GSMA

5G Delivers New Wave of Automation for Manufacturing

Featuring compelling case studies of live commercial services, this ebook explains how leading manufacturers are turning to 5G to dramatically improve the efficiency and effectiveness of their operations.

Connected Manufacturing and Production community ebook

The GSMA Connected Manufacturing and Production community

GSMA is a membership-led organisation where members collaborate with industry peers and stakeholders, engage in influential discussions, and drive industry-wide initiatives that address the most pressing industry challenges and opportunities. As a GSMA member, you'll have a seat at the table where decisions are made, specifications are developed, and the future of mobile telecommunications is shaped. Join a global community of like-minded professionals and organisations who share a common goal of advancing the mobile ecosystem for the benefit of billions of people worldwide.

The GSMA Connected Manufacturing and Production community brings together industry experts with connectivity leaders through our quarterly forums to collaborate and solve the industry's biggest challenges. Members receive discounts and access to speaking slots at our global MWC events, as well as access to industry specific training, reports and 1:1 meetings with our experts.

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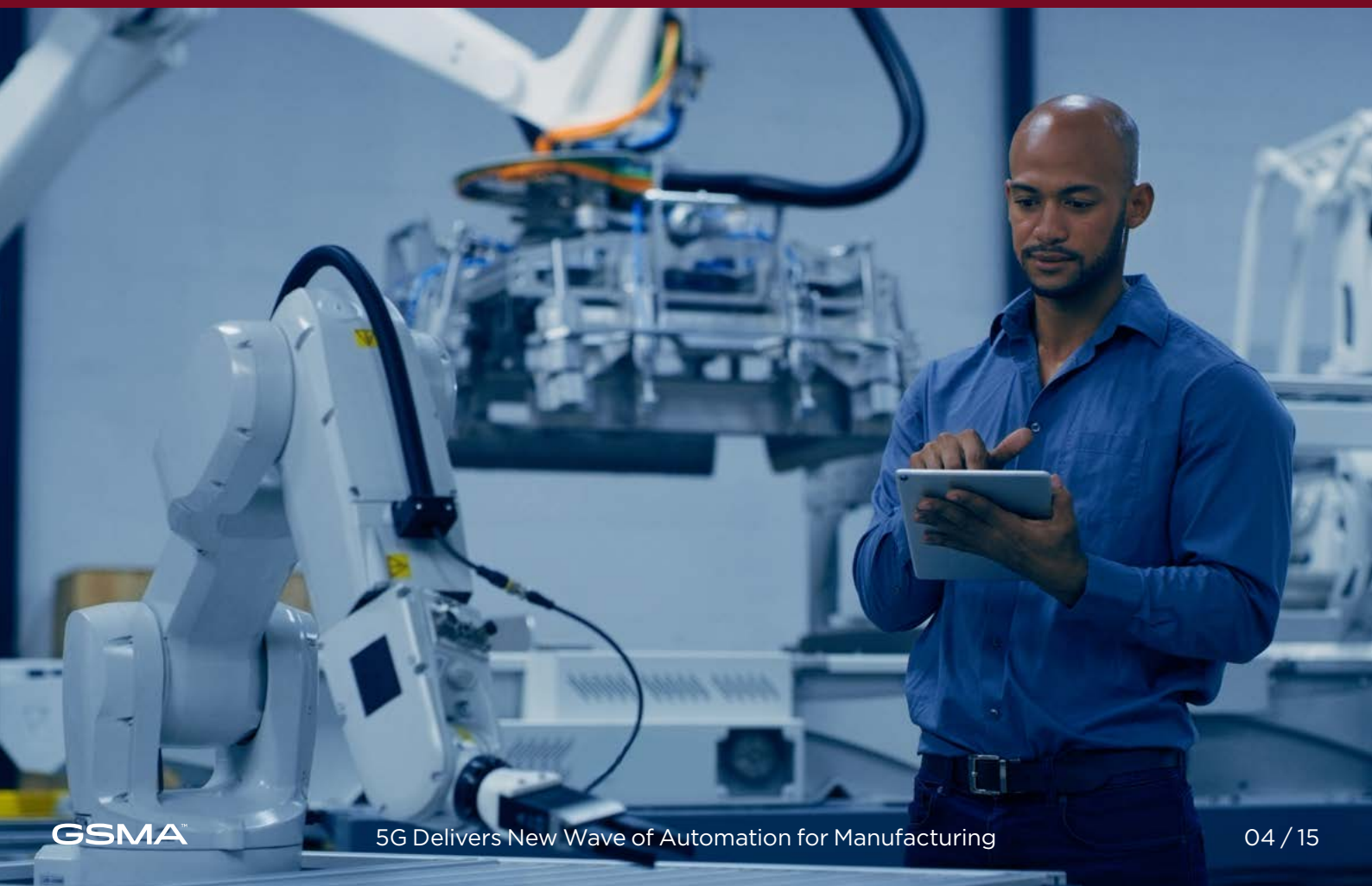


