

LTE Diameter Signaling Index

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“Diameter signaling will grow to more than 565 million MPS by the year 2020. As use cases continue to evolve and networks move to the cloud, we see Diameter signaling at the forefront controlling the world’s networks for generations.”

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Executive Summary

The world’s LTE networks will generate 565 million Diameter messages per second (MPS) by the year 2020. This represents a compound annual growth rate of 53%. 4G services, as well as device types and subscriber behavior heavily influence Diameter signaling. As LTE continues to grow, we will see Diameter signaling increase as well, especially as new services are introduced in those networks.

LTE penetration rates will reach 40% by the year 2020 with 560 networks in service by the end of 2016 in 170 countries.¹ LTE/4G traffic has finally surpassed 3G traffic in 2015 with 4G/LTE representing 47% of the total mobile data traffic in 2015.²

Mobile data traffic grew 75% in 2015 and is projected to continue growing at a fast pace, again impacting Diameter signaling as these data sessions require the support of policy management and charging.³

Industry Trends and Indicators

Oracle Communications LTE Diameter Signaling Index

GLOBAL	2015	2016	2017	2018	2019	2020	CAGR
Basic Policy	38,564,461	69,690,030	122,298,429	165,079,313	277,761,440	389,230,856	58.78%
VoLTE	14,149,022	21,064,113	40,479,528	52,704,948	64,687,168	80,670,785	41.64%
Connected Car	13,365,815	20,090,350	31,028,062	42,313,574	54,750,076	74,803,398	41.12%
LTE Broadcast	1,681,783	4,387,865	5,513,585	10,757,231	12,683,557	20,933,149	65.58%
TOTAL MPS	67,761,081	115,232,358	199,319,604	270,855,066	409,882,241	565,638,188	52.87%

¹ GSA LTE Evolution Report, July 2016

² Cisco VNI 2016

³ Cisco VNI 2016



Table 1: Global Diameter Signaling

Smart devices are outselling feature phones at a fast pace. Smart devices represented 43% of total devices in 2015, and generated 97% of the data traffic in the wireless network. 32% of these devices were smartphones, growing to 40% in 2020.⁴ Smartphones drive subscriber behaviors as Diameter intensive data plans and smart devices drive Diameter transactions.

These data points are important to understand because these are the drivers to Diameter growth. Subscribers (and their devices) impact how the network is used, which in turn impacts the number of Diameter transactions we will see in the network.

The strongest growth area for Diameter signaling continues to be LTE Broadcast. As service providers begin implementing eMBMS technology to handle the enormous demand for video on mobile devices, Diameter signaling supporting LTE Broadcast will grow from 1.7 million MPS to 21 million MPS.

Policy continues to show strong growth in all markets, with a CAGR of 59%. We are seeing maturity in policy management use cases, as service providers implement data plans and more sophisticated applications. This is why we are projecting policy management signaling to grow from 38 million MPS in 2015 to more than 389 million MPS in 2020.

We are finally seeing VoLTE become reality worldwide. VoLTE will contribute 81 million MPS to global Diameter signaling by 2020 representing a CAGR of 42%. This is followed closely by Connected Car, which we believe will contribute 75 million MPS by 2020.

As LTE penetration continues to increase, we are seeing Diameter signaling growth continue, although in some regions we are also seeing this growth begin to flatten as the region reaches 100% penetration rates and we see the applications begin to mature. However, we also see new programs such as Smart Cities and Connected Car that reach beyond the traditional mobile handset that will have a significant impact on Diameter signaling.

We will see M2M devices begin moving to 4G chipsets gradually, with 34% of M2M traffic using 4G by 2020.⁵ The growth in M2M/IoT devices moving to 4G/LTE networks will ultimately have an impact on policy management signaling, simply by sheer volume of sessions requiring signaling.

⁴ Cisco VNI 2016

⁵ Cisco VNI 2016



In this year's report, we use new models to more closely reflect what we see occurring worldwide. For example, the modeling for VoLTE and LTE Broadcast only include operators who have either implemented, or have announced plans to implement these technologies. We have also taken into consideration the maturity of LTE in all markets and how policy management is implemented.

Asia Leads The World In Diameter Signaling

ASIA	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	38,043,865	73,130,831	125,192,949	163,048,413	266,319,868	384,808,828	58.85%

Table 2: Total MPS for Asia

More than 56% of the world's LTE connections will be in Asia by 2020.⁶ As we look at the amount of Diameter transactions coming from Asia, it helps to understand that only a handful of countries are generating the majority of Diameter signaling.

We see tremendous growth continuing in the region as Asia signaling grows from 38 million MPS in 2015 to 385 million MPS in 2020, for a CAGR of 59%. Asia represents 68% of the world's Diameter signaling traffic. LTE penetration is perhaps highest in this region when you consider the number of LTE subscribers in China alone. The Cisco VNI projects this growing to 43% in 2020. However, 2G and 3G technologies continue to be the most widely implemented wireless technology in Asia.

Another factor of Diameter growth in the region is the amount of mobile data traffic generated by countries such as China, Japan, Indonesia, and India. China alone accounts for more than 50% of all LTE connections in Asia followed by these other three countries.

Consider the following list of LTE Diameter signaling in these four countries:

- » China represents 55% of Diameter traffic in Asia
- » India represents 16% of Diameter traffic in Asia
- » Japan represents 8% of Diameter traffic in Asia
- » Indonesia represents 5% of Diameter traffic in Asia

By the year 2020, China will generate 37% of the world's Diameter signaling. India will follow at 11%, with Japan and Indonesia contributing 5% and 3% respectively.

Asia	2015	2016	2017	2018	2019	2020
China	26,205,332	52,621,452	82,459,537	101,944,377	158,826,296	211,494,397
Indonesia	567,817	1,682,213	3,717,785	6,038,921	11,950,097	19,512,373
Japan	5,531,155	8,763,354	12,179,449	14,572,269	22,215,943	29,057,714
India	98,392	1,146,774	3,941,391	9,401,970	26,424,406	62,332,295

Table 3: Top contributors in Asia

As the above table shows, China will generate 211 million MPS by 2020. This is followed by:

- » India will generate 62 million MPS
- » Japan will generate 29 million MPS
- » Indonesia will generate 19.5 million MPS

Collectively these four countries alone will generate 322 million MPS, or 57% of the world's Diameter traffic by the year 2020.

⁶ Ovum World Cellular Information Service

Middle East and Africa Shows Strong Diameter Growth

ME & AFRICA	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	1,876,380	3,120,310	5,992,332	9,106,869	14,006,849	18,611,641	58.23%

Table 4: Total MPS for Middle East & Africa

The Middle East & Africa will grow from 1.9 million MPS to 19 million MPS of Diameter signaling by 2020, representing a 58% CAGR. There are many factors contributing to this growth rate.

Like Asia, there is strong mobile data growth being projected for the region, which in turn will impact Diameter signaling. In 2015, the region saw mobile data grow by 117%. Mobile data will continue to grow at a rate of 71% CAGR by 2020.⁷ Today, 3% of all mobile connections are LTE, in 47 networks. This is expected to grow to 17% by 2020.⁸ This strong growth in mobile data and LTE connections will increase in Diameter transactions.

The challenge of spectrum and device cost continues to be a barrier for most countries. High illiteracy and a very low return on investment in more rural areas continue to prevent widespread implementations of LTE. Only 8.65% of the world's LTE connections are in this region.

Most of the growth is occurring in the most populated areas with a strong economy. If the government chooses to subsidize mobile broadband connectivity, and the cost of devices decreases, this will have a positive impact on Diameter.⁹

In the African region, Nigeria has the largest number of LTE connections, and is the largest generator of Diameter traffic creating 3 million MPS of Diameter signaling by 2020. The seven largest Diameter networks in this region and the percentage of Diameter signaling they will create by 2020 are reflected below.

- » Nigeria represents 17% of the regions Diameter traffic by 2020
- » Saudi Arabia represents 16% of the regions Diameter traffic
- » Turkey represents 14% of the regions Diameter traffic
- » Egypt represents 8% of the regions Diameter traffic
- » Iran represents 6% of the Diameter traffic
- » South Africa represents 5% of the regions Diameter traffic
- » United Arab Emirates represents 5% of the regions Diameter traffic

⁷ Cisco VNI 2016

⁸ Ovum World Cellular Information Service

⁹ Ovum World Cellular Information Service



ME & Africa	2015	2016	2017	2018	2019	2020
Egypt	3,385	42,526	152,548	442,760	976,295	1,560,753
Nigeria	24,891	120,081	374,267	907,589	1,947,019	3,073,219
South Africa	131,924	163,519	299,180	463,647	721,143	922,747
Iran	156,177	176,793	348,690	581,055	909,047	1,092,532
Saudi Arabia	433,125	828,602	1,396,218	1,908,577	2,592,216	2,907,247
Turkey	-	257,894	662,812	1,191,695	1,971,959	2,593,950
United Arab Emirates	199,647	287,870	483,388	655,655	894,294	1,001,878

Table 5: Top contributors in Middle East & Africa

Nigeria will contribute the most MPS for the region by 2020 at 3 million MPS. This is followed by Saudi Arabia with 3 million MPS. This is an interesting comparison when you consider that Nigeria has a much larger population than Saudi Arabia, but it is anticipated that Saudi Arabia will have more sophisticated applications and data plans, creating many more Diameter transactions than typical.

- » Nigeria will generate 3 million MPS by 2020
- » Saudi Arabia will generate 3 million MPS by 2020
- » Egypt will generate 1.5 million MPS
- » South Africa will generate 922 thousand MPS
- » Iran will generate 1 million MPS
- » Turkey will generate 2.6 million MPS
- » UAE will generate 1 million MPS

Collectively these seven nations will generate 13 million MPS by 2020, or 2% of the world's Diameter signaling.

Europe Generates 12% of the World's Diameter Signaling

Europe represents two different pictures of LTE. Countries such as Russia in Eastern Europe represent a large portion of the Diameter signaling for the region. We split Europe between the East and West to provide better modeling.

Eastern Europe

EASTERN EUROPE	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	1,387,231	2,910,716	6,323,222	10,237,364	19,294,400	32,910,099	88.38%

Table 6: Total MPS for Eastern Europe

Eastern Europe generates 5.82% of the global Diameter signaling traffic. The majority of this traffic is coming from Russia. Below are the largest contributors of Diameter signaling in the region.

- » Russia will generate 65.55% of the regions Diameter signaling by 2020
- » Poland will generate 19.32% of the regions Diameter traffic
- » Romania will generate 8.32% of the regions Diameter traffic
- » Ukraine will generate 6.07% of the regions Diameter traffic

Collectively, these four countries account for 5.78% of the world's Diameter signaling traffic.

Eastern Europe	2015	2016	2017	2018	2019	2020
Poland	334,765	1,004,236	1,885,998	2,893,305	4,417,198	6,357,955
Romania	156,259	236,163	498,942	851,689	1,532,150	2,737,906
Russia	745,513	1,657,136	3,530,159	6,512,164	12,215,428	21,573,657
Ukraine	43,921	62,816	83,386	237,668	705,761	1,998,611
Total MPS	1,280,458	2,960,351	5,998,485	10,494,826	18,870,537	32,668,129

Table 7: Top contributors in Eastern Europe

Eastern Europe creates 1.4 million MPS of Diameter signaling, growing to 33 million MPS by 2020. This represents a CAGR of 88%. If we break out the top producers of Diameter signaling in Eastern Europe, we are looking at 4 countries. Russia is by far the biggest producer of Diameter traffic, followed by Poland.

- » Russia will generate 22 million MPS by 2020
- » Poland will generate 6 million MPS by 2020
- » Romania will generate 3 million MPS by 2020
- » Ukraine will generate 2 million MPS by 2020

Collectively these four countries generate 33 million MPS of Diameter signaling by the year 2020.

Western Europe

WESTERN EUROPE	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	5,123,711	8,527,708	15,168,008	24,204,772	29,895,761	34,065,445	46.06%

Table 8: Total MPS for Western Europe

Western Europe generates 5 million MPS in 2015, growing to 34 million MPS by 2020 for a CAGR of 46%. There is still plenty of opportunity for growth as LTE penetration only reached 23% in 2015. This will grow to just over 53% by 2020.¹⁰

The region saw its mobile data grow by 52% in 2015¹¹, which should be reflected in Diameter growth year over year. Five countries represent the top producers of Diameter signaling.

