

Oracle Communications LTE Diameter Signaling Index

4th Edition

ORACLE WHITE PAPER | OCTOBER 2015





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Executive Summary

Oracle Communications forecasts that global Long Term Evolution (LTE) Diameter signaling will grow from 30 million messages per second (MPS) in 2014 to 395 million messages per second (MPS) by 2019, representing a compound annual growth rate (CAGR) of 68%.

This year's Oracle Communications LTE Diameter Signaling Index, 4th Edition, outlines the global trends in LTE Diameter signaling growth through 2019. The report provides guidance on demand for overall network signaling capacity. Four key applications are used to chart the impact of applications on Diameter signaling and the associated growth rates.

We have organized this year's report according to data from five regions, as opposed to four as in previous reports. We made this change in order to more accurately reflect our sources and summarize the impacts on the economy, technology and smartphone penetrations, as well as overall Diameter signaling.

The Oracle Communications LTE Diameter Signaling Index provides guidelines for engineers, network planners, and executives tasked with capacity planning for Diameter implementations. We focus on the newest trends in the industry and provide a high-level view of how applications will impact the Diameter signaling network once they are implemented. The calculations are based on the number of LTE connections, the types of devices being used in the region, and subscriber behaviors — all fundamental requirements for modeling Diameter signaling traffic.

Other findings in this year's report:

- We see video services evolving to LTE Broadcast as networks continue their evolution to all-IP. LTE Broadcast is the fastest growing generator of Diameter signaling, generating 49.5 million MPS by 2019, at a CAGR of 75%.
- Latin America & the Caribbean show the highest growth in Diameter signaling, increasing from 311,000 MPS in 2014 to 15.4 million MPS by 2019. This represents a CAGR of 118%.
- North America is beginning to show maturity in Diameter signaling. Generating 82.9 million MPS by 2019, signaling growth in this market has slowed to a CAGR of 42%.
- Asia Pacific is the largest generator of Diameter signaling creating 188 million MPS by the year 2019, at a CAGR of 78%.

A bonus of this report is the ability to customize LTE Diameter signaling data to better understand the impact on your network. Visit <https://oracle-dashboard.com/diameter/> and try the online Diameter Signaling Calculator. Input the specifics about your network (such as number of connections) and you will receive a report generated by the same modeling tool used to create this global Index.



Industry Trends and Indicators

LTE is being implemented worldwide, usually in densely populated markets where subscribers are most likely to pay for smartphones and the data plans that come with them. There have been 360 commercially launched LTE networks in 124 countries, with an additional 251 service providers committing to LTE to date.¹ LTE will reach 39% penetration rate (by connections) by 2019 for a CAGR of 40%. Actual service provider results show a greater increase than that which we projected in last year's report.

Meanwhile, 3G-based WCDMA – considered by some to represent the end of life for 3G – continues to show growth.² In many markets, HSPA+ (which uses WCDMA technology) is being offered in place of LTE service. In those cases, the subscriber base continues to use its existing devices and to realize faster speeds – although still not as fast as those of LTE.

WCDMA growth is important to the purpose of the signaling report, because it is supported by SS7 signaling, which will continue to be valuable as subscribers move from 3G/UMTS and GPRS networks to HSPA+. WCDMA will have reached 43% penetration rate at a CAGR of 12% by 2019.³

The digital lifestyle has engulfed us all, as evidenced by the steady growth of mobile data traffic. Mobile data accounted for just 4% of all IP traffic in 2014, but will increase to 14% of all IP traffic by 2019. Mobile data traffic will grow at a rate of 57% CAGR.⁴ It is estimated that connected devices will grow to three devices per capita by 2019.

Video will represent 72% of all IP traffic by 2019, at a CAGR of 66%.⁵ This is an important factor for LTE Broadcast as service providers look for a more efficient means of distribution, both in mobile and fixed networks.

Smartphones reached 29% penetration rate globally in 2014. The United States reached 66%, while Western Europe reached a 58% penetration rate. Asia Pacific reached a 28% penetration rate. Analysts project the global penetration rate will have reached 58% by 2019.⁶

We continue to see machine-to-machine (M2M) and the Internet of Things (IoT) implementations, but it is unclear if service providers will continue to use 3G technology for these connections or if they will increase usage of LTE networks to support traditional M2M. The introduction of 4G-enabled smart cars will have some impact on the number of connections, and is included in the modeling for this report.

However, M2M and IoT represent data connections that are still rather simple and not Diameter intensive. As more and more policy-based traffic is implemented in this area, we expect this to have a more dramatic effect on Diameter signaling.

¹ GSA Evolution to LTE Report, January 7, 2015

² Ovum World Cellular Information Service

³ Ovum World Cellular Information Service

⁴ Cisco Visual Networking Index: Forecast and Methodology, 2014–2019

⁵ Cisco Visual Networking Index: Forecast and Methodology, 2014–2019

⁶ Informa

Oracle Communications LTE Diameter Signaling Index

Global Diameter signaling will reach 395 million MPS by 2019.

GLOBAL	2014	2015	2016	2017	2018	2019	CAGR
Mobility	2,987,567	6,102,680	10,549,827	15,492,760	20,118,521	25,366,541	53%
Policy	17,836,307	44,194,714	91,548,098	134,178,001	223,381,301	277,012,152	73%
LTE Broadcast	3,016,398	8,405,217	12,695,763	21,804,954	30,122,740	49,478,398	75%
VoLTE	5,834,668	11,905,912	21,738,157	27,904,508	35,933,892	43,106,732	49%
TOTAL MPS	29,674,940	70,608,524	136,531,845	199,380,222	309,556,455	394,963,823	68%

Table 1: Global Diameter Signaling Forecast

Global Diameter signaling will surpass total global IP traffic by 2019. The total messages per second (MPS) for Diameter signaling traffic will increase to 395M MPS by 2019. Simultaneously, global IP data traffic will grow at a CAGR of 23%,⁷ and Diameter signaling will grow at a CAGR of 68% globally by 2019.

Mobility will generate 25.3 million MPS at a CAGR of 53% by 2019. Because mobility generates a low number of transactions in the Diameter network, we have not considered it as a major factor in Diameter traffic generation. As VoLTE implementations grow, and roaming in the LTE network increases, our model may change.

Policy continues to drive the majority of Diameter signaling, creating 277 million MPS at a CAGR of 73%. Policy implementations are increasing, and the use cases have become sophisticated enough that the number of Diameter transactions between policy enforcement points and charging has increased. For these reasons, we believe policy will continue to make an impact on global Diameter signaling.

LTE Broadcast will create 49 million MPS at a CAGR of 75%. LTE Broadcast, based on evolved Multimedia Broadcast Multicast Service (eMBMS) technology, is starting to gain momentum in the market, with 14 countries now trialing LTE Broadcast.⁸ This technology is being used for much more than just multimedia distribution to phones, as some markets are using it for digital signage, pay-per-view television, and live video feeds at sporting events. Given the large number of transactions required in the Diameter network to support LTE Broadcast, we believe this technology will have a major impact on Diameter Signaling as it matures.

Voice over LTE (VoLTE) has finally become a reality, with 80 operators in 47 countries investing in VoLTE deployments.⁹ With 14 countries implementing VoLTE, we believe it will have a moderate impact on signaling, at least in the early years of implementation. VoLTE will generate 43.1 million MPS at a CAGR of 49% by 2019.

⁷ Cisco Visual Networking Index: Forecast and Methodology, 2014–2019

⁸ GSA LTE Broadcast (eMBMS) Global Update & Industry Trends, March 2, 2015

⁹ GSA Evolution to LTE Report, January 7, 2015

Asia Pacific shows tremendous growth and increase in MPS

ASIA PACIFIC	2014	2015	2016	2017	2018	2019	CAGR
Mobility	1,201,695	3,489,796	6,887,489	10,538,803	13,211,210	15,984,461	68%
Policy	5,560,624	20,561,091	43,692,525	61,960,713	111,702,095	138,813,454	90%
LTE Broadcast	1,507,872	3,947,085	6,399,718	8,567,342	11,112,233	13,444,874	55%
VoLTE	2,223,145	5,826,649	9,452,515	12,652,081	16,410,674	19,855,546	55%
TOTAL MPS	10,493,337	33,824,621	66,432,246	93,718,938	152,436,211	188,098,336	78%

Table 2: Asia Pacific Diameter Signaling Forecast

Asia Pacific will account for 188 million MPS with CAGR of 78%, becoming the largest generator of Diameter signaling traffic in the world. Mobility will account for 16 million MPS at a CAGR of 68%. Meanwhile, policy implementations will continue to impact Diameter signaling generating 139 million MPS with a CAGR of 90%. VoLTE will generate 19.9 million MPS at a CAGR of 55%, while LTE Broadcast will create 13.4 million MPS with a CAGR of 55%.

We are beginning to see the impact of China in the region, as China Mobile, China Unicom, and China Telecom have all shown growth in the number of LTE connections they provide. However, the region's Diameter signaling is continues to be shaped by the largest markets outside of China:

- » India
- » South Korea
- » Japan
- » Indonesia

We will not see the number of LTE connections surpass that of WCDMA until 2017 in this region, and even then there will be a close tie between the two competing technologies. We will begin to see a 9% decline in WCDMA however, as more subscribers move to LTE.¹⁰ This decline will take place as mobile devices drop in price, and as service providers create data plans that support those devices affordably, even in the more-depressed economies. We have seen some trends to this effect but not on a large enough scale to impact this Index.

Asia Pacific will continue as a growth market for Diameter signaling as many countries have announced their plans to support LTE in the coming years. Increased LTE support will definitely increase Diameter traffic, since the region is characterized by population density.

¹⁰ Ovum World Cellular Information Service

Middle East & Africa show growth but remain small contributor to traffic

MIDDLE EAST/AFRICA	2014	2015	2016	2017	2018	2019	CAGR
Mobility	126,425	226,906	367,587	444,881	575,396	894,346	48%
Policy	456,233	1,803,628	4,542,010	8,652,811	16,597,484	24,162,500	121%
LTE Broadcast	116,370	257,359	494,286	812,142	1,321,403	1,923,263	75%
VoLTE	170,191	375,879	721,085	1,183,270	1,926,051	2,803,310	75%
TOTAL MPS	869,219	2,663,772	6,124,969	11,093,104	20,420,333	29,783,420	103%

Table 3: Middle East & Africa Diameter Signaling Forecast

The Middle East & Africa will generate a combined 29.8 million MPS at a CAGR of 103%. Mobility will account for 894,000 MPS at a CAGR of 48%. Policy generates 24.2 million MPS at a CAGR of 121%. VoLTE makes up 2.8 million MPS at a CAGR of 75% while LTE Broadcast accounts for a modest 1.9 million MPS with a CAGR of 75%.

LTE is showing growth among the largest operators in key countries: Saudi Arabia, Turkey and Iran represent the largest markets in the Middle East, while Egypt, South Africa, and Nigeria represent the largest markets in Africa. Saudi Arabia, Turkey, and Nigeria are the largest LTE markets (by connections) in the region.¹¹

Given the focus on data plans in the largest of the regions markets, we expect policy to play an important role in delivering these services. That fact will trigger growth in policy-associated Diameter signaling. Likewise, we see VoLTE implementations in Saudi Arabia and UAE as well as implementations in Africa having a modest impact on signaling. VoLTE is still in its early stages of implementation, so we are projecting only modest impacts at this time.

