Mobile Device
TRENDS

An analysis of GCF device certifications in 2018

Many hundreds of different mobile phones and devices are certified by GCF each year. From the following analysis of the GCF's 2018 certifications some interesting and occasionally surprising insights into the mobile phone, IoT devices and components of their ecosystems may be seen.

The data comes from the GCF programme, which by combining conformance and interoperability tests undertaken in laboratories with field trials on multiple commercial networks, certification, verifies the quality of the interoperability between mobile phones, wireless IoT devices across different network elements and vendors' infrastructure.

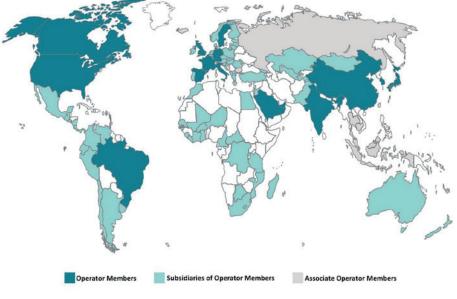February 2019

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Introduction to
GCF

Founded in 1999, the Global Certification Forum (GCF) is the globally-recognised quality mark for the interoperability of devices that incorporate mobile connectivity.

GCF certification is based on test cases defined by organisations, such as 3GPP, CTIA, GSMA, NFC Forum, OMA, and oneM2M. GCF operator and manufacturer members together identify and agree a selection of available test cases for each technology and functionality to be brought within the scope of the programme to deliver a robust but reduced-cost testing regime that meets the evolving market needs.

GCF certification comprises lab-based conformance and interoperability testing complemented by field trial testing on live commercial networks.

As of January 2019, over 100 device manufacturers are participating in GCF. The programme is also recognised by operators with interests in global markets *(Fig 1)*.

A number of GCF operator members have undertaken studies to evaluate device performance on their networks, monitoring features such as RSCP, Ec/Io, dropped calls, etc. These studies have shown that devices from GCF members perform significantly better than devices from non-member companies.

GCF operator members

■ Operator Members   ■ Subsidiaries of Operator Members   ■ Associate Operator Members

Fig 1

Common, rigorous and trusted certification criteria promote commonisation of operator acceptance testing schemes. By minimising duplication, GCF certification reduces acceptance testing costs and contributes to improved economies of scale for device manufacturers.

The initiative provides a consistent, optimised flexible, scalable framework for certifying any

mobile device: from a simple single-mode low-cost featurephone to flagship multi-mode, multi-band smartphones, modules, tablets, wireless routers, IoT modules and products.

By adopting GCF certification into its quality management system, a manufacturer can significantly expand the size of the market it can target: a certified, multi-mode, multi-band device

can be marketed to the customers of multiple network operators worldwide. In national markets where operators are not directly involved in the marketing of devices, distributors can reduce their after-sales service overheads by prioritising products that have been shown to meet GCF's globally recognised benchmark of conformance and interoperability.

Originally developed for GSM, GCF certification broadened to cover newer technologies as they were adopted: GPRS, EDGE, 3G UMTS (WCDMA), HSPA, 4G LTE, LTE-Advanced, and LTE-Advanced Pro. And as 5G commercial deployment begins, GCF is preparing to include it in the programme.

The effective use of frequency bands, and the handling of the growing number of band combinations available in devices / to networks is assisted by the GCF initiative, which provides an effective method for verifying the correct operation of Carrier Aggregation currently up to 5CA.

In December 2014, GCF became the recognised certification programme for CDMA2000 devices.

GCF can also certify standards-based client applications such as RCS and NFC.

The quality of interoperability assured by the programme facilitates successful international and national roaming for end users.

Key GCF milestones:

Date	Event
September 2018	GCF and TTA announce global certification solution for oneM2M
August 2018	First RSP eSIM consumer devices certified
May 2018	GCF introduces MVNO membership categories
February 2018	RSP eSIM certification for consumer devices introduced
December 2017	GCF starts development of 5G device certification
September 2017	First LTE CAT M1 device certified
March 2017	First NB-IoT device certified
February 2017	Platform certification introduced
December 2016	Certification of first device supporting Carrier Aggregation
December 2014	First CDMA2000 devices certified
October 2013	Certification for client applications introduced
October 2012	First dual-mode FDD-/TDD-LTE device certified
September 2011	First TDD-LTE device certified
March 2011	First FDD-LTE device certified
August 2008	First HSUPA device certified
June 2008	First HSDPA device certified
February 2006	First 3G device certified
May 2000	Certification of first device – GSM
1999	GCF founded

GCF device certifications

Certified devices are listed on the GCF website at:

A list of certified modules suitable for adding mobile connectivity to other products and qualifying for GCF's optimised certification programme can be found at:

https://www.globalcertificationforum.org/products/certified-modules.html

Executive
SUMMARY

This annual review of mobile device trends is based on an analysis of device certifications published by the Global Certification Forum during 2018. The analysis provides insights into the mobile technologies and functionalities being requested by operators and end users across markets worldwide.