As 5G and artificial intelligence (AI) mature, major manufacturers are harnessing these technologies to become more efficient and responsive to market demands. In industrial settings, devices and sensors networked via 5G can gather vast amounts of real-time data. This data can then be analysed by AI to optimise a wide range of processes. With a cloud-native core, standalone 5G networks can provide highly flexible and versatile connectivity that can be precisely tailored to the demands of a particular production environment.

Manufacturers are increasingly working with the mobile industry to deploy 5G networks across factories and other production sites (see Figure 1). The GSMA supports this cross-industry collaboration through the GSMA Connected Manufacturing and Production Community, which brings together mobile operators, enterprises, and the broader ecosystem to accelerate the benefits of 5G technologies in the industrial sector.

Figure 1:
Mobile operators and manufacturers now work together within a broad digital ecosystem

In manufacturing, there are many different use cases for 5G connectivity. For example, it can be employed to remotely control and monitor production lines, robots and vehicles, improving safety and efficiency. A 5G network can also continuously collect data that can be used to optimise processes and guide proactive maintenance and upgrades, as well as enabling machine vision applications that can automate quality checks. Indeed, reliable and ubiquitous connectivity can enable a manufacturer to create a complete digital twin of production plants, giving it a comprehensive and real-time view of their operations. 5G networks can also be deployed rapidly onsite and remove the limitations of network cabling restrictions present with current solutions.

This ebook outlines how Airbus, which is on the steering group of the GSMA Connected Manufacturing and Production Community, and Hamburger Containerboard, a leading paper and packaging manufacturer, are using private 5G networks to generate considerable value for their businesses today.

If they don't wish to deploy their own private networks, manufacturers can take advantage of the increasing flexibility and functionality of public mobile networks. Businesses can now tailor this connectivity to their needs through the network application programming interfaces (APIs) being made available by mobile operators via the GSMA's Open Gateway initiative. These standardised APIs can, for example, be used to temporarily boost the quality of the connectivity to support a specific use case, or to locate a specific asset and piece of equipment.

The GSMA has large ambitions to steer and expand this capability to allow industrial equipment of different manufacturers and suppliers to communicate effortlessly between each other. These developments will allow for faster timelines, increased efficiency and smoother and cheaper implementation.

Airbus embraces 5G for fast and reliable connectivity

Airbus designs, manufactures and delivers industry-leading commercial aircraft. It operates across 180 locations worldwide and has 18,000 direct suppliers. As Airbus' 150,000 employees produce, transmit and analyse huge volumes of data daily, the business requires a highly efficient, reliable and secure information and communications infrastructure.

To meet that need, Airbus is increasingly turning to 5G. Airbus says[1], "5G signals offer uninterrupted connectivity wherever the network is in use, even in areas where coverage was previously patchy or non-existent." Airbus believes 5G can support superior services, applications and features, compared with other technologies. "5G can achieve a throughput of up to 1.4 gigabytes per second, or four times more than the current Airbus Wi-Fi," the company notes. "The network offers new services, higher speeds and greater capacity. A much larger volume of data can be exchanged without network congestion."

Airbus is rolling out private 5G across its commercial aircraft production locations globally. Already in operation in France, 5G is set to be deployed in Germany, the UK and Spain during 2025, while Chinese and North American sites will soon follow. Airbus is also preparing to pilot 5G at Airbus Helicopters and Airbus Defence and Space.

At the final assembly line for the Airbus A350 passenger aircraft in Toulouse, "all outdoor or dense and complex areas" are now connected to the company's private 5G network. As a result, machine operators can input data into a mobile device instantaneously, rather than having to return to their workstation, sometimes hundreds of metres away, to manually log information. Once uploaded, their data portal allows access to information from anywhere in the world for global analysis and decision making.

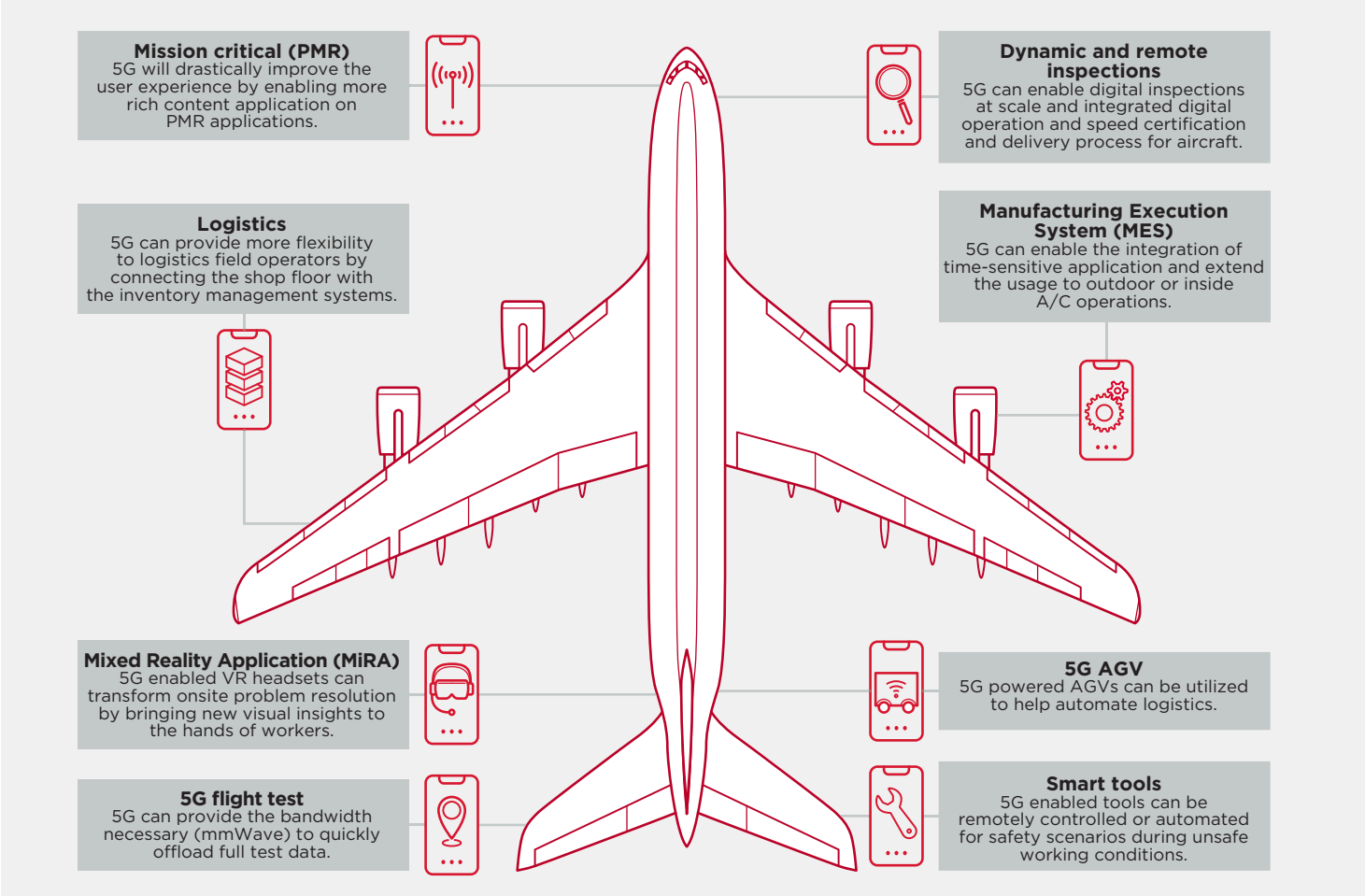
Airbus says its private 5G network will also support the positioning and data provision for autonomous guided vehicles (AGVs), such as the robots that transport fuselage sections between stations at the Airbus Atlantic Montoir-de-Bretagne plant or those which drop off tools and assembly kits at the A321 final assembly line in Toulouse Lagardere. At the same time, the network can provide secure communications for on-site security teams and firefighters.

In 2023, Airbus outlined to the GSMA[2] how 5G connectivity is enabling it to connect 4,000 industrial assets (smart tools, drilling centres, milling, moulding, AGVs, robots, automated parts shop etc.) to its manufacturing execution system (see Figure 2) and enterprise resource platform. The aim is to integrate all the data generated by these assets, and create a single and unified interface for any operational and business application. That will result in greater visibility and interoperability, giving Airbus more insight into shop floor operations and supporting further automation.

1 https://www.airbus.com/en/newsroom/stories/2024-06-the-future-is-calling-unveiling-airbus-private-5g-network

2 https://www.gsma.com/solutions-and-impact/technologies/internet-of-things/wp-content/uploads/2023/06/GSMA-Private-5G-Industrial-Networks-Report-June-2023.pdf and https://www.gsma.com/solutions-and-impact/industries/connected-manufacturing/gsma_resources/industry-4-0-brownfield-evolution-framework-2023/

Figure 2:
Airbus is exploring how 5G can enhance many different aspects of aircraft production



Source: GSMA Private 5G Industrial Networks Paper

Airbus is enabling automatic ordering of parts and tools from its tool shops, and automatic data transfers between various production stations avoiding human errors. At the same time, the monitoring and modularisation of the data generated by machines allows for predictive maintenance, so that worn components can be detected and replaced before they cause wider damage. That equates to less downtime and greater production efficiency. The savings can be very substantial. For example, if a drilling head breaks in a simple titanium piece, it may be necessary to scrap the entire piece at a cost of €200,000.

Airbus is exploring how private 5G can connect cameras and smart glasses, enabling remote experts to guide on-site staff through maintenance, repairs, and training programmes. The flexibility of using 5G and Edge Cloud-based image processing offers a lower entry barrier and is fast to deploy. Additionally, the responsiveness of 5G smart tools, when used with a geolocation system, ensures that tool operators follow pre-defined actions, thereby avoiding human errors in production. This also supports digital quality control and quality assurance (QC/QA).

Airbus told the GSMA that the new information and communications infrastructure has enabled it to optimise production processes and quality control, resulting in an overall increase in its ROI of about 20%. For the competitive manufacturing sector, in which margins are generally small, that represents a major boost for the bottom line.

5G is far more flexible than 4G

Hakim Achouri, 5G and IoT expert for digital aviation at Airbus, says that 5G has multiple advantages over 4G. In 2018, Airbus began using 4G to support a range of indoor and outdoor use cases. But 5G has since become key to delivering Autonomous Mobile Robot (AMR) and Automated Guided Vehicle (AGV) connectivity to produce the new Airbus A321XRL, "which comes with disruptive reshuffling of several production lines with much higher [levels of] automation," he explained in an interview[3] with RCR Wireless in December 2022.

Elaborating on the value of 5G, Hakim Achouri said the faster the connection, the better the overall user experience. "So 5G is better than 4G," he noted. "More complex features are coming [down the line], which are not available in vendor products yet; things like URLLC (ultra reliable low latency connectivity) will be required in some use cases, like AR for remote rendering. TSN (time sensitive networking) is very important for industrial robotics."

In short, the flexibility offered by 5G is critical for manufacturers, such as Airbus. "If you open the technology up, and look inside, then LTE (4G) is more rigid in a way, and more complex to configure. 5G is more open; [you can] automate the core network with other IT tools," Hakim Achouri told RCR Wireless, before recommending that other manufacturers explore the potential of 5G. "Just try it," he said. "It can be at a small scale, and if you don't understand you can get help. It really brings value. It is not just wireless; it is also services that are built into the technology."

3 https://www.rcrwireless.com/20221208/5g/thats-the-fun-part-how-to-scale-private-5g-by-the-only-enterprise-that-knows

5G covers extensive Hamburger Containerboard plants

With 10,000 employees in 16 countries, the Prinzhorn Group is one of the leading players in the European packaging, paper and recycling industry. Some of its production facilities are huge - the Spremberg plant of Hamburger Containerboard (which is part of the Prinzhorn Group) is the size of 50 football pitches. To provide high quality connectivity over such a large area, Deutsche Telekom has installed a private 5G campus network[4]. The network, which has its own 5G core, employs more than 120 antennas covering an outdoor area of around 174,200 square metres and an indoor area of 180,000 square metres. That makes it one of the largest private 5G networks in Europe.

Hamburger Containerboard says the 5G network will help it to optimise information flow, and logistics and production processes at the Spremberg plant, which employs 450 staff and produces 840,000 tonnes of paper annually. Initially, the network will connect scanners and forklifts, and enable the manufacturer to track spare parts and better manage its documents. The company also has plans to connect IoT sensors to monitor and control production and maintenance, as well as AGVs and augmented reality systems.

"When it comes to paper processing, we rely on data, efficiency and our employees," says Michael Krumay, Head of Digitalisation Operations at Hamburger Containerboard. "With 5G, we will now further optimise the information, logistics and production processes on site... With the new 5G campus network, we will make our processes and, above all, information flow even more efficient in the future and further strengthen our competitiveness and the Spremberg location."

In addition to eight 5G radio sites outdoors, Deutsche Telekom has installed 116 specially protected active indoor antennas for the plant's particularly demanding production environment with high temperatures and humidity.

Hamburger Containerboard's 5G standalone network operates separately from the public mobile network. The entire infrastructure, from the antennas to active system technology, gateways and network servers, is located on the site in Spremberg, which means that all data traffic remains in the local campus network. Klaus Werner, Managing Director of Business Customers at Telekom Deutschland, says: "Thanks to its network architecture with 5G standalone technology, the network meets particularly high security requirements and supports functions important to the industry such as network slicing and ultra-low latency."

At the same time, this architecture enables rapid data processing. The deployment of a full 5G network on-site means the company's data-intensive applications benefit from ultra-short response times. The network employs frequencies in the range of 3.7 to 3.8 gigahertz, reserved specifically in Germany for private networks. As a result, up to 100 megahertz of bandwidth are exclusively available for use by the paper and packaging plant.

Deutsche Telekom says that Hamburger Containerboard can flexibly adapt the private network and manage different functions on-demand. For example, data traffic within the campus network is prioritised for certain applications as needed. The flexibility of using 5G and Edge Cloud-based image processing offers a lower entry barrier and is fast to deploy. "The closed system is characterised by its high level of data and failure security," the telecoms operator adds. "Thanks to a redundant architecture of the local core network, the network continues to function reliably even if there is an interruption to the cloud-based management portal. Additionally, the paper manufacturer benefits from guaranteed and continuous availability," supporting digital quality control and quality assurance. This approach not only secures the current infrastructure but also ensures future-proofing by enabling scalable and adaptable network solutions that can evolve with technological advancements.

4 https://www.telekom.com/de/medien/medieninformationen/detail/5g-fuer-papierhersteller-prinzhorn-1066588

Making one of Europe's largest paper mills more efficient

Hamburger Containerboard is also using 5G at other sites. In 2023, the company partnered[5] with telecoms operators O2 Telefónica and Drei Österreich to build a similar 5G campus network at its Pitten, Austria site – one of Europe's largest paper mills – to speed up information sharing, and logistics and production processes.

"The 5G campus network at our Pitten site is an important efficiency lever for us to address the challenges in energy, raw material and logistics costs while optimising our production," explained Michael Krumay, Head of Technics at Prinzhorn Group's Pitten mill, at the time of the deployment. "Because of O2 Telefónica's expertise and commitment to 5G campus networks for the industry, we decided to have the telecommunications group implement the network at our site."

Covering the entire factory site (an area of more than 100,000 square metres), the 5G network is connecting scanners, radios, smartphones and tablets, that were previously networked via Wi-Fi. However, as is common with many sites, the company found Wi-Fi was unable to cover the entire site and its multi-story, 100-metre-long paper machine with steel structures and concrete walls. "This is where 5G can bring its technological advantages to bear: Due to its propagation characteristics, it covers the plant site better," says O2 Telefónica. "In addition, the 5G network is very stable and offers high data rates and short response times. The operation of a closed campus network on its own frequencies also ensures a high level of security."

The paper mill's 5G-networked terminals, monitoring screens, dashboards and mobile apps in production, maintenance and intralogistics provide staff with digital access to information in real time. That helps them to optimise a wide range of processes and boost productivity. Hamburger Containerboard also has plans to use the 5G network to map the waste paper storage area, the forklifts and the raw material as digital twins.

5 https://www.telefonica.de/news/press-releases-telefonica-germany/2023/02/digitization-boost-for-the-paper-industry-o2-telefonica-builds-5g-campus-network-for-prinzhorn-group.html

Conclusions and next steps

Benefits of 5G networks for manufacturing and production

Broader coverage
Manufacturers are using 5G networks to cover the entirety of their production plants, providing robust connectivity both inside and outside buildings.

Greater reliability
As 5G uses dedicated spectrum, it provides far more dependable connectivity than Wi-Fi and other technologies that rely on licence-exempt spectrum used by multiple different networks.

Stronger security
Encrypted by default, 5G traffic is inherently secure. In the case of a private standalone 5G network, manufacturing data does not need to leave the production site, further bolstering security.

Faster throughput
Airbus says its private 5G network is delivering 1.4 Gbps connectivity – four times faster than its Wi-Fi network.

Greater responsiveness
Standalone 5G networks can be configured to deliver the very low latency connectivity required for the remote control of machinery and vehicles.

Future-proofing capabilities
5G networks facilitate the integration of edge cloud and AI processing, allowing for rapid and straightforward deployment. This ensures that manufacturing systems remain adaptable and ready for future technological advancements.

In addition to Airbus and Hamburger Containerboard, many other manufacturers are adopting 5G. For example, Haier, the consumer electronics and home appliance producer, validated plans to deploy 5G solutions in about 100 of its manufacturing facilities globally. 5G will help Haier harness AI, particularly machine vision, which requires low-latency connections between high-definition cameras, the AI modules at the factory site, and the training servers located off-site.

In a similar vein, Comau, which produces advanced industrial automation products and systems, has tested an ultra-low latency radio link provided by a 5G network slice at its Turin site. The responsive connectivity enabled Comau to perfectly align the movement of a robot and the respective virtual rendering, providing it with a real-time view of its production processes.

These benefits were highly evident in 5G trials conducted by multiple mobile operators in China at the end of 2023 using 100 MHz of bandwidth in frequency range 1 (see Figure 3). The trials demonstrated that 5G can already meet many of the most demanding requirements for manufacturing connectivity. With the rollout of 5G-Advanced solutions over the next few years, the technology will become even better suited to underpin demanding manufacturing applications.

Figure 3:
In trials, 5G technologies demonstrated that they can meet most industrial requirements

Type	5G theoretical capability	5G trial capability	Industrial requirