a separate study published in January 2016, MarketsandMarkets forecast that the global maritime satellite communication market will grow from USD2.01 billion in 2015 to USD3.10 billion by 2020. It believes the market is growing because of rising demand for enriched data communication to improve operation efficiency, on-board security and surveillance, as well as employee/passenger welfare. MarketsandMarkets also said more end users are being attracted by less expensive satcoms technology being introduced by major vendors and service providers.

Video communication services are expected to reflect higher growth owing to increasing use of video-conferencing, HDTV and entertainment applications. MarketsandMarkets said the passenger ship end-user segment will show the highest growth among all other end users due to an increase in demand from business travellers for advanced communication systems at sea and their expectations for high-speed data equipment.

According to the firm, the maritime satcoms market has seen rapid technology shift from MSS to VSAT. It said the latter will continue to dominate the market over the next four years.

"This shift is attributed to the bandwidth and cost advantages that VSAT offers to marine users," said MarketsandMarkets. "The penetration of VSAT technology is maximum in Ka-band. On the other hand, penetration

across Ku-band will show the highest growth owing to increasing deployment of maritime satellite communication services across Ku-band during the forecast period."

The company said that as the market is becoming more customer-centric, even small vessel owners are now able to subscribe to VSAT communication services. But it also pointed out that various factors, such as lack of awareness among customers and expensive infrastructure to support maritime satellite communication, are hindering growth.

Expansion and stagnation

Oluwole Babatope, Senior regional analyst West Africa, IDC

Over the last decade, the telecoms industry has been a key sector for foreign direct investments into most African countries. The region has been the fastest growing telecoms market in the world, hence it was seen as the next frontier for growth and expansion by global telcos and investors.

However, a number of telecom markets in Africa have started to stagnate as they approach maturity for voice services; consequently, there has been decline in investment in legacy technologies (i.e. 2G).

Key areas of growth that are still attracting investment in Africa include rolling out or optimising 3G networks, LTE, expansion of metro fibre networks, and laying undersea fibre cables. Additionally, in a bid to expand and increase footprint across the continent, global and pan-African telcos have been strategically acquiring local telcos and ISPs.

Although Africa presents opportunities for growth and expansion, the challenges faced by the region's telcos to generate revenue and sustain profitability cannot be over-emphasised. One major obstacle is the lack of reliable and consistent power supply. A constant dependence on diesel generators for power increases opex for telcos, thereby affecting profitability.

Physical security remains another challenge. There have been widespread cases of persistent acts of vandalism of telecoms infrastructure, theft of diesel generators from cell sites, and incidences of fibre cables cuts during road construction. All this has a direct impact on overall profitability as these incidences significantly affect continuity of services and therefore disrupt revenue generation and raise network operating costs.

Telecom Namibia is just one example of an African operator that has suffered here, and the media section on its website catalogues a long list of thefts and criminal damage to its infrastructure.

Other costs include the acquisition of land for sites, government taxes, and informal taxes from various 'community organisations' that all cumulate into higher operating costs. In addition, the downward pressure on tariffs driven in part by competitive forces have led to decreases in top-line growth year on year. This pressure, coupled with the ever-rising cost of operations due to the factors mentioned above as well as foreign exchange fluctuations, have seen telcos that are no longer willing to weather the storm exit the African market.

For example, readers will recall that in 2005 Zain established operations in Africa after it acquired the subsidiaries of Celtel International's 13 countries for about USD3.4bn. The operator acquired licenses in two more markets and invested in network expansion and upgrades. But after only five years of operation, the group changed strategy and quit 15 of its 17 markets in Africa (Morocco and Sudan were retained).

As well as building networks in its home country, Indian telco Bharti Airtel had already been increasing its international operations with businesses in the Seychelles, Bangladesh, Sri Lanka and other Asian markets. In 2010, it expanded its footprint into Africa after buying Zain's African operations for USD10.7bn. It later acquired two more markets on the continent and now operates in Burkina Faso, Chad, Congo Brazzaville, DRC, Gabon, Ghana, Kenya, Malawi, Madagascar, Niger, Nigeria, Rwanda, Seychelles, Sierra Leone, Tanzania, Uganda and Zambia.

However, Bharti Airtel is now contemplating exiting some of its operations in Burkina Faso, Chad, Congo Brazzaville, and Sierra Leone in order to consolidate resources in its home country and select key markets in Africa.

The fact that this decision comes after just five years of operating in Africa points to the continent's challenging business environment and concerns about long term sustainability and profitability.

Further proof of this came in 2014 when Etisalat Group agreed to sell its West African subsidiaries under the Moov brand to Maroc Telecom. Etisalat had steadily experienced declining revenues from its international subsidiaries, with all of its West African businesses (including Nigeria) only contributing about seven per cent to its revenues in 2014.

The deal included Benin, Central African Republic, Côte d'Ivoire, Gabon, Niger and Togo. The sale of Prestige Telecom, an IT services specialist based in Côte d'Ivoire that had been providing support to Etisalat in these countries, was also included in the deal.

In contrast to Zain, Airtel and Etisalat, operators like Vodacom which operates in nine markets, as well as MTN and Orange who each operate in 16 markets, are adopting a different strategy in Africa.

For example, Orange recently initiated its Essentials 2020 plan that focuses efforts on providing converged services. It has therefore strategically exited the Kenya market whilst also planning to enter markets like Burkina Faso, Chad, Congo Brazzaville and Sierra Leone that align with its agenda.

The French telco is optimistic about the potential that exists in Africa, and has consequently reshuffled its management structure to create a single holding company for its subsidiaries in the Middle East and Africa. This new structure replaces the multiple holding company model, and the reshuffle is expected to facilitate simplicity and clarity in management.

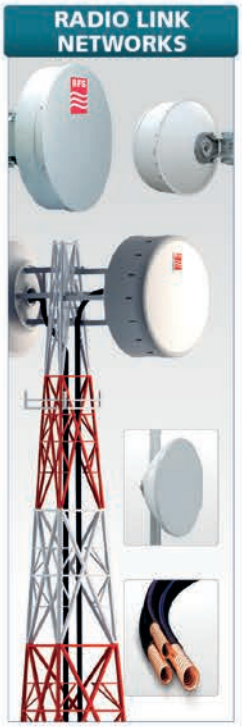
Orange is expecting a 20 per cent revenue increase by 2018. It has already increased its stake in Moroccan subsidiary Medi Telecom from 40 to 49 per cent, and has initiated plans to sell between 10 and 15 per cent of its 99 per cent stake in Egyptian subsidiary Mobinil (which has now been branded as Orange).

Despite the challenging operating environment, IDC believes telcos can still maintain financially sustainable operations in Africa by implementing the following strategies:

- Collaborate with network infrastructure providers to transfer the burden of managing networks and risk thereof to third-party providers. This will enable the operator to focus on core businesses which includes providing innovative services and improving customer experience.
- Telcos entering Africa should adapt strategies that have succeeded in other regions to the specific operating environments in Africa. For example, while price competition was a successful strategy for Airtel in India, the same strategy in Africa negatively affected its profitability due to low ARPUs in all the fragmented markets on the continent.
- Telcos need to focus on building and growing their enterprise product and service portfolios to appeal to customers in the business sector (especially SMBs).

The latter could prove to be key. As profit margins in the consumer sector continue to fall as mobile penetration across Africa continues to rise, there is a sustained decline in ARPU. The business segment therefore presents a viable next frontier of growth for telcos.

The **RFS** Product Portfolio



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chapter 2 Cellular networks

LTE connections pass one billion

Alan Hadden, Vice president, GSA

The global LTE success story continued in 2015, a year in which 104 operators commercially launched 4G/LTE service. The *Evolution to LTE* report published by the Global mobile Suppliers Association (GSA) in January 2016 confirmed that 480 operators have commercially launched LTE networks in 157 countries, and predicts that this will rise to 550 operators by year end.

Most LTE deployments globally use paired spectrum (FDD). The TDD mode is complementary and the best choice for providing high-speed mobile broadband access in unpaired frequencies. Both FDD and TDD networks are deployed in Africa, matching spectrum assets and the different regulatory environments that prevail in the region.

Of the 480 LTE networks that have now been commercially launched: 409 operators deployed LTE using FDD mode only; 50 deployed LTE using TDD mode only; and 21 deployed using both FDD and TDD.

LTE is growing faster than any other mobile communications system technology and supports one in seven connections worldwide today, having passed the one billion milestone in Q4 2015 and ending the year at 1.068bn.

The world saw 552.2 million LTE subscriptions added in 2015, representing 107 per cent annual growth. Almost 1.7 million were being signed up daily in the last quarter alone. With 156 million connections in Q4, LTE achieved 75 per cent more users than 3G/HSPA. The number of LTE and LTE-A subscriptions will pass the 3G/WCDMA-HSPA global total in 2020. GSM subscriptions fell by 141 million in Q4 2015.

The APAC region has the largest share of LTE subscriptions with 54.3 per cent, followed by North America (22.8 per cent) and Europe (14.8 per cent).

In Africa, 4G/LTE mobile broadband connectivity arrived in several countries for the first time during 2015 in Benin, Botswana, Cameroon, Ethiopia, Gambia, Malawi, Morocco, and Somalia; several new players also entered the various markets.

Africa had 6.073 million LTE subscriptions by the end of 2015, up from 2.71 million 12 months earlier – an impressive 124 per cent annual growth. In terms of subscriber numbers, the top 10 LTE markets are (highest first): South Africa, Morocco, Nigeria, Angola, Uganda, Kenya, Ethiopia, Namibia, Zimbabwe and Gabon.

Spectrum

The most widely used spectrum for LTE network deployments worldwide continues to be 1800MHz (3GPP band 3). This is in commercial service in 100 countries on 213 LTE networks, i.e. 44.4 per cent of all LTE networks globally.

The 1800MHz band also has the most developed user devices ecosystem: 2,381 have so far been announced, and 54 per cent of all LTE devices can operate in this band.

The next most popular contiguous band for LTE deployments is 2.6GHz (3GPP band 7). This is used in 108 networks (22.5 per cent), typically as a capacity band.

800MHz (band 20) is by far the most popular sub-1GHz choice for LTE coverage and continued to gain share in 2015 with 100 operators – more than one in five globally have deployed LTE networks using this spectrum. The next most popular contiguous band is AWS (band 4) and is used by 45 LTE operators.

Being part of ITU Region 1 (which also includes Europe and Russia), Africa can directly leverage and benefit from the fact that the three most popular bands for LTE deployments not only have the largest user device ecosystems, but are also widely allocated and in use for FDD deployments in the region's markets. This also greatly assists LTE roaming for customers of African operators.

The pace of TDD deployments has been relatively modest in Europe, with most using 2.6GHz spectrum. There are extensive TDD network deployments elsewhere, particularly in China where there is soaring TDD growth, and also in Africa, the Americas and Asia.

In Africa, 2.3GHz (band 40) and 2.6GHz (bands 38 and 41) are the most common for TDD. Band 41 is the band with most subscribers globally since it has been deployed in major markets such as China, US and Japan.

Prospects for TDD deployments using 3.5GHz spectrum (bands 42 and 43) are also excellent at the global level, and 17 networks use this spectrum for commercial service, including two operators in Nigeria.

LTE-Advanced

Investment in LTE-A technology worldwide is strong. 163 LTE operators (around a third) are investing in LTE-A deployments, studies or trials in 72 countries and 116 operators have commercially launched systems in 57 countries, including in Gabon and Kenya. LTE-A technology trials are progressing in Angola and South Africa.

18 LTE-A networks support Category 4 user devices (101-150Mbps theoretical peak downlink) but the vast majority (around 75 per cent or 86 networks) support Category 6 devices which are capable of a theoretical peak downlink data speed of 151-300Mbps and 50Mbps on the uplink. More than

half of Category 6 networks support the maximum 300Mbps theoretical peak rate.

Evolution of LTE doesn't stop there. Eleven Category 9 systems (301-450Mbps downlink) have already been commercially launched, and the first Category 11 system (451-600Mbps) has gone live in Australia.

Several LTE-A Pro networks with even higher capabilities and performance levels are scheduled for deployment in 2016-2017, using features that have been standardised by 3GPP in Release 13 (and more will follow in Release 14).

Another big trend is the rapid shift to transporting voice over LTE networks. 118 operators in 56 countries are investing in VoLTE deployments, studies or trials of which 46 operators have commercially launched VoLTE-HD voice service in 29 countries, including South Africa and Uganda.

The *Status of the LTE Ecosystem* report published by GSA in February 2016 confirmed the rapid expansion of the LTE ecosystem and a boom in the availability and performance of LTE devices. 1,770 devices were added to GSA's LTE devices database (GAMBoD) during the year, confirming 67 per cent annual growth, and the number of manufacturers grew 34 per cent in the same period.

The smartphone is the largest LTE device category. 2,706 smartphones including operator and frequency variants have been announced, giving an improved 61.2 per cent share of all LTE device types. Ninety-eight per cent of LTE smartphones are multimode, capable of operating on at least one 3G technology in addition to LTE. Almost 50 per cent can operate on 42Mbps DC-HSPA+ networks.

Digital dividend

Last November's World Radiocommunication Conference (WRC-15) acted to confirm the use of 700MHz spectrum (band 28) for mobile broadband globally, including in ITU Region 1. This spectrum is very much favoured for coverage and arises as a digital dividend from the transition by TV broadcasters from analogue to digital transmission (in Europe this is effectively a second digital dividend as 800MHz band 20 was the first).

International support for the APT700 band plan, specifically the FDD arrangement (3GPP band 28 pairing 703-748MHz with 758-803MHz) continues to strengthen and positions APT700 as a near global band which should lead to vast economies of scale benefits for Africa. It's worth noting that Europe's 700MHz band plan is compatible with the APT700 arrangement (lower duplexer).

While harmonising the use of global and regional spectrum removes uncertainty and encourages growth, new frequencies need to be identified for 4G and to meet the anticipated mobile broadband capacity demands for future 5G services and use cases.

The GSA Spectrum Group (GSG) has been formed to contribute to the international and national spectrum work, and intends to actively participate in the ITU World Radiocommunication Conferences. The GSG will operate in all regions around the world mirroring closely the ITU-R organisation structure, and will do vital work leading up to WRC-19.

The group comprises around 45 spectrum and regulatory experts from GSA executive and member companies, and is applying for ITU sector membership.

The GSA has launched a new website which continues to provide a wealth of unique market data, statistics and industry insights. Readers should register at www.gsacom.com.

Africa embraces the future

With 4G rollouts still continuing at a pace, 2015 saw the ITU finalise the main goals, process and timeline for 5G, and established the overall roadmap for the development of systems under the name "IMT-2020".

IMT-2020 is an extension of the ITU's existing family of global standards for International Mobile Telecommunication systems. The organisation reported that work on IMT-2020 was now well under way in close collaboration with governments and the global mobile industry. The next step taken was to begin work on establishing detailed technical performance requirements for the radio systems to support 5G, taking into account the needs of a wide portfolio of future scenarios and use cases, and then to specify the evaluation criteria for assessment of candidate radio interface technologies to join the IMT-2020 family.

Over 2016-2017, Working Party 5D will define in detail the performance requirements, evaluation criteria and methodology for the assessment of the new IMT radio interface. Evaluations by independent external groups and a definition of the new radio interfaces to be included in IMT-2020 will then take place during 2018-2020. The whole process is planned to be completed in 2020 when a draft new ITU-R Recommendation with detailed specifications for the new radio interfaces will be submitted for approval within ITU-R.

The union said the new systems will "usher in new paradigms" in connectivity in mobile broadband wireless systems. For example, it said they will support extremely high definition video services, real-time low latency applications, and the expanding IoT.

With a timeline now established, Etisalat Group announced it had plans to be the region's first operator to launch 5G.

JANUARY 2015

Ooredoo said its 3G network in Algeria has been ranked as the fastest in North Africa in 2014 by the official Network Quality Benchmark. It added that it has also become one of the first operators in the world to achieve network throughput of 63Mbps, and is the first in Africa to deploy a 400G ultra-broadband mobile access network. The operator claimed 3.5 million customers have now signed up for its 3G service since it was launched in December 2013.

FEBRUARY

CommProve is working with an African telecoms regulator to monitor the QoS of multiple mobile network operators. The Ireland-based firm, which specialises in end-to-end network management, said it is unable to name the regulator or the country where it's from. The regulator has deployed CommProve's *GSP* monitoring solution at sites run by each of the operators. It provides KPIs for every cellco, based on the experiences of every subscriber across each network and round the clock. The information gathered is fed back to a centralised reporting system, and is based on the actual calls or data sessions that subscribers make, or try to make in the case of service failures.

MARCH

ZTE has signed a deal to build Algeria Telecom's LTE Phase II project. This is the second time the vendor has worked with the telco following its LTE Phase I project, with the first purchase order for Phase II covering 14 provinces in the north east region. Algeria is the second country in this part of Africa to offer commercial LTE services, having launched its Phase I project in April 2014 with the added help of Nokia Networks. 4G services based on LTE are also available in the region from Smile Communications in Nigeria.

APRIL

Nexmo, which specialises in providing application program interfaces (APIs) for cloud communication, has signed a deal with Mobilis, Algeria's first independent mobile operator and a subsidiary of Algeria Telecom.

Etisalat and Ericsson revealed that they would exchange knowledge and share their solutions to develop 5G. Rollouts could happen in any of Etisalat's African operations, including Sudan (Canar), Egypt, Nigeria, amongst others.

The plan for the future of mobile communications in Africa and the move to 5G was put into perspective by a study by the GSMA. In its *Mobile Economy – Sub-Saharan Africa 2015* report, the association said the mobile industry contributed USD102 billion to the region's economy in the previous year. This was equivalent to 5.7 per cent of sub-Saharan Africa's GDP, with mobile operators directly contributing 1.7 per cent or USD31bn. The GSMA forecasts the industry to contribute USD166bn in value to the region by 2020 which will be equivalent to eight per cent of expected GDP.

The technological march forward was punctuated in March with Telecom Namibia (TN) discontinuing both its *Switch* voice and 3G-EvDO data services on its legacy CDMA network. It said all CDMA sites were shut down on 31 March 2015 as it has transitioned most customers off the technology and onto TN Mobile's faster HSPA+/LTE networks.

"The entire CDMA footprint is already covered with GSM which we began building in 2013," said an announcement on the operator's website. "Customers who are still using their CDMA services are kindly advised to swap their CDMA numbers with a GSM SIM card of TN Mobile."

TN said the main reasons for the shutdown were to avoid operating two mobile networks and offer services over a single GSM platform. The move also enabled the firm to re-use the spectrum as needed. The operator added that CDMA was no longer able to "favourably compete" with GSM-based 3G and 4G LTE technologies. "CDMA is fast becoming obsolete around the world and the maintenance of the same will not be a simple affair for any telco in the mid and long term," stated the company.

4G spreads and diversifies

As detailed in this chapter's introduction, 2015 was notable for the continued spread of LTE. There were numerous new deployments and expansion projects.

For instance, Telkom expanded its LTE-A network to an additional 22 suburbs across South Africa, adding to what it claimed was "already the largest LTE-A network in the country". The expansion covered areas in greater Johannesburg, the Western Cape, KwaZulu-Natal and Tshwane. The firm claimed its LTE-A speeds were comparable to those available over a fibre network, offering a "compelling" alternative to fixed line broadband with the configuration supporting downlink rates of up to 150Mbps.

The longer-term goal is for much higher speeds than that. Back in late September 2014, the operator said it was upgrading its network to offer customers peak speeds of more than 200Mbps, with a view to developing its network to ultimately deliver LTE-A peak speeds of 3Gbps.

Another country to enjoy its first LTE-A network was Kenya. Safaricom rolled out 4G services in Nairobi and Mombasa.

The launch was described as part of the firm's push to "democratise data", according to CEO Bob Collymore. "The direct impact of data on our economy has already been noted through the increasing number of businesses and services offered online," he said. "With 4G, we can deliver revolutionary services like telemedicine, virtualisation, or real-time video that have immediate and transformational impact on our society." The operator added that it planned to launch "affordable" 4G-enabled devices, including phones, routers and modems. To date, the promise to expand coverage to other towns has so far not been delivered on.

The difficulties in moving to 4G have not just been experienced by Safaricom. Airtel was given the go-ahead by the Communications Authority of Kenya (CAK) to launch its 4G network back in May 2015. Preparations had already been made with upgrades to its 3G network in Nairobi, Mombasa and Kitali as part of a USD26m plan to prepare for LTE. The latest update is that Airtel Kenya hope to launch 4G services by the end of 2016.

Also playing catch-up with Safaricom is Orange Kenya, which was also given permission to launch 4G trials on its networks, which almost certainly means it will be allowed to launch the technology on a commercial basis.

African countries could look to Malawi for helpful hints on furthering their LTE dreams. Access Communications not only implemented the country's first LTE network but also claimed to have completed it in record time with the help of Italy-based Athonet.

Huawei created a bespoke end-to-end *eLTE* system for the Addis Ababa City Light Rail Transit project.

The agreement will see Nexmo provide Mobilis with, among other things, online security solutions. Sid Ahmed Zaidi, business development and international roaming deputy director for Mobilis, said Nexmo will bring "advanced" communication tools to a growing network of 15m subscribers.

MAY

Egyptian cellco Mobinil and Huawei have now successfully completed the implementation of a Single RAN project. Mobinil began implementing the system in 2011 in an effort to pave the way for better coverage and services, and facilitate 3G technologies which it first launched in 2008. The operator said its move to Single RAN has resulted in a better customer experience mainly through improved voice quality and reductions in dropped and blocked call rates. It added that the new technology is also more energy efficient.

JUNE

Botswana Telecommunications Corporation Ltd (BTCL) is planning to trial 4G this year. CEO Paul Taylor told local reporters that a commercial rollout would begin towards the end of 2015 following trials that were expected to start during Q1. While BTCL has yet to issue any official statements about its 4G plans, the *Botswana Guardian* said the firm is currently deploying LTE trial sites across the country and is also investing BWP110m (USD11m) in a network upgrade programme. Mascom Wireless and Orange have already demonstrated their 4G capabilities in the country.

JULY

Truphone has added South Africa as one of five new emerging market business hubs. The UK-based firm – which describes itself as "the mobile network operator without country borders" – offers in-bundle plans across 66 countries. It said these provide multiple international numbers on a single SIM, enabling businesses to make international calls that are treated as local ones, and giving contacts a direct way to get in touch on a local number.

AUGUST

South Africa's Cell C said some rival MNOs

Access' network offered initial services aimed at clients who require high speed internet access and voice services in Blantyre's business district.

Athonet said it was able to implement LTE for the operator in a matter of weeks using *PriMo*, its software-based mobile network infrastructure solution. The firm said this virtualises and increases performance of the mobile core, and can run on standard IT servers or in the cloud. It integrated this distributed virtual EPC with Access' existing infrastructure, including its CDMA network.

Athonet said the fully virtualised software approach has created an ultra-broadband LTE service with guaranteed low latency and high reliability. Speaking at the time, the company's head of operations Massimiliano Gianesin said: "Our software approach to infrastructure means that mobile networks in developing countries can be deployed very rapidly and cost-effectively both in terms of capex and opex, avoiding the complexity of legacy products and simplifying operations."

LTE has also branched out in what's claimed to be the first use of the technology in an African metro railway system. The Addis Ababa City Light Rail Transit (AACLRT) project had its telecommunications systems provided by Huawei, including an end-to-end eLTE trunking solution and related comms systems. These have been used to support vehicle-mounted devices and dispatching systems which were provided by another project partner, Shenzhen Communication Technology.

Huawei said that just one of its *eLTE* cells can provide a wireless network that covers 1,200m, and requires just four baseband units and nine radio remote units. The vendor added that *eLTE*'s ultra-wideband technology would enable wireless dispatching and various other services, including voice trunking and single-network ticketing data management, thereby reducing the need for trackside devices and lowering maintenance costs.

Vodacom's mobile data centre carries complete power backup with on-board generators, network equipment, and more.

In order to avoid duplicating network capacity and minimise the investment required for each device, Huawei said it based the AACLRT's system on a single backbone network that can support multiple services, including communication, signalling, SCADA and fare collection.

Cellular innovation

In what was claimed to be an African first, Vodacom developed a mobile recovery system to ensure its network would be even more resilient in the case of an unforeseen, catastrophic incident. The *RAN Mobile Recovery Solution* is essentially two mobile data centres housed on board a lorry.

The operator said the solution would give it the ability to restore functionality at any of its South African mobile telephone exchange (MTX) sites which link its RAN to the core network "These mobile data centres effectively allow us to recover our site within 48 hours instead of the two years it typically takes to build a new MTX site," said Vodacom network engineering officer Beverly Ngwenya: "We call this a 'hole-in-the-ground' recovery solution because it's used in the very unlikely event that our entire facility's functionality completely disappears."

The new solution was tested by simulating the recovery of an entire MTX site, choosing Midrand which provides connectivity to hundreds of thousands of customers in the southern and central parts of Gauteng. Vodacom reported that the tests ran smoothly and that no loss of service was reported.

Separately, Vodafone Egypt has built a unique, prefab MTX in the Nile Delta region in a bid to respond to the increased demand for mobile data in the region. "The business needed to quickly and cost effectively increase the number of MTX units in its network, particularly in highly populated regions, without losing any of the resiliency," explained Ahmed Abdelwahab, Vodafone Egypt's MTX planning and optimisation expert.

Vodafone said its engineers created a three-storey, 400m^2 building that was ready to ship in 12 weeks and operational in six months. All the components for the facility were manufactured and tested in advance before being sent in containers to the site, ready for assembly.

More innovation was demonstrated by South African mobile operator Cell C. Following months of testing, the company launched *Wi-Fi Calling* to its entire customer base on 1 October 2015.

According to the operator, the service effectively turns any Wi-Fi hotspot into a Cell C base station. This promises to give subscribers extended coverage, wherever they are, enabling them to make calls and send texts "seamlessly"

are deliberately preventing subscribers from cancelling contracts early by charging them "excessive and unreasonable" penalties. While it doesn't name names, the firm said it's aware of certain instances where customers are being asked to pay full subscription fees for the remainder of their contracts, plus an additional termination charge. Cell C pointed out that the Consumer Protection Act clearly specifies that penalty charges cannot be an amount which would have the effect of "negating the consumers' right to cancel".

SEPTEMBER

Ooredoo is working with Nokia on what it said are the first 4G technology tests in Tunisia. They began at the start of September with Ooredoo deploying pilot networks in two major cities. While the initial results have shown a download speed equal to 69Mbps, the operator claimed its 4G technology may exceed 100Mb speed when it's launched in the first half of 2016. Ooredoo's operation in Tunisia was previously known as Tunisiana, but changed following a global rebrand.

OCTOBER

Paratus Telecom is using Infinera's *TM-Series* WDM system for its metro network in Windhoek. It's claimed the upgrade provides the operator with an optimised 10Gbps transport solution upgradeable to 100Gbps. With its acquisition of local voice company VOX in 2014, Paratus said it has experienced "immense growth" in converged data traffic requiring next-generation network technology built on an advanced fibre-optic infrastructure. "The *TM-Series* packet-optical network solution effectively addresses our bandwidth requirements to keep up with the rapid growth in converged network services," said Samantha Geyser, the operator's executive of planning.

NOVEMBER

MTN will use Ericsson's *Order to Cash* BSS platform to standardise the customer experience of its products and services in all 22 countries where it is operational. As part of the deal, Ericsson will be responsible for the replacement of all legacy infrastructure with its new *Charging System*, along with its *Multi Activation* and *Multi Mediation* software. According to the vendor, *Multi Mediation* supports the retrieval and

Following its own investigations, Gemalto said there are "reasonable grounds" to believe a joint surveillance operation by the NSA and GCHQ (pictured) "probably happened" during 2010-11.

over the Wi-Fi network. When using the service outside South Africa, customers can use any Wi-Fi hotspot to make any call to any network at their local Cell C tariff plan rates.

Operator woes: hacking, failing, and cancelling

Africa saw its fair share of problems in 2015. A hacking scandal erupted following revelations published on the *Intercept* website in mid-February that UK intelligence agencies had the potential to hack SIM cards manufactured by digital security specialist Gemalto.

According to the report, during 2010 and 2011 operatives from the US National Security Agency (NSA) and the UK's Government Communications Headquarters (GCHQ) hacked SIM card encryption keys engraved in Gemalto's and possibly other vendors' SIM cards.

Citing former NSA IT contractor and whistleblower Edward Snowden as its source, *Intercept* said the intelligence agencies had "the potential to secretly monitor a large portion of the world's cellular communications, including both voice and data". KuppingerCole senior analyst Alexei Balaganski claimed the intelligence agencies did not just resort to hacking, but also ran a global surveillance operation on Gemalto's employees and partners. Despite all the revelations, Gemalto maintained that its SIM cards were secure.

Beyond worrying about whether calls are secure is whether a call can be made at all. The QoS tests carried out by the Independent Communications Authority of South Africa (ICASA) back in October 2015 showed Cell C, MTN and Vodacom all failed to meet call retention targets.

Using Ascom's TEMS investigation tool, ICASA's drive-test focused on network performance measured in terms of call setup success rates (CSSR) and retention of voice calls (drop call rates). The results showed that the three operators did not meet the target in terms of call retention, whilst Vodacom met the CSSR target.

In Nigeria, however, operators were under considerably more pressure to deliver high-quality services. The country has become the latest to threaten mobile operators with imprisonment if they fail to deliver quality services to customers.

Dupe Atoki, director general of Nigeria's Consumer Protection Council (CPC), said mobile users are having to deal with dropped calls, unsolicited texts and calls, and the disappearance of their credit. She said such poor quality of service has left the government with no choice but to impose harsh measures.

"In order to enforce consumer rights and ensure compliance with CPC's enabling law, CPC has adopted a strategy of criminal prosecution of recalcitrant businesses or litigations to achieve satisfactory redress," warned Atoki.

In Zimbabwe, Telecel paid the ultimate price for allegedly not paying its fees and its flouting of the country's back ownership laws by having its license cancelled by the government. Foreign ownership of Zimbabwean companies is limited to 49 per cent by law, but Telecel's local operation was estimated to have only 40 per cent local ownership.

Talks continued after the cancellation of the license and by July Telecel was making initial payments for a new license. The operator promised it would take all possible steps to maintain the full range of its services throughout this process, and said the welfare of its customers and partners was of the "utmost importance and priority".

processing of user data from all network nodes. The data can then be made available to the relevant IT back-end systems and billed in real-time.

DECEMBER

The Zambia Information and Communication Technology Authority (ZICTA) has discovered illegal SIM cards being sold in Masala townships in Ndola, the country's third-largest city and commercial centre for its copper mining region. Working with local police, ZICTA's compliance officers confiscated an unknown number of pre-registered MTN and Airtel SIMs. The authority said they were being sold to the public contrary to Zambian legal regulations which state that purchasers submit a completed SIM card registration form to the seller.

Rahiel Nasir, Editorial director, African Wireless Communications Yearbook

The year ahead: If there's one nut the continent's mobile network operators have found it hard to crack, it's the enterprise market. In the conversations I have had with major operators such as MTN and Orange, this is the sector that comes up repeatedly when I ask them where their pain points are.

But that now looks set to change. Operators have been boosting their international connectivity capabilities by forging alliances with other service providers. For example, MTN has now teamed up with Telefónica, Liquid Telecom, amongst others, and has also enhanced its own MPLS network as part of efforts to offer enterprise class services and attract more business customers on the continent.

However, if you take the enterprise IT services offered in developed markets as a model, what's really needed in Africa is an ecosystem of data centres, cloud entities and network availability that guarantees uptime for all mission critical applications.

The continent's MNOs are, by their very nature, already cloud service providers. And by investing in fibre, satellite as well as their own cellular networks, they can offer the availability enterprise users demand. Some, like Vodacom for example, have even built their own data centres. Factor in M2M and the IoT, and 2016 could be the year that African MNOs finally crack that nut.

Hesham El Nahhas, GM for Africa, Middle East & Turkey, RFS

Radio Frequency Systems (RFS) has been involved in developing unique telecoms infrastructure solutions for more than a century. Today, the US-headquartered firm has six factories around the world, as well as five R&D centres in Australia, China, France, Germany and the US.

So what about Africa? Here, RFS says its business is expanding on a continent where the wireless infrastructure market grew by at least 10 per cent in 2015, as Hesham El Nahhas explains.

"In Africa and all over the world, the need for mobile broadband is increasing in all environments. Last year, RFS participated in wireless network deployments in many African countries including Nigeria, Uganda, Tanzania, Algeria, and several others. Some were new installations while others were upgrades as part of network optimisation.

"Many operators know they need premium technology for active components, but may not realise that compromising on the quality of passive components – such as the antenna – can cripple network performance. RFS works closely with operators to provide infrastructure solutions that can help future-proof their networks, which is essential to long-term success."

El Nahhas says one project the company is currently working on is the deployment of a wireless network for the metro system in Algiers. He says that because RFS has more than 40 years experience in providing communications technology for railways, metro systems, road tunnels and underground mines, it is "uniquely" qualified to take on such projects, and can deliver "trusted, best-in-class products even for the most demanding environments".

So how has he seen the continent's wireless communications market adapt and evolve in 2015? "A great deal of modernisation is taking place, and high-speed network capacity has become essential. Many networks in Africa are changing from 2G to 3G and 4G. With so much improvement going on, it's important that the upgrades are done well and are future-proof to accommodate new technologies."

As is well documented, El Nahhas says fixed lines are scarce in many African countries so users are heavily dependent on mobile communications, and this intensifies the need for high-quality infrastructure. He adds that the region presents interesting opportunities for RFS, as operators stand to benefit from technologies that have already been proven elsewhere. "With network improvement and expansions coming online later than in some other parts of the world, prime opportunities exist for deployment of the most innovative infrastructure solutions.

For example, instead of adding visual clutter with more antennas to enable LTE, they can skip ahead to using new multi-band antennas handling 3G at 900MHz, LTE at 1800MHz, etc., on the same band, as well as lower or higher bands such as LTE 800MHz or LTE 2.6GHz."

El Nahhas says multi-band antennas are a big part of the solutions RFS brings to these markets. He adds that two new ultra-broadband models in the company's *RF X-TREME* family are facilitating triple-band site upgrades for reduced cell interference in high-traffic areas.

"In Uganda, LTE Band 20 interference with CDMA850 prompted the government to mandate a fast fix. RFS provided its *Interference Mitigation Filter* to solve the problem, and has so far supplied over 500 filters that are being used at 200 sites in the country."

"Additionally, parts of Africa have environmental conditions that present unique challenges. In desert conditions, towers and pylons need extreme wind resistance. RFS' innovative radome design dramatically reduces wind load and tower loading. The wind load resistance on RFS' antennas is a key advantage in these challenging environments."

He goes on to say that accelerating LTE deployments and a growing need for hybrid solutions will continue to drive Africa's market expansion.

"RFS' hybrid solutions bundle DC cables and fibre cables together into a single cable, offering the flexibility to expand or deploy new RRHs when needed. Deployments of our *HYBRIFLEX* hybrid solutions in Tunisia and Algeria, and in the greenfield operation in Myanmar, have been very successful.

"Small cell backhaul is another significant focus for developing microwave technology. In Africa, operators use microwave backhaul to roll out and control the overall end-to-end quality of network service. RFS' *Invisiline* transparent antennas minimise visual impact, and in 2015 we added the industry's smallest E-band (80GHz) microwave antenna to the *Invisiline* family. The antenna's 122mm reflector and 166mm radome diameter make it visually unobtrusive in any landscape."

So looking ahead, what challenges does El Nahhas envisage for RFS in Africa during 2016? He says modernisation and expansion of network infrastructure will continue unabated on the continent throughout this year and beyond.

"To fulfil the ever-growing demand for network capacity, operators will need to carefully weigh the balance between quality and cost of components, such as antennas, and beware of low-cost, inferior offerings. In the long run, operators making an investment in future-proof solutions will face fewer problems as the infrastructure continues to evolve.

"The most competitive networks will incorporate some of the industry's latest technologies that are suited to all kinds of challenging environments, and to meeting ever-increasing capacity requirements, so they can keep up with the changes ahead.

"RFS will continue expanding its business in Africa in 2016, completing deployments currently under way, and providing its highest-quality solutions where they are needed.

"The company is also planning to increase its presence in Africa by building up its team in key markets – namely North Africa, Central and East Africa and also South Africa."

Igor Biasetti, Sales manager MEA, Coiler Corporation

Last year was "very fruitful" for repeater supplier Coiler in Africa. According to regional sales manager Igor Biasetti, the company significantly strengthened its position in several territories.

"They include Namibia, where Coiler repeaters have been extending coverage for almost a decade now, and Mauritius, Cape Verde and the Seychelles, where our high-power *CR* and *AX* models will soon be deployed on the UMTS network. Our *VB* mid-power indoor repeaters have been tested and approved by Maroc Telecom Networks, while our SOHO plug-and-play series will soon be deployed by Vodacom in Mozambique.

"Globacom Nigeria is also testing some of our equipment, and their feedback so far is extremely positive. MTN Global invited us to participate in a large tender, in which we offered our entire portfolio – quite a big step forward for Coiler in the region."

Biasetti says the biggest trend his company witnessed on the continent in 2015 was the continued rise of LTE as well as an increasing focus on quality.

"In more countries, 4G is becoming a top priority for operators who want to provide added-value services to their customers. There has been a significant increase in demand for LTE solutions, especially in countries that are taking the lead in Africa in terms of technology.

"Although price still is one of the most important factors driving operators, a growing trend for quality products can also

be seen. Operators are increasingly realising that the value of equipment is not only in its price but also in the quality of the hardware and in the additional services available on top of the equipment.

"By offering African operators innovative products and tools to accompany repeaters – such as remote network analysis devices and highly advanced management software solutions – Coiler's portfolio is well aligned with this movement.

"There is also a trend towards multi-technology solutions in one box that are able to address several coverage issues simultaneously – flexibility and adaptability are the keywords for operators here. Our *VB* series, which can be connected to create dual or triple band repeaters, can be a very interesting solution for operators who anticipate future expansions of their networks.

"Simple-to-install, intelligent, auto adjustable solutions also seem to gain space on the continent, following a global trend. Our *AT* and *PS* series repeaters, for example, have received a lot of attention recently thanks to their embedded antennas and plug-and-play installation.

"Rolling out 4G technology fast enough to meet demand is definitely one of the main challenges for African operators in the coming year. A lot of infrastructure still needs to be put in place to address indoor and outdoor coverage issues, both in Africa's growing megacities and in remote villages.

"By extending coverage without having to deploy more costly base stations, repeaters and signal boosters are an excellent solution to improve access to networks throughout the continent; I am convinced their place in hetnets in Africa will continue to grow steadily in the coming years.

"The big challenge for Coiler is providing the continent with the high-quality products and services we are globally renowned for, but at prices more in line with the budgets of the region. With a portfolio as wide as ours we believe we are in a unique position to offer the most flexible solutions to operators throughout the continent. In the coming year, we expect to expand our business to even more countries and establish new strategic cooperation with operators throughout the region.

"Earlier this year, we launched the *ST* series, a brand new line of 4G intelligent single band repeaters, and *NMS* Infinity, a cloud-based management system for remote repeater control and network monitoring.

"These new products – which allow operators to remotely control and troubleshoot repeaters while gathering valuable real-time and historical network Big Data – should give us even more of an edge over competitors. We hope to see this integrated repeater system deployed in several of the more mature African markets in the coming year."