LTE Broadcast is being implemented by at least one operator in the region,¹² and given the promise of the technology, it is likely that other service providers will follow as successes in early implementations become prominent.

The Saudi Arabian market is a key driver in this region as the economies in cities such as Dubai are particularly strong, contributing to steady sales in smartphones¹³ and sophisticated data plan offerings. These trends will lead to significant increases in Diameter signaling.

¹¹ Ovum World Cellular Information Service

¹² GSA LTE Broadcast (eMBMS) Global Update & Industry Trends, March 2, 2015

¹³ Ovum World Cellular Information Service

Europe shows steady growth as LTE implementations increase

EUROPE	2014	2015	2016	2017	2018	2019	CAGR
Mobility	488,151	833,782	943,696	1,061,108	1,481,391	2,104,255	34%
Policy	2,120,742	7,844,263	16,928,234	27,824,440	45,534,361	56,857,813	93%
LTE Broadcast	616,205	1,289,880	2,167,950	4,256,967	8,162,287	13,810,142	86%
VoLTE	553,827	2,057,126	2,934,842	3,753,198	4,906,947	5,913,397	61%
TOTAL MPS	3,778,924	12,025,051	22,974,722	36,895,713	60,084,985	78,685,607	84%

Table 4: Europe Diameter Signaling Forecast

Europe will contribute 78.7 million MPS to the global Diameter signaling with a CAGR of 84%. Mobility will account for 2.1 million MPS at a CAGR of 34%. Policy lags the North America region generating 56.9 million MPS, with a CAGR of 93%. LTE Broadcast generates 13.8 million MPS with a CAGR of 86%. VoLTE will add another 5.9 million MPS to Diameter traffic, with a CAGR of 61%.

Network expansions continue to drive LTE growth throughout the region but especially in its largest markets. Southern Europe continues to suffer from economic issues, thus limiting growth in the area. Russia represents the largest LTE potential in the East, followed by Poland and Romania. Germany, the United Kingdom, and France are the largest LTE markets in the West.¹⁴

Russia and Germany are big contributors to LTE growth (by connections). These countries have the highest number of LTE connections in the region by far,¹⁵ and looking at the services being offered in these countries, policy plays a major role.

We see more policy-intensive use cases such as sponsored data being implemented. The Spotify/Beezer deal in Germany is a good example of this. Metered data in Western Europe is another use case helping drive policy-related Diameter MPS.

We expect high growth for LTE Broadcast as several service providers in the region have plans of implementing the technology.¹⁶ As LTE Broadcast begins to mature in the market, we will see this have a major impact on Diameter signaling traffic.

VoLTE is already deployed in Germany, and we see implementations throughout Europe in the largest markets.¹⁷ We will continue watching VoLTE implementations in Europe as this has a large impact on Diameter signaling.

¹⁴ Ovum World Cellular Information Service

¹⁵ Ovum World Cellular Information Service

¹⁶ GSA LTE Broadcast (eMBMS) Global Update & Industry Trends, March 2, 2015

¹⁷ GSA Evolution to LTE Report, January 7, 2015

North America reaches LTE maturity and slower growth

NORTH AMERICA	2014	2015	2016	2017	2018	2019	CAGR
Mobility	1,090,792	1,397,326	1,872,961	2,621,914	3,553,685	4,413,575	32%
Policy	9,639,520	13,594,804	24,764,369	31,984,543	42,319,270	46,706,398	37%
LTE Broadcast	730,968	2,806,010	3,430,728	7,830,369	8,984,109	19,513,848	93%
VoLTE	2,760,765	3,350,678	8,056,163	9,361,580	11,158,310	12,315,063	35%
TOTAL MPS	14,222,046	21,148,818	38,124,221	51,798,406	66,015,374	82,948,884	42%

Table 5: North America Diameter Signaling Forecast

North America will generate 82.9 million MPS with a CAGR of 42%. Mobility in North America will contribute a modest 4.4 million MPS, with an expected CAGR of 32%. Policy will account for 46.7 million MPS with a CAGR of 37%. LTE Broadcast will add 19.5 million MPS with a CAGR of 93%, while VoLTE generates 12.3 million MPS with a CAGR of 35%.

The United States has reached a penetration rate of 45% for LTE, while WCDMA sits at 25%. This demonstrates a strong push by service providers to rid themselves of GSM 2G/3G and CDMA networks as quickly as possible. North America continues to show an aggressive growth rate in the number of LTE connections.

The United States leads over Canada in Diameter signaling MPS given the population and LTE penetration rate.

LTE Broadcast is being implemented by the largest of the LTE service providers, contributing to the strong numbers we have for this use case.¹⁸ We believe the MPS associated with LTE Broadcast will grow as more users connect to video services.

VoLTE is also being implemented, and as we see this service mature in the region, we will see some modest growth in the Diameter signaling associated with the service.

¹⁸ GSA LTE Broadcast (eMBMS) Global Update & Industry Trends, March 2, 2015

Latin America & Caribbean represent the largest growth region

LATIN AMERICA/CARIBBEAN	2014	2015	2016	2017	2018	2019	CAGR
Mobility	80,504	154,870	478,094	826,054	1,296,840	1,969,904	90%
Policy	59,187	390,928	1,620,960	3,755,494	7,228,092	10,471,986	182%
LTE Broadcast	44,982	104,883	203,082	338,134	542,708	786,270	77%
VoLTE	126,740	295,580	573,552	954,380	1,531,911	2,219,416	77%
TOTAL MPS	311,415	946,261	2,875,687	5,874,062	10,599,551	15,447,576	118%

Table 6: Latin America & Caribbean Diameter Signaling Forecast

Latin American & Caribbean countries will account for 15.4 million MPS at a CAGR of 118%. Mobility will generate 2 million MPS with a CAGR of 90%. Policy will account for 10.5 million MPS at a CAGR of 182%. LTE Broadcast will bring in 786,000 MPS with a CAGR of 77%, while VoLTE will generate 2.2 million MPS at a CAGR of 77%.

Latin America represents the strongest growth of all the regions. The forecast for LTE connections in the region was initially low, but after reporting of actuals last year, the projections have been corrected, representing strong growth in this year's report.

Brazil is the largest LTE market in the region, followed by Mexico and Colombia. Argentina and Peru are countries to watch as they show strong growth in LTE connections. The Dominican Republic and Puerto Rico are the largest LTE markets in the Caribbean.¹⁹

We have seen this market lead the way with innovative policy use cases, adding to the MPS in the region. Sophisticated rules and creative data plans are responsible for increasing the policy-related signaling. This is especially true in Brazil, which has proven itself to be very innovative with data plans.

As VoLTE rolls out in the larger markets of the region, we expect to see strong growth in the signaling traffic, but we suspect it will take a few years for this to occur. LTE Broadcast is still new, and we have not seen any commitments to the technology in the region. We believe this will change and therefore we have forecast a very modest MPS with the possibility for strong growth.

HSPA+ is enjoying strong growth throughout the region and will remain the dominant technology through 2019 (based on the number of connections).²⁰ It is worth noting, however, that this region can be full of surprises and we expect to see stronger growth in the LTE market than that which is currently reported.

¹⁹ Ovum World Cellular Information Service

²⁰ Ovum World Cellular Information Service



The Future of Signaling

We have seen this year that HSPA+ has continued to show strength in the number of connections, providing a comfortable alternative to LTE for service providers that cannot justify the investment in moving their networks to LTE. Since HSPA+ is based on 3G network technology, this is good news for SS7.

SS7 signaling growth (in terms of investment) has not stalled, and we see networks consolidating while eliminating older platforms. As networks migrate to an all-IP infrastructure, SIGTRAN deployments continue to drive the SS7 market. Given the forecasts for HSPA+ in the next five years, we believe we can expect to see SS7 networks around the world for some decades to come.

As stated earlier, LTE penetration rates are higher than we forecast last year, as stated earlier. We expect LTE to grow quickly in the next five years as subscribers begin their migrations to these networks through service provider offerings. As service providers increase their LTE coverage, the number of connections will only increase. Yet as we have said all along, it will be a slow but steady growth curve. LTE will not take the world by storm overnight, as confirmed by what we currently see.

As operators continue to recognize the value of policy in the network, we anticipate at some point they will begin implementing policy in their 3G networks. Some service providers have already done this, taking advantage of the low cost of 3G (3G modems in connected devices for example) and an all-IP infrastructure. Policy in these networks will certainly mean an increase in Diameter signaling, but we do not currently have a means for measuring Diameter traffic in 3G networks.

Another major factor in LTE rollout will be the migration to cloud. We are already seeing implementations of virtualized LTE components, and as the standards for network function virtualization (NFV) become more complete, we can expect that full orchestration will become available to LTE networks.

The decision to implement LTE in the cloud is more about building elastic networks with fast delivery of services than it is about cost. Delivering services in the cloud opens up many opportunities for service providers in terms of efficiencies and speed-to-market. This will make cloud-based LTE attractive in many markets.

Diameter signaling will increase even in these virtual networks. Diameter signaling is still needed to deliver LTE and IMS service, and the ability to virtualize various components provides service providers with more flexibility in their implementations. Adding more components means adding to the Diameter signaling MPS.



Annex A

Report Methodology

Our modeling uses LTE connections as the base for calculations. We take into consideration the Diameter interfaces and transactions required to support various use cases. These assumptions are built into our models. The models also take into consideration data from our LTE experience where possible (such as average number of PDN connections per hour, etc).

The use cases were chosen based on their impact to LTE Diameter signaling. Sometimes there are many variables to take into account, depending on the type of access, session modifications, and credit control. We build the basic Diameter requirements to establishing a service for the use case, and do not take into account the many variables. This means our report is conservative in its view, and the actual MPS for Diameter signaling is likely higher than our projections.

The forecast period shifts every year, as this Index considers growth beginning in 2014 rather than 2013, and extending through 2019. Because 2014 saw higher penetration rates in some regions than previously projected, the overall CAGR for Diameter changed accordingly. Specifically, earlier industry projections for Latin America and the Caribbean were much lower than reported this year.

The Index is an LTE Diameter traffic demand model rather than an engineered network model. It is a baseline model that serves as a starting point from which service providers can layer on additional factors such as network architecture, topology, capacity requirements, geo-redundancy and others needed to design a robust, reliable and scalable Diameter network. Readers are cautioned not to rely solely on this macro-level analysis to predict their unique needs.

The Index focuses solely on LTE networks and does not account for Diameter traffic on 3G networks, other than 3G-to-4G mobility. The Index also excludes IMS applications with the exception of VoLTE.

The Oracle Communications LTE Diameter Signaling Index relies on a number of industry resources such as LTE subscriber data from Ovum, industry trends from GSA, and the Cisco Visual Networking Index for general market context. IETF, 3GPP and GSM Association specifications are used for determining traffic flows for each unique service. The flows are then used to determine the number of Diameter messages that are created for individual session types. These are then applied to complex traffic models based on a number of different factors.

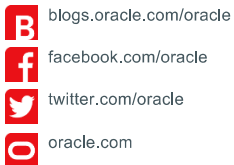
Traffic flows are also validated in Oracle's Diameter Traffic Laboratory, which is a dedicated facility that uses the Oracle Communications Diameter Signaling Router and Policy Management network elements. In this report and forecast, we use the industry standard metric of messages per second (MPS) for the volume of signaling traffic in a network. The 3GPP standards refer to Diameter transactions as two messages (request/answer). In this Index the total number of Diameter messages is counted in the MPS.



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Oracle Communications LTE Diameter Signaling Index
October 2015
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