A total of 641 devices were GCF certified by 65 manufacturers in 2018. Certifications increased by 23.0% compared with 2017.

5G

Towards the end of 2017, GCF started the development of 5G device certification to cover both the non-standalone (NSA) and standalone (SA) 5G system modes of operation.

The 3GPP has yet to announce its final 5G NR specification; however, GCF is prepared for when it does – expected Q1 of 2019 and GCF certification will apply to 3GPP 5G NR implementation.

We forecast that certifications for 2019 devices supporting 5G will likely be a modest number and they will use the sub-millimetre wave bands. For this, the foundations / preparation to introduce the certification of 5G devices is in place and the certification of early commercial devices supporting 5G is already possible. And while no certifications took place in 2018, January 2019 saw GCF's first 5G NR certification - Keysight Technologies' 5G Conformance Toolset.

Multi-mode devices

The need to support end users served by operators whose network infrastructures include more than one generation of mobile technology is reflected by the fact that 91% of all devices certified in 2018 incorporated more than one bearer technology. 65% of devices incorporated three or more technologies.

Pre-launch testing is required to demonstrate that each individual bearer technology is performing correctly and that the incorporated technologies interwork with each other to deliver seamless operation to end users when moving between areas covered by different technologies. GCF's widely recognised certification framework is the most cost-effective way of robustly testing these core, but complex communications capabilities.

An upside of such complexity is that certified multi-mode, multi-band devices can be marketed in multiple territories, thereby giving operational improvements for manufacturers.

As new radio technologies are introduced the number of bands in a typical GCF-certified device increases. However, this increase is concentrated in the newer LTE standards, and the use of GSM technologies starts to decline.

Many operators are considering when to roll up 3G services, so while 3G technology is expected to decline the small increase in supported GSM bands is unexpected.

Number of bands in 'average' GCF-certified device (across all devices)							
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
GSM	3.5	3.5	3.5	3.2	3.1	3.1	3.2
3G	2.2	2.6	2.7	2.9	3.1	3.2	5.1
FDD-LTE	0.3	1.2	2.3	3.6	4.6	6.0	7.6
TDD-LTE	0.0	0.0	0.1	0.3	0.6	1.0	1.3

In 2018, 64% of all certified devices incorporated GSM, 3G and LTE, down slightly from 66% in 2017.

Modules accounted for 26% of all certifications (up from 16% in 2017).

LTE

In GCF certified products support of FDD-LTE is still higher than support of TDD-LTE

By the end of 2018, GCF had enabled the certification of LTE devices in 24 FDD-LTE bands/sub-bands and 7 TDD-LTE bands

548 devices supported FDD-LTE 85.5% of all certifications a marginal increase over the 84% in 2017

341 devices supported TDD-LTE, 53% of all certifications, a significant increase on 2017, when 40% (209) of certified devices supported TDD-LTE.

Certification of devices supporting Carrier Aggregation was 276 devices in 2018, 43% of all certified devices and (50% of LTE devices). This matches 2017 data, where it was certified in 42% of all devices and 49% of LTE devices. The programme is used to certify devices capable of aggregating two, three or four downlink bands along with two uplink bands and the trend is for certification of an increasing number of CA bands.

VoLTE support was certified in 327 devices, representing half of all devices, and 58.5% of LTE devices. This is analogous with 2017, when 59% of certified devices supported VoLTE.

Cellular IoT

There has been a 200% increase in devices incorporating a cellular IoT standard since 2017.

This is only the second year GCF has certified the Low Power Wide Area (LPWA) communications technologies standardised by 3GPP for IoT applications. NB-IoT featured in 19 devices; LTE CAT M1 (FDD) featured in 22; LTE CAT M1 (TDD) in one; and EC-GSM in three. It's notable that two standards have dominated – NB-IoT and LTE CAT M1 (FDD), with EC-GSM having minimal traction.

3G (UMTS/WCDMA)

Operators are seeking to replace 3G data capacity with LTE. However, the expected dip in 3G certifications didn't materialise – in fact in 2018 the proportion of all devices incorporating 3G increased – from 82 of all 2017 certifications to 87% in 2018.

Despite this, it still appears support for 3G among manufacturers is dropping, with 3G only incorporated into multi-mode devices.

The penetration of HSDPA remained static compared to 2017, at 85%, while HSUPA penetration increased to 84% in 2018, up five points on 2017.

Dual-carrier HSDPA was incorporated into 64% of all certified devices. This is up from 57% in 2017, and 49% in 2016.

CDMA2000

54 devices, 8% of all certified devices, incorporated CDMA2000. All the certified CDMA2000 devices also incorporated LTE. 42 (80%) of the CDMA2000-capable devices also incorporated UMTS/WCDMA, and all 42 of these were quad-mode devices that also incorporated GSM.

GSM

The support of GSM across all devices continues to decline. GSM was still a feature of 75% of all certified devices, down from 81% in 2017 and 84% in 2016. However, 33 GSM-only devices (or 6% of all devices) were brought to market.

EDGE usage also continues to decline, reflecting LTE's now-dominant position as the principle bearer technology for data services. EDGE was incorporated into 67% of all devices in 2017, down from 71% in 2017 and 77% in 2016.

Platforms

A platform is any hardware or software sub-system that provides defined functionality within the scope of the GCF certification programme. The programme enables manufacturers to design new wireless products – including chipsets – around previously certified functionality and reuse the test results and certification of the platform used.

And while there was a fall in platform certifications during 2018 (12, down from 20 in 2017), this was likely due to market adjustment and, based on discussions with GCF members, we expect this to rise in the future. The growth would to be driven through the certification of single-variant chipsets, such as those used for IoT.

eSIM

The GCF certification programme is broadening to allow the fundamentals of service applications. This includes eSIM (aka RSP / remote SIM provisioning) and Secure NFC (see below).

The certification of eSIM devices was introduced in the final months of 2018. For this, GCF has worked with the GSMA to introduce this as part of the standard GCF certification, based on the GSMA's eSIM test specification for consumer devices. GCF also offers standalone certification for eSIM devices and this is accessible to all organisations (members and non members) wishing to certify only the eSIM functionality of their product.

eSIM is a global specification developed by GSMA that enables remote SIM provisioning of an eSIM device, and allows consumers to store and switch between multiple-operator SIM profiles on their device. Manufacturers and operators can use eSIM to enable consumers to select the operator of their choice and then securely download that operator's SIM profile to access the network.

This certification has already begun with 5 devices certified before the end of 2018. It is expected many more products will be certified during 2019.
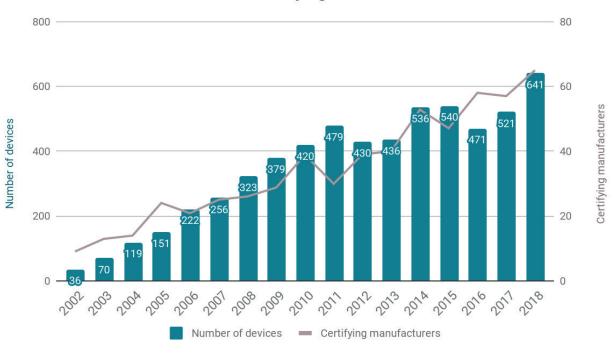
Secure NFC

During 2018 GCF certified 114 smartphones (37% of all smartphones certified) which support UICC based Secure NFC services according to GSMA NFC specifications.

A device supporting Secure Element based NFC services (UICC/eUICC/eSE) supports services using NFC for contactless payment, ticketing, eID, and access control where medium or high security is required. Use cases are primarily where a smartphone replaces traditional customer media like contactless smart cards.

GCF Certifications
BY YEAR

Growth continued in 2018 with a significant increase in both the number of device certifications (up 23.0% on 2017) and the number of manufacturers certifying at least one device (up 14%). Both figures represent records.
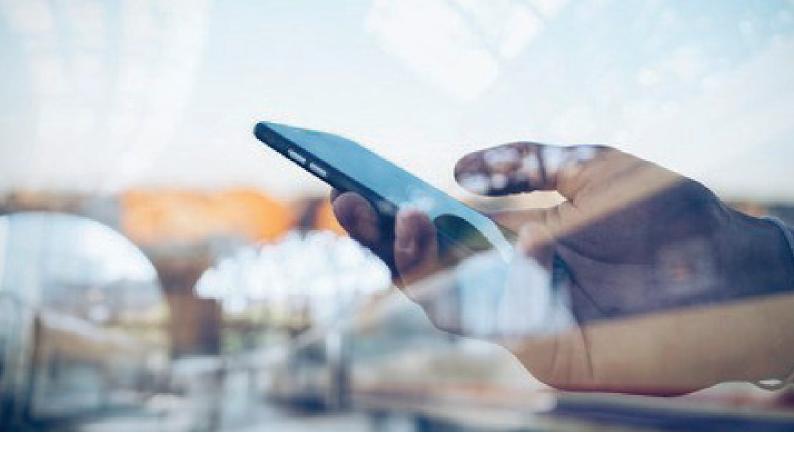

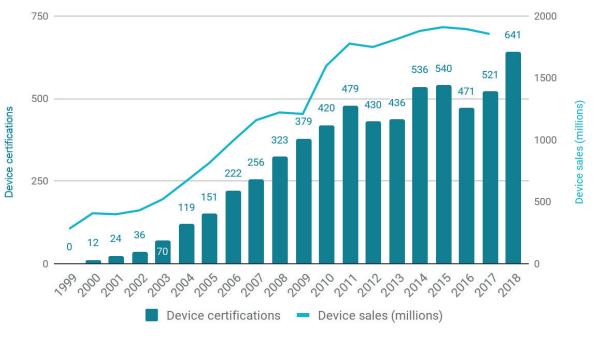GCF Certified devices & certifying manufacturers 2002 - 2018

Fig 2

The data shows that certification benefits manufacturers of all sizes. Three manufacturers certified 50 devices or more; 37 manufacturers certified three devices or fewer. And of the 65 manufacturers certifying devices in 2018, 10 were new members.

Comparing annual certifications against global device sales suggests there is a relationship between the choice of devices in the global market and overall market size *(Fig 3)*.

Comparison of global device sales and device certifications 1999-2018
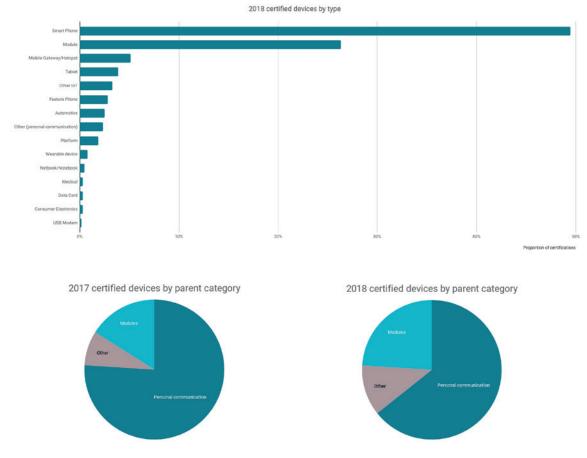

Device certifications: 0, 12, 24, 36, 70, 119, 151, 222, 256, 323, 379, 420, 479, 430, 436, 536, 540, 471, 521, 641

- Device certifications
- Device sales (millions)

Fig 3

†*Device sales source: 'Gartner Worldwide Manufacturer Sales to End Users of Mobile Terminal Devices', collated by GCF. Gartner attributed the pause in the growth of sales in 2008/09 to the collapse in consumer confidence in many developed economies in the wake of the September 2008 international banking crisis. No data is yet available for 2018.*

2018-Certified Devices
BY TYPE

While smartphones still represent the largest class of devices certified (49%), the growth in the number of modules has increased significantly, making up over a quarter of all devices certified (up from one-sixth in 2017, *Fig 4*).

2018 certified devices by type

2017 certified devices by parent category

2018 certified devices by parent category

Fig 4

The number of smartphones certified increased to 317 in 2018, but their overall share dropped from 55 to 49%. This is due to the significant growth in the number of modules being developed. Mobile gateways and hotspots were the only other category to make up more than 5% of certifications.

The proportion of certifications for both tablets and feature phones and USB modems fell in comparison with 2017 reflecting changes in the product market Tablets dropped from 6% to just under 4%, whereas feature phones dropped from 5% to less than 3%, and USB modems, which made

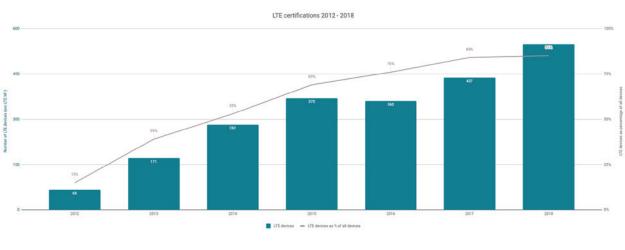up 2% of 2017 certifications, had just one device certified (0.2%) in 2018.

The rise of modules meant that devices enabling personal communications – smartphones, feature phones, tablets, notebooks, mobile gateways/portable hotspots, USB modems, etc. – made up 64% of all certified devices, down from 76% in 2017.

In addition to modules, many of which are for IoT devices, medical and automotive systems accounted for 2.8% of certified devices, and other IoT devices accounted for 3.3%.

LTE penetration continues,
but 3G undergoes a resurgence

Penetration of LTE in certified devices continued its inexorable rise in 2018, albeit at a reduced rate (*Fig 5*).

LTE certifications 2012 - 2018

Fig 5

In 2018, 548 certified devices (85%) supported LTE. FDD-LTE was supported in all 548 of these devices, and of these TDD-LTE was incorporated into 341 devices (53%, up from 40% in 2017). As per 2017, all TDD-LTE-capable devices also incorporated FDD-LTE; however, the proportion supporting simultaneous FDD/TDD operation dropped from 82 to 75%. Additionally, 11 of the 548 devices incorporated the cellular IoT variant, LTE CAT M1 (total 559 devices).

There was also a significant rise in certifications supporting Gigabit LTE, with 32 Category 16/ Category 18 devices certified, up from just six in 2017.

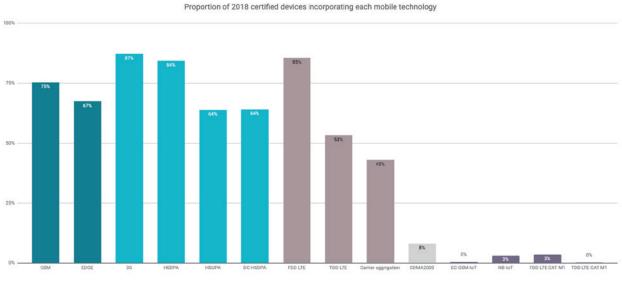VoLTE operation was certified in 51% of LTE devices (327 devices).

How this compares with 3G/2G

The resurgent growth in 3G is particularly noteworthy. In 2017 LTE overtook 3G (UMTS/WCDMA/HSDPA/HSUPA) as the most commonly certified mobile technology, with LTE featured in 84% of certified devices and 3G in 82%. With operators seeking to phase out 3G for LTE we had anticipated 3G's share to drop further, but 2018 saw a resurgence in the use of 3G. 3G was also featured in 559 certified devices (87%).

GSM featured in 75% of devices (down from 81% in 2017, *Fig 6*).

Proportion of 2018 certified devices incorporating each mobile technology
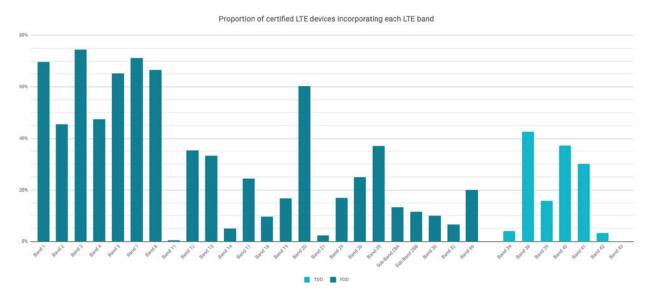

Fig 6

The penetration of HSDPA has remained roughly static (up two points from 2017), while the penetration of HSUPA has declined from 79% in 2017 to 64% in 2018. The implementation of dual-carrier HSPA has increased significantly, with 64%t of certified devices in 2018, from 57% in 2017 and 49% in 2016.

Multi-band devices open door to global LTE market

The GCF programme enables the certification of devices designed to operate in 24 FDD-LTE and sub-bands and 7 TDD-LTE bands and various CA combinations. During 2018, all bands covered by the GCF initiative had devices certified (Fig 7).

Proportion of certified LTE devices incorporating each LTE band

Fig 7

Incorporating multiple bands expands the potential market for a given device. With its extensive coverage of LTE bands, GCF is being used to certify devices destined for use in all the leading mobile markets worldwide.

Band 3 (1800 MHz) retained its position as the most commonly certified LTE band in 2018: it featured in 478 devices (86% of LTE devices, and 75% of all devices).

Band 7 (2600 MHz) remains the second most certified LTE band, incorporated into 456 devices (82% of LTE devices), followed by Band 1 (2100 MHz) in 447.

The US 850 MHz bands (Bands 5 and 26) and AWS bands (Bands 4 and 66) are also commonly implemented in GCF-certified devices, with all increasing as a proportion of devices certified compared with 2017.

Band 8 (900 MHz) is widely implemented in LTE devices to facilitate 're-farming' of a spectrum that is still widely used around the world by GSM operators, and has likewise increased its penetration.

Band 28, the APT 700 MHz band, which has been allocated in major markets in Latin America and Asia Pacific including Brazil, Argentina, Japan, Korea, India, the Philippines, Australia and New Zealand, was certified in 37% of certified LTE devices, a one percentage point increase on 2017.

The number of certified bands in LTE devices continued to increase during 2018. Of the 548 devices incorporating FDD-LTE, 408 (93% of LTE devices) incorporated three or more LTE bands, while 80% incorporated five or more bands (*Fig 8*).
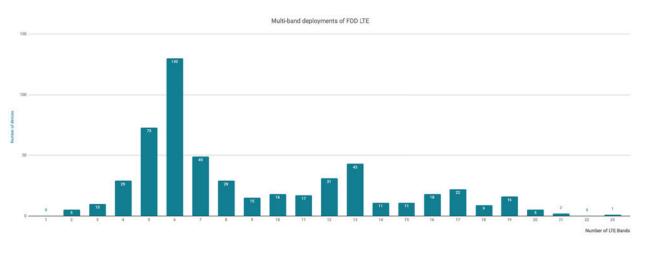

Multi-band deployments of FDD LTE

Fig 8

As in 2017, the modal number of FDD-LTE (excluding LTE CAT M1) bands is six; however, the average number is increasing. Two hundred and four (36% of LTE devices) incorporated 10 or more FDD-LTE bands, up from 47 devices (13%) in 2017. Eighty-four devices supported 15 or more FDD-LTE bands, up from 28 in 2017.

In 2018, the 'mean' LTE device incorporated 9.0 FDD-LTE bands, up from 7.1 in 2017.

With such a diversity of bands, the number of potential inter- and intra-band Carrier Aggregation (CA) combinations is enormous. GCF has developed a flexible certification framework which enables manufacturers to demonstrate that their devices will work effectively in CA band combinations deployed by network operators while keeping costs down. The number of devices deploying CA increased in the past year with 274 devices certified (43% of LTE device certifications), albeit the proportion was down on 2017, which had 49% (216 devices) deploying CA.

Manufacturers still embracing 3G, despite operator prioritisation of LTE for data delivery

Even though operators and device manufacturers have continued to prioritise LTE for the delivery of data services, certifications for HSDPA and HSUPA have increased compared with 2017. Certifications for 3G (UMTS/WCDMA) also increased by five points to 87% of all certified devices in 2018.
It is, however, worth noting that no standalone 3G devices were certified in 2018.

Certification of HSDPA increased from 82% in 2017 to 85% of all devices in 2018, back to 2016 levels. HSUPA featured in 84% of certified devices, up from 79% in the prior year. In addition, the penetration of dual-carrier HSPA once again increased, to 64% of all devices. This is up from 57% in 2017 and 49% in 2016.

Two or more 3G bands were certified in all bar one device deploying 3G (*Fig 9*). Three hundred and seventy-one devices (66% of 3G devices) were certified in four or more 3G bands.
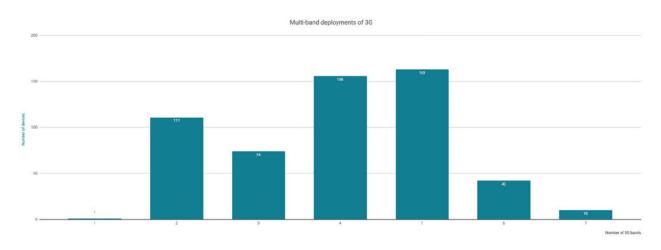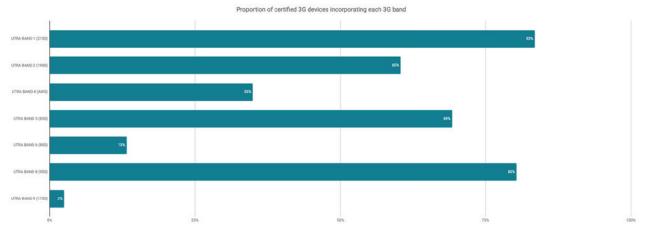

Multi-band deployments of 3G

Fig 9

GCF
Global Certification Forum

The 2100 MHz band featured in 535 of the 559 certified devices (83% of all devices and 96% of 3G-capable devices, *Fig 10*).

Proportion of certified 3G devices incorporating each 3G band

Fig 10

The 900 MHz band remained the second most frequently certified 3G band – in 515 devices (80% of all devices and 92% of all 3G devices).

The most commonly certified US 3G band remained 850 MHz, albeit this has declined from 81% of devices certified in 2017 to 69% (44 devices) in 2018.

220 devices (39% of certified devices deploying 3G) incorporated three US 3G bands.

The decline of GSM continues

The penetration of GSM continued its decline, now standing at 75% of certified devices, down from 84% in 2016 and 81% in 2017 *(Fig 11)*.
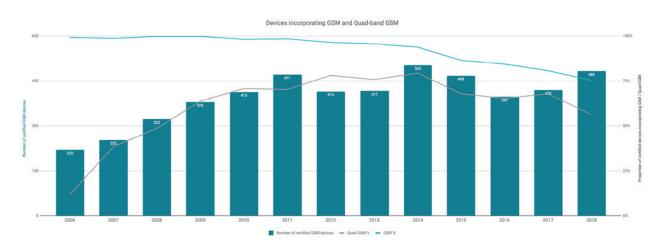

Devices incorporating GSM and Quad-band GSM

Fig 11

Twenty certified devices (3% of all certifications) were GSM-only. The majority of which were either modules (15) or feature phones (4).

EDGE was certified in 432 devices (67% of all devices, and 89% of all GSM-capable devices).

And certifications for quad-band GSM devices also saw an accelerated decline, with a 12-point reduction compared to 2017 (from 68 to 56% of all devices), the largest drop in this category of device.

A decline in both single-mode devices and those using four-plus bearer technologies

In 2017 the number of relatively simple, single-mode devices targeted to specific applications increased from 11% of certifications (51 devices), to 16% (82 devices). This increase didn't continue, however, with 2018 seeing single-mode devices make up just 9% of 2018 certifications (51 devices).
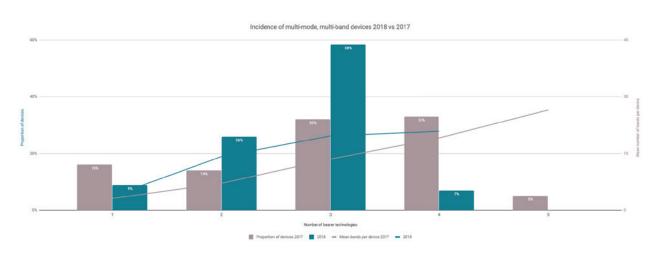

Fig 12 – Note, bearer technologies have been classified as 2G (GSM/EDGE), 3G (WCDMA/UTRA/HSDPA/HSUPA), 4G (FDD-LTE, TDD-LTE), CDMA2000, NB-IoT, LTE M1 (TDD, FDD), EC-GSM

Single-mode devices

There has been a significant fall in the proportion of single-mode devices, down from 16% of certifications in 2017 to just 9% in 2018. These drops were particularly visible in the number of single-mode LTE devices (16, down from 40 in 2017) and GSM (20, down from 33 in 2017) device certification. However, certifications for single-mode devices using an LPWA category (NB-IoT or LTE CAT M1 or EC-GSM) increased significantly from 6 in 2017 to 20 in 2018.

This fall is likely related to the increasing availability of modules supporting multi-mode: in 2017, single-mode devices accounted for 55% of modules; in 2018 this figure had more than halved to 24% *(Fig 14)*.

This increasing level of complexity can also be seen in a small but significant rise in the number of bands used by these single-mode devices, rising from a mean of 3.1 bands per single-band device in 2017 to 3.7 bands in 2018.

Multi-mode devices

Of particular note is the reduction in the number of devices using four-plus bearer technologies.

In 2017, the modal number of bearer technologies per device was four (35% of certifications), closely followed by three bearer technologies (33%). In 2018, the modal number of technologies used was down to three (58% of certifications), and just 7% of devices used four. None incorporated five bearer technologies (down from 5% in 2017).
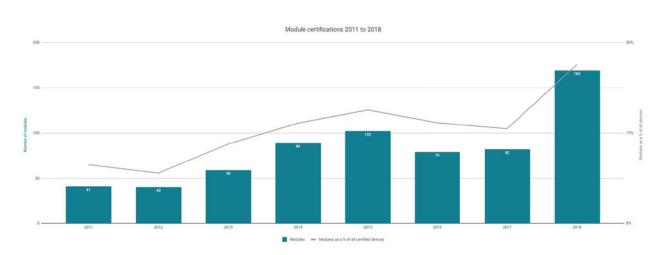
Despite this drop in the number of bearer technologies used, the overall complexity increased significantly, with 2018-certified devices having a mean of 17.3 frequency bands. Those with three technologies had a mean of 19.0 bands per device, and those with four had a mean of 33.7.