Joseph Habib, Leader of wireless, CommScope, MEA

Joseph Habib says the big theme at this year's Mobile World Congress was 'Mobile is Everything'. "CommScope witnessed tons of information about the evolution of networks and the underlying technology that enables our mobile world. We also heard a lot about the emergence of the IoT, and plenty of organisations talked about 5G defined.

"Nowadays, expectations for network connectivity in the workplace are very high. Almost all of us expect access to high-performance, desktop PCs and/or laptops, which are networked through wired connections or unlicensed wireless spectrum via Wi-Fi. Mobile devices such as cellular phones have become another reliable and compelling option when connecting indoors.

"People are obsessed with their mobiles and see indoor wireless coverage as important as having access to water and electricity. There are about two billion smartphone users globally and about 80 per cent of cellular data sessions originate or terminate inside a building. But 98 per cent of commercial buildings do not have dedicated systems to guarantee reliable indoor cellular coverage. Why is that? To find out, CommScope recently commissioned research firm Coleman Parkes to carry out a study.

"We surveyed the professionals who design and manage buildings to explore their attitudes and insights about enterprise mobility. The results show that whilst the driving force for reliable cellular connectivity in a building is clear, the reality on the ground is that stakeholders are not invested enough in dedicated indoor systems.

"This is especially surprising considering that survey respondents estimated that the value of a property could increase by an average of 28 per cent with the implementation of a dedicated in-building wireless system. The commercial imperative for investing in dedicated in-building wireless systems is becoming clearer as challenges associated with system costs and technical complexity are confronted and overcome.

"Cellular connectivity in the building is now as important as making available any basic utility for a building. Would you refuse to invest in water supply within your building because it was deemed too expensive or complicated to do? The workplace of the future will have a plethora of choices for connecting, and dedicated indoor cellular systems will become the norm in buildings of all sizes."

Luke Taylor, Deputy CEO and CCO, Neural Technologies

Neural Technologies says its risk management solutions analyse billions of transactions daily, providing protection for one in seven of the world's mobile phone users. The UK-based firm has been in the industry for more than 25 years, and in Africa it has worked with Safaricom, Kenya, MTN, Telkom in South Africa, Meditel in Morocco and Zain Sudan.

According to deputy CEO Luke Taylor, 2015 saw an evolution in the continent's market, and he reckons proof of this came via Neural's risk management global survey data.

"The wireless communications market in Africa has come a long way over the past couple of years and is starting to enter a new phase of its evolution: market maturity.

"Whilst Africa is large, and its individual countries all have very different political, geographic and infrastructural challenges, some nations are heading towards market maturity.

"Although there are still some African countries and rural areas with lower mobile penetration rates due to lack of infrastructure, countries such as Botswana, Mali, Mauritius and South Africa have reached over 70 per cent penetration. In South Africa in particular, many reports cite over 100 per cent penetration, as people are carrying more than one mobile phone, however, the percentage of smartphone penetration is still below 50 per cent in sub-Saharan Africa overall.

"In countries where the penetration rates are highest, operators are beginning to focus more on customer retention than new acquisition, because it costs more to win a new customer than to retain an existing one, and our survey data reflects the start of this attitude shift."

More than 100 telecoms fraud experts completed the Neural Technologies Risk Management Global Survey which asked questions about key aspects of the communications market, from company losses to the emergence of Big Data, OTT and IoT.

Taylor says 42 per cent of respondents globally considered OTT (including video, audio and other media) more of a threat than an opportunity, citing the increasing trend of OTT bypass fraud and customer distrust of over-the-top services as reasons.

Fifty per cent saw opportunities to increase ARPU through OTT by offering OTT apps, on-demand services (including TV, movies

and sports add-ons), and broadening product offerings. The remaining eight per cent saw OTT as both a threat and an opportunity.

Globally however, Taylor points out that the regions had very different perspectives: "Only 17 per cent of North American respondents saw OTT as an overall opportunity, compared to 61 per cent of African respondents. And Africa showed an above average recognition of the opportunities delivered by the IoT (including home appliance monitoring, healthcare monitoring and smart metering) at 78 per cent, compared to the global average of 74 per cent."

He continues by saying 2015 saw changes in consumer demand across the continent, with more calls for new technology and data services such as IoT, OTT and app availability like *Facebook*.

"As the available market is starting to reach maturity, there is a drive towards customer retention, with pricing reductions and lower margins coming into play. Termination rates are decreasing and voice calls are becoming more competitively priced, so the need to maximise revenue is key.

"Consequently, I was not surprised to see that African operators are keen to offer additional services and subscriptions, adding competitiveness and increasing ARPU through selling M2M and similar services via IoT and OTT channels."

Neural's survey also questioned operators about mobile money and asked if they had implemented services such as branchless banking and money transfers. Here, Taylor says Africa and South East Asia showed the highest rates of offering e-wallets/contactless payment services at 61 and 75 per cent respectively.

"We have seen the increase in mobile money across these areas, as the drive to reach the world's unbanked population continues. At this year's Mobile World Congress in Barcelona, the GSMA announced that mobile money services exceeded one billion transactions in December 2015 with 100 million new registered accounts becoming active in 2015.

"Mobile money services are becoming an increasingly important part of the global telecoms and banking industries, and we will only see it grow further in years to come.

"Fraud continues to be perceived as the biggest threat from offering mobile money services. Over 80 per cent of our respondents cited it as their primary concern.

"However, it was encouraging to see 45 per cent of global respondents recognising mobile money as a channel for new services and revenues. In Africa, this rose to over 50 per cent, which gives us an indication on where the market will be heading in the next 12 months and beyond."

According to Neural's study, revenue loss varies widely by region, with Africa seeing 17 per cent losses compared to the lowest level of eight per cent in Western Europe.

"African respondents reported the highest level of internal fraud globally, and our clients continue to tell us that fraud, collusion and bribery continue to feature heavily in some parts of Africa. Of course, internal fraud occurs everywhere – each region surveyed attributed a percentage of loss to it, but it is exacerbated in emerging countries due to the diversity of wealth typical in these areas."

Over the next 12 months, Taylor reckons African operators will continue to address the big revenue threats: bypass fraud, internal fraud, etc. In addition, he believes the owners of the international gateways (which in Africa's case is the government) will begin to impose more regulations in an attempt to prevent revenue losses and increase licensing income from telecom authorities. This will add another layer of pressure.

"Furthermore, whilst the market begins to get to grips with understanding more of the data it is processing, the region still has issues with quality and consistency, and I think there will be greater focus than ever on quality improvement, both to avoid penalties and to aid customer retention."

Richard Schumann, VP of Africa sales, AdaptiveMobile

Founded in 2004, AdaptiveMobile claims to be the only mobile security company offering products designed to protect all services on both fixed and mobile networks through in-network and cloud solutions. The Ireland-based specialist says it solutions provide operators with advanced threat detection and actionable intelligence, helping them to protect more than one billion subscribers worldwide.

AdaptiveMobile has several regional offices around the world including one in Johannesburg from where it currently works with 22 MNOs across 18 countries in Africa.

In 2015, the company says it was busy building relationships with the continent's large operator groups, looking at how to best assist them in delivering protection to their subscribers. Traditionally, AdaptiveMobile had a focus on the "larger theatres" but this is now shifting toward the group operations which, according to Richard Schumann, has set up the firm for an "interesting and profitable" 2016.

"Africa has always been on the cutting edge of technology, and culturally, Africans tend to consider new technologies as a way of eliminating redundancies and costs in the networks. Traditionally, [the] operators have focused on subscriber acquisition as a growth strategy. However, over the past year new technologies and innovation within the operators seem to have shifted toward customer retention by driving solutions that enhance the user experience."

Schumann says this may have been driven by the larger markets reaching maximum subscriber penetration, and the bigger groups looking for ways to maximise customer satisfaction and retain users while looking at ways of maximising their spend.

So what does he see as the upcoming challenges for African telecoms during the year?

"The ability to make the transition away from traditional voice and text services and educate the subscribers in the Internet of Things will allow the operators to focus their attention on driving the subscriber into next-generation OTT services and, as such, drive the usage of data to a significant level. This should drive the cost of data services down, and as mobile is the only viable data service in most of Africa it is expected that this would drive revenues over the next 12 months."

Schumann continues by saying AdaptiveMobile's plans for the region over the next 12 months will be to drive revenue generation for the MNOs by eliminating the illegal use of both the SS7 and traditional transmission networks. "This focus will allow for an increase in revenue and lower interconnect costs for the operator, as well as increased subscriber protection for the end user."

In 2015, the company says it increased its presence in Africa by 16 countries following the MTN Group's deployment of its *Grey Route Controls* platform. AdaptiveMobile claims it's seeing a strong demand for this service and says this is being driven by its "leading edge" work in identifying, mitigating and protecting against the latest mobile security threats and shielding operators worldwide from financial exploitation. It says the region's MNOs are using the solution to identify and shut down grey route traffic and recapture millions of dollars in revenue each month.

MTN said *Grey Route Controls* was enabling it to successfully block unwanted messages terminating to its subscribers via unauthorised routes. Speaking last November, Mohammed Buari, senior manager of alliance operations for the MTN Group's enterprise business unit, said: "Since deploying its network protection platform, MTN Nigeria now records significant new revenues monthly and has stopped the primary streams of grey route messages."

In a study[1] published late last year, AdaptiveMobile's threat intelligence unit

described grey route traffic as extremely resilient: "It's pervasive nature and ability to continuously find new ways to enter networks makes it harder for operators to detect and gain control of these routes."

The study revealed that mobile operators worldwide are missing out on millions of dollars per annum due to application-to-person (A2P) SMS bypass fraud.

Through analyses of network data collected across five continents, the company verified that A2P SMS bypass fraud is significantly affecting operator revenue opportunities and will continue to grow until a security solution is put in place. A CAGR of 127 per cent is predicted for the enterprise A2P messaging market by 2020, making it worth USD7.5bn and a considerable challenge for operators around the globe.

According to the report, one unnamed African operator was able to recapture more than USD44 million per annum through using the *Grey Route Controls* service. AdaptiveMobile adds that other benefits of its platform for the operator include a significant decrease in the volume of customer complaints and billable time-handling concerns. Furthermore, the insights obtained via the software enables them to identify new revenue streams in vertical markets as well as gain market share over competitors.

[1] Turning Grey into Gold – AdaptiveMobile Threat Intelligence Unit Analysis on Recapturing A2P Messaging Revenue

Magnus Nmonwu, Regional director, Sage West Africa

Mobility is the growth engine of Nigeria's economy and the mobile internet is rapidly transforming the way the country does business, according to Magnus Nmonwu, West Africa director for business software specialist Sage. As a result, he says employees and managers are increasingly able to access information on the road to serve customers, speed up decision-making, and save time.

"With sub-USD50 smartphones on the way, rapid improvements to telecom infrastructure, and the availability of affordable cloud applications, the mobile internet is empowering enterprises to be more flexible, responsive and efficient than ever before.

"Nigeria is adopting the mobile internet as quickly and enthusiastically as it did mobile voice services some years ago. It is helping people to enhance their lives and to improve their standard of living, while enabling enterprises to transform how they operate."

Citing statistics from Ericsson's *Mobility Report (also see Chapter 1, State of the Markets, pp8-19)*, Nmonwu says total mobile subscription penetration in sub-Saharan Africa is about 80 per cent but will grow to 100 per cent and a billion mobile subscriptions by 2021. "As one of the largest mobile markets in Africa, Nigeria is leading the trend based on these results. As one example of mobile's impact on the country's economy, consider the fact that the Ministry of Science and Technology forecasts that the mobile market will be worth USD166bn in 2020 and directly employ about 2.7m people.

"Many of our customers and employees today walk around with smart devices that give them access to apps and information wherever they are. For example, *Facebook*'s statistics show that 7.1 million Nigerians access its platform every day, and 100 per cent of its monthly users access it on a smartphone."

Nmonwu believes that tapping into this behaviour gives organisations new ways to interact with employees, suppliers, customers and other stakeholders. He says this ranges from mobile marketing, advertising and e-commerce for consumers, to mobilising business applications such as ERP solutions.

"A salesperson can now easily check from a tablet or smartphone whether a product is in stock while on-site with a customer, and place the order without going to the office. And managers can now use their time between meetings and at airports more productively.

"Mobile technology is also helping HR departments to become more efficient and to build better relationships with employees. For example, companies can offer employee self-service (ESS) across mobile devices to streamline HR processes, and engage with personnel more effectively.

"With mobile ESS, companies can enable employees to file leave applications, submit doctor's notes when they're ill, and make expense claims – all from their devices. They can look up their payslips, change their personal details, and more, all without needing to do paperwork, visit, or call the HR department."

In addition to the productivity boom, Nmonwu says organisations need to adopt mobile business processes and apps to meet the expectations of employees and customers.

"Today's consumers and employees want to interact with companies using accessible, easy to use mobile services and apps. The future is mobile for Sage. We are giving our customers the power to control their businesses from the palm of their hand, connecting them to accountants and partners with real time and intuitive information about their businesses.

"Enterprises thus need to start mobile security and device management, so that they can support mobile employees. Today's consumer wants service on demand from a handset and today's employee wants to be productive wherever he or she is, at anytime or in any location. With this, we expect to see a great deal of investment into mobile technology in West Africa over the next year or two."

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