- » France will generate 16% of the regions Diameter signaling by 2020
- » Germany will generate 30% of the regions Diameter signaling
- » Italy will generate 18% of the regions Diameter signaling
- » Spain will generate 12% of the regions Diameter signaling
- » The United Kingdom will generate 22% of the regions Diameter signaling

Western Europe will generate 6% of the world's Diameter signaling traffic by 2020.

Western Europe	2015	2016	2017	2018	2019	2020
France	877,572	1,556,206	2,502,389	4,192,536	4,984,820	5,566,694
Germany	1,005,475	2,025,203	3,570,220	6,518,800	8,460,633	10,194,715
Italy	503,986	1,126,945	2,120,676	4,000,816	5,229,681	6,285,151
Spain	683,854	1,081,068	1,751,818	2,993,629	3,618,368	4,031,186
United Kingdom	1,441,202	2,564,619	3,754,904	5,955,762	6,852,438	7,436,500
Total MPS	4,512,089	8,354,041	13,700,007	23,661,543	29,145,940	33,514,246

Table 9: Top contributors in Western Europe

By the year 2020, Germany will be the top producer of Diameter MPS in the region, followed by Italy.

- » Germany will generate 10 million MPS of Diameter signaling by 2020
- » Italy will generate 6 million MPS of Diameter signaling
- » France will generate 6 million MPS of Diameter signaling
- » The United Kingdom will generate 7 million MPS of Diameter signaling
- » Spain will generate 4 million MPS of Diameter signaling

Collectively these countries will generate 34 million MPS of Diameter signaling by 2020.

¹⁰ Ovum World Cellular Information Service

¹¹ Cisco VNI 2016

North America Diameter Networks Maturing

NORTH AMERICA	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	19,796,476	24,845,744	41,731,167	55,848,798	68,486,807	79,625,280	32.10%

Table 10: Total MPS for North America

North America leads the world in LTE penetration as its service providers move aggressively to sunset 2G and 3G services. It is projected that 59% of connections in the United States will be 4G/LTE by the year 2020.¹² This shows a maturing market that will be generating a lot of Diameter traffic in the years to come.

The United States represents the largest Diameter traffic generator in the region producing 95% of the regions signaling by the year 2020. This represents 13% of the world's Diameter signaling.

North America	2015	2016	2017	2018	2019	2020
United States	16,809,747	21,850,287	36,686,346	50,629,532	61,888,971	76,020,392
Total MPS	16,809,747	21,850,287	36,686,346	50,629,532	61,888,971	76,020,392

Table 11: Top contributors in North America

North America generates 20 million MPS in 2015, more than tripling to 80 million MPS by 2020.

¹² Ovum World Cellular Information Service

Latin America and the Caribbean Showing High Growth

LAD & CARIBE	2015	2016	2017	2018	2019	2020	CAGR
TOTAL MPS	1,533,418	2,697,049	4,911,926	8,408,850	11,878,556	15,616,895	59.07%

Table 12: Total MPS for Latin America and the Caribbean

Latin America and the Caribbean continue to show slow but steady growth in Diameter networks. The region will generate 15.6 million MPS by 2020 at a CAGR of 59%. This is only 3% of the world's Diameter traffic but changes in the telecommunications sector in the region bring promises of more growth.

In Mexico, a new player may add more sophisticated services to the area, while frequency auctions in Argentina show LTE growth. Brazil is talking about new broadband infrastructure but with the local economy in the state it is in today, that promise may never develop. There are currently 63 LTE networks in the region, with 14 networks in the planning phase.¹³

In 2015, only 4% of the connections were LTE, although this is projected to reach 32% by 2020.¹⁴ The largest contributor of Diameter signaling continues to be Brazil, generating 63% of the regions Diameter signaling by 2020. Mexico produces 28% of the regions Diameter signaling by 2020.

- » Brazil will generate 63% of the regions Diameter signaling by the year 2020
- » Mexico will generate 28% of the regions Diameter signaling
- » Argentina will generate 13% of the regions Diameter signaling
- » Colombia will generate 13% of the regions Diameter signaling
- » Peru will generate 8% of the regions Diameter signaling

LAD & Caribe	2015	2016	2017	2018	2019	2020
Argentina	163,066	311,783	614,464	1,013,199	1,534,591	2,017,219
Brazil	978,722	1,990,059	3,357,749	5,337,335	7,793,422	9,856,164
Colombia	167,863	276,211	570,226	974,839	1,515,686	2,004,175
Mexico	266,985	573,641	1,103,500	2,021,464	3,165,358	4,316,892
Peru	134,427	268,126	456,279	747,519	1,088,496	1,305,083
Total MPS	1,711,063	3,419,820	6,102,218	10,094,356	15,097,553	19,499,533

Table 13: Top contributors in Latin America and the Caribbean

¹³ Ovum World Cellular Information Service

¹⁴ Cisco VNI 2016



When it comes to Diameter MPS, Brazil leads the region with 979 thousand MPS in 2015, growing to 10 million MPS by 2020. Mexico generated 267 thousand MPS in 2015 and is expected to create 4.3 million MPS by 2020.

- » Brazil will generate 10 million MPS of Diameter signaling by 2020
- » Mexico will generate 4.3 million MPS of Diameter signaling
- » Argentina will generate 2 million MPS of Diameter signaling
- » Colombia will generate 2 million MPS of Diameter signaling
- » Peru will generate 1.3 million MPS of Diameter signaling

Collectively these five countries will generate 19.5 million MPS of Diameter signaling by the year 2020, representing 4% of the world's Diameter signaling.

Diameter Drivers – Use Cases That Impact Signaling

Diameter signaling is heavily influenced by the applications it supports.

For example, for a mobile device to connect to the network and request a data connection there is minimal Diameter transactions. But if we look at LTE Broadcast, we can see that there are many Diameter transactions required to deliver the service to a single device.

As we have been saying from the beginning, to calculate Diameter growth, there are many variables that must be taken into consideration. The use case is the largest consideration. This is why we have separated the use cases from the regional data in this years index. We hope to put more focus on the impact of these use cases.

Policy Management

BASIC POLICY	2015	2016	2017	2018	2019	2020	CAGR
ASIA	18,497,230	41,777,805	74,051,785	98,260,701	183,646,824	274,157,944	71.47%
ME & AFRICA	1,122,840	1,863,819	3,560,635	5,647,436	9,496,817	12,740,091	62.54%
EASTERN EUROPE	772,149	1,793,743	4,045,435	6,441,243	13,552,327	23,133,351	97.38%
WESTERN EUROPE	3,934,116	6,105,785	9,299,173	13,558,246	17,648,589	20,254,164	38.78%
NORTH AMERICA	13,386,299	16,576,731	28,857,820	36,522,306	46,817,080	50,310,100	30.32%
LAD & CARIBBEAN	851,827	1,572,147	2,483,581	4,649,381	6,599,803	8,635,206	58.92%
TOTAL MPS	38,564,461	69,690,030	122,298,429	165,079,313	277,761,440	389,230,856	58.78%

Table 14: Basic policy management MPS by region

We enhanced our policy management modeling to reflect more current market conditions and data plans. The worlds Diameter networks have moved beyond simple traffic management policy use cases, and we now see much more complex implementations.

As reported in earlier versions of the index, policy is a major driver of Diameter signaling, especially in prepaid networks. We are also seeing new data plans offering different tiers and family plans. In 2015, 73% of the world's data plans were tiered, while 60% were shared data plans.¹⁵

Our modeling considers speed cap, throttling, and turbo button as use cases. In addition, we have added four miscellaneous use cases with varying numbers of transactions to reflect all regions. Most of the world's LTE networks would use these use cases at a minimum.

We are projecting that Diameter signaling associated with policy management will grow from 39 million MPS to 389 million MPS by 2020, for a global CAGR of 59%. North America will realize a CAGR of 30% by 2020 for policy related signaling. North America is primarily a post-paid market, which does not generate as many Diameter transactions as prepaid networks.

¹⁵ Cisco VNI 2016



We are projecting the following growth for policy management Diameter signaling globally by 2020:

- » Asia generated 18.5 million MPS in 2015 growing to 274 million MPS by 2020 for a CAGR of 71%
- » Eastern Europe generated 772 thousand MPS in 2015 growing to 23 million MPS by 2020 for a CAGR of 97%
- » ME & Africa generated 1.1 million MPS in 2015 growing to 13 million MPS by 2020 for a CAGR of 63%
- » Latin America & Caribe generated 851 thousand MPS in 2015 growing to 8.6 million MPS for a CAGR of 59%
- » Western Europe generated 3.9 million MPS in 2015 growing to 20 million MPS for a CAGR of 39%

Globally, policy management Diameter signaling will grow from 39 million MPS in 2015 to 389 million MPS in 2020, for a CAGR of 59%.

VoLTE

GLOBAL	2015	2016	2017	2018	2019	2020	CAGR
ASIA	10,250,578	16,432,304	30,915,507	39,285,174	48,602,783	61,646,277	43.16%
ME & AFRICA	319,633	615,051	1,370,597	1,892,400	2,277,100	2,876,354	55.18%
EASTERN EUROPE	43,351	105,921	522,994	952,699	1,443,084	2,439,696	123.91%
WESTERN EUROPE	359,560	632,630	2,695,243	4,294,211	4,879,502	5,490,220	72.49%
NORTH AMERICA	3,175,899	3,278,206	4,432,744	5,507,371	6,483,672	6,949,962	16.96%
LAD & CARIBBEAN	0	0	542,443	773,093	1,001,027	1,268,276	NA
TOTAL MPS	14,149,022	21,064,113	40,479,528	52,704,948	64,687,168	80,670,785	41.64%

Table 15: VoLTE MPS by region

VoLTE is finally becoming a reality with 55 networks deployed in 88 countries. There are 56 networks either in deployment or planning to deploy VoLTE in 39 countries.¹⁶ The modeling used in this index only considers the networks either already deployed or in planning phase. We are projecting that VoLTE will grow from 14 million MPS to 81 million MPS by 2020 for a CAGR of 42%.

- » North America generated 3 million MPS in 2015 growing to 6.9 million MPS in 2020 for a CAGR of 17%
- » Asia generated 10 million MPS in 2015 growing to 62 million MPS in 2020 for a CAGR of 43%
- » Eastern Europe generated 43 thousand MPS in 2015 growing to 2.4 million MPS in 2020 for a CAGR of 124%
- » ME & Africa generated 320 thousand MPS in 2015 growing to 2.9 million MPS in 2020 for a CAGR of 55%
- » Western Europe generated 359 thousand MPS in 2015 growing to 5.5 million MPS in 2020 for a CAGR of 72%

Latin America & the Caribbean will not be implementing VoLTE until 2017 when they are projected to generate 542 thousand MPS, growing to 1.3 million MPS by 2020. There is not enough history to calculate CAGR.

¹⁶ GSA "Evolution to LTE Report, VoLTE Global Deployments," April 8 2016

LTE Broadcast

GLOBAL	2015	2016	2017	2018	2019	2020	CAGR
ASIA	417,155	616,728	827,328	1,051,644	1,344,892	1,777,730	33.63%
ME & AFRICA	8,163	18,015	25,648	43,359	50,621	56,292	47.14%
EASTERN EUROPE	43,881	122,921	208,872	467,612	736,583	1,278,988	96.30%
WESTERN EUROPE	402,771	1,160,658	1,564,109	3,131,898	3,584,682	3,982,049	58.13%
NORTH AMERICA	809,812	2,408,383	2,682,789	5,709,124	6,166,251	12,672,447	73.34%
LAD & CARIBBEAN	0	61,160	204,839	353,594	800,528	1,165,643	NA
TOTAL MPS	1,681,783	4,387,865	5,513,585	10,757,231	12,683,557	20,933,149	65.58%

Table 16: LTE Broadcast MPS by region

More than 55% of mobile data reported in 2015 was video, which will grow to 75% by the year 2020.¹⁷ This presents a major challenge to service providers as they seek a more efficient method of distributing video while optimizing their infrastructure. LTE Broadcast answers this call.

LTE Broadcast uses evolved Multimedia Broadcast Multicast Service (eMBMS) technology to more efficiently deliver video or other content from one source to multiple devices within a cell or a core network. The largest barrier to LTE Broadcast has been a lack of devices that support the technology, but there are now 97 devices supporting eMBMS, with additional devices being developed.

We included all regions in our modeling that were planning for eMBMS and calculated the MPS as if they had already deployed the technology. This gives us the ability to calculate a CAGR for LTE Broadcast. The only exception to this was Latin America and the Caribbean. West Europe service providers are either in trial or planning to implement eMBMS in 13 networks, 7 different countries. Asia follows with 11 networks in 7 different countries.¹⁸

LTE Broadcast is used for a number of different services, including:

- » HD Mobile TV
- » Pre-distribution of content such as software releases
- » Real-time traffic reports, parking space locators and safety services for Connected Cars
- » Sports broadcasts with statistics, replays, merchandise offers and more
- » Emergency Services alerts and announcements
- » Digital signage (electronic billboards)

This index only takes into account the networks already deployed and those networks that have announced plans for eMBMS in its modeling.

¹⁷ Cisco VNI 2016

¹⁸ GSA "LTE Broadcast Pulse Check," April 27 2016



LTE Broadcast generates a lot more Diameter transactions than other Diameter applications, and has the biggest impact on signaling. This is reflected in our modeling below.

- » Asia generated 417 thousand MPS in 2015 growing to 1.8 million MPS in 2020 for a CAGR of 34%
- » ME & Africa generated 8 thousand MPS in 2015 growing to 56 thousand MPS in 2020 for a CAGR of 47%
- » Eastern Europe generated 43 thousand MPS in 2015 growing to 1.3 million MPS in 2020 for a CAGR of 96%
- » Western Europe generated 402 thousand MPS in 2015 growing to 4 million MPS in 2020 for a CAGR of 58%
- » North America generated 809 thousand MPS in 2015 growing to 13 million MPS in 2020 for a CAGR of 73%

Latin America & the Caribbean are not projected to implement LTE Broadcast until 2016, generating 61 thousand MPS in its first year. We project that this will increase to 1.2 million MPS by 2020. There is not enough data to calculate a CAGR. We have projected 21 million Diameter MPS for LTE Broadcast globally.

Connected Car

GLOBAL	2015	2016	2017	2018	2019	2020	CAGR
ASIA	8,878,902	14,303,994	19,398,329	24,450,894	32,725,369	47,226,877	39.69%
ME & AFRICA	425,744	623,425	1,035,452	1,523,674	2,182,311	2,938,904	47.17%
EASTERN EUROPE	527,850	888,131	1,545,921	2,375,810	3,562,406	6,058,064	62.92%
WESTERN EUROPE	427,264	628,635	1,609,483	3,220,417	3,782,988	4,339,012	58.98%
NORTH AMERICA	2,424,466	2,582,424	5,757,814	8,109,997	9,019,804	9,692,771	31.94%
LAD & CARIBBEAN	681,589	1,063,741	1,681,063	2,632,782	3,477,198	4,547,770	46.17%
TOTAL MPS	13,365,815	20,090,350	31,028,062	42,313,574	54,750,076	74,803,398	41.12%

Table 17: Connected Car MPS by region

Perhaps the most talked about application today is Connected Car. It is estimated that there will be 220 million connected cars on the road by the year 2020, with a CAGR of 45%. Not all of these cars will be active however, with only 88 million projected to actually use the 4G services in the car.¹⁹

We usually tend to think of 4G services in the vehicle, with WiFi zones for driver and passengers. However, the industry is demonstrating many new uses for this technology. Autonomous cars are the hottest topic, with 180 thousand autonomous cars projected for 2020.²⁰

Car manufacturers are already taking advantage of LTE for the collection of telematics from the vehicle, providing diagnostics and other vehicle information. Insurance companies have recently jumped into the fray using LTE wireless services to send driving data to central reporting centers, offering consumers discounts for safe driving if they opt-in to the program. Insurance telematics also provides insurance companies with crash data in the event of an accident, helping them to determine fault.

Navigation is a natural extension, and the industry has already seen where In-Vehicle Systems (IVS) out-shipped personal navigation systems in 2013.²¹ Navigation will become more important as countries begin looking at ways to capitalize on the in-vehicle presence of navigation systems.

Several countries are exploring the idea of using these in-vehicle navigation systems for Road Usage Charging. Toll roads today require expensive infrastructure to record vehicles passing through sensors. However, with Connected Car, the vehicle can track its progress using an internal navigation application. The navigation system would be equipped with maps identifying toll roads, and rather than using sensors on the road, the navigation system tracks when the vehicle is traveling on a toll road. The application then reports this data via 4G/LTE to a central toll road administration center for charging to an account.

Today, the number of Diameter transactions required to support a connected car is small. The vehicle is really just another 4G device connecting to the network for data, but as the use cases evolve to more sophisticated services such as road usage charging and autonomous vehicles, there will be many more transactions in Diameter.

¹⁹ Business Intelligence

²⁰ Business Intelligence

²¹ GNSS Market Report, Issue 4, March 2015



Our modeling projects Asia leading the world in Diameter MPS for Connected Car, followed by North America.

- » Asia generated 8.9 million MPS in 2015 growing to 47 million MPS in 2020 for a CAGR of 40%
- » ME & Africa generated 425 thousand MPS in 2015 growing to 2.9 million MPS in 2020 for a CAGR of 47%
- » Eastern Europe generated 527 thousand MPS in 2015 growing to 6 million MPS by 2020 for a CAGR of 63%
- » Western Europe generated 427 thousand MPS in 2015 growing to 4.3 million MPS by 2020 for a CAGR of 59%
- » North America generated 2.4 million MPS in 2015 growing to 9.7 million MPS in 2020 for a CAGR of 32%
- » LAD & Caribbean generated 681 thousand MPS in 2015 growing to 4.5 million MPS in 2020 for a CAGR of 46%

We project that globally connected cars will generate 75 million MPS of Diameter signaling by the year 2020 for a CAGR of 41%

5G and The Future of Signaling

Signaling is an important function within the telecommunications network, and the introduction of virtual networks does nothing to diminish this role. We will continue to see an increase in the use of Diameter and Session Initiation Protocol (SIP) signaling, as these are the command and control of the wireless networks.

The fact that we virtualize these networks does not eliminate the need for signaling. The real question becomes how quickly Diameter will replace Signaling System #7 (SS7) in the world's networks, going well beyond the 40% penetration rate predicted by 2020.

We are still seeing a lot of demand for SS7 signaling in many different markets. We do not believe that SS7 is going to be eliminated by 2020, nor do we believe SS7 will go away by 2030. There is still a lot of use for SS7 signaling in the world's wireless networks, as well as fixed line. There will be a co-existence between Diameter and SS7, where the Diameter signaling will be supporting premium networks while SS7 is relegated to non-premium networks.

We continue to see strong growth in HSPA technology as an alternative to LTE. HSPA of course is a 3G technology, supported by SS7. In some developing countries, we see this growth continue well through 2020, but this does not mean Diameter will not continue to enjoy wide spread implementation and growth. It is more likely that we will see Diameter reach a penetration rate of over 60%, but never 100%.

When we look at other initiatives in our industry such as Smart Cities and Connected Cars, it becomes obvious that Diameter will be key as the signaling protocol to enable these initiatives to work. The role of Diameter is increasing, and will continue to increase as these initiatives mature. This is where we see the most growth for Diameter signaling.

Diameter was built for the cloud. It is an easy migration from big iron to cloud when working with Diameter components, and a natural extension to other functions in the cloud. As more service providers begin implementing their cloud services, Diameter will be there. Telco in the cloud will be a fast growing segment in our industry and Diameter an enabler for many new cloud services.



Appendix 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 2015 extending through 2020. Because 2015 saw higher penetration rates in some regions than previously projected, the overall CAGR for Diameter changed accordingly.

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.

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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Integrated Cloud Applications & Platform Services

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