The highest number of implemented bands in 2018 was 42, up from 37 in 2017.

Wireless
MODULES

2018 saw a significant rise in module certifications, with 169 certifications (up from 82 in 2017), representing 26% of the total, a 10-point increase on 2017 (*Fig 13*).

Module certifications 2011 to 2018

Fig 13

Despite this rise, growth came from just a handful of manufacturers. Nineteen companies certified modules during 2018 (up from 16 in 2017), and over 75% of module certifications came from just four companies. Additionally, two manufacturers that exclusively developed modules were among GCF's top 10 manufacturers by number of certifications.

As with certified devices generally, a variety of multi-mode, multi-band modules are currently being offered to the market. 2017's rise in single-mode modules appears to be an anomaly, with just 24% of the 169 certified modules (40 modules) being single-mode, down from 55% in 2017 (45 out of 92) and reverting to 2016 proportions, when single-mode devices represented 24% of all certified devices. Generally, modules tend to incorporate fewer bearer technologies than all certified devices, with the modal number being two (42% of all modules).

There has been a significant increase in complexity since 2017, with 76% of modules certified in 2018 being multi-mode (*Fig 14*), compared with just 45% of modules in 2017.
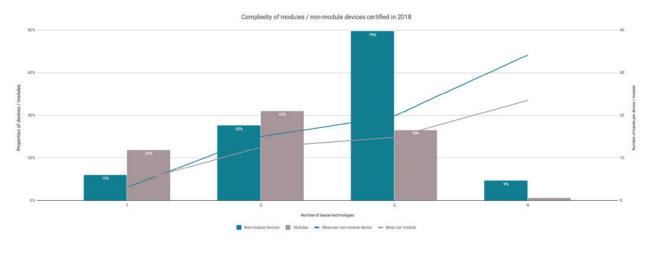

Fig 14

And while, as per all devices, there has been a reduction in the number of modules using four-plus bearer technologies, the number of frequency bands per module certified in 2018 has risen significantly, now standing at 11.4 per module and 13.7 per multi-mode module.

The maximum number of frequency bands for a module was 33.

In 2017, FDD-LTE overtook GSM as the most commonly certified bearer technology in modules, with 50 modules incorporating FDD-LTE, versus 46 GSM. In 2018, the use of FDD-LTE (101 modules certified) dropped to third place behind 3G (116) and GSM (105). LPWA technologies were used in 27 modules *(Fig 15)*.
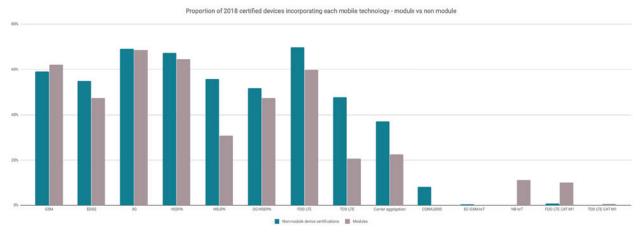

Fig 15

38 of the FDD-LTE modules (37% of all modules) supported Carrier Aggregation.

CONCLUSION

In a global mobile ecosystem that now embraces multiple distinct bearer technologies deployed across numerous frequency bands, GCF certification provides a practical, robust, low-cost and industry-recognised means of ensuring that devices will interoperate correctly with networks and meet the performance expectations of end users and network operators.

In 2018, the average GCF-certified device incorporated 2.6 bearer technologies and operated across 17.3 frequency bands and demonstrating the conformance and interoperability of today's sophisticated multi-mode, multi-band smartphones to the satisfaction of the world's mobile operators would be more difficult, time-consuming and expensive without a scheme such as GCF certification. However, this GCF device analysis shows that the scheme remains relevant to the pre-launch testing of relatively simple single-mode and even single-band devices too.

With 2019 set to be the first year for 5G devices and networks to enter the market, the need to demonstrate this conformance and interoperability remains paramount. And while we expect a slow uptake – mirroring that of 4G (or perhaps even slower), it will be interesting to see how this rise takes off in the 2019 and 2020 GCF Mobile Device Trends reports.

GET IN TOUCH
WITH US!

e. **gcf@globalcertificationforum.org**

w: **https://www.globalcertificationforum.org/**

Twitter: **@GCF_Certified**

LinkedIN: **https://www.linkedin.com/company/global-certification-forum-gcf-ltd/**

Global Certification Forum Ltd
Suite 1, 3rd Floor, 11-12 St. James's Square
London
SW1Y 4LB
United Kingdom

GCF™
Global Certification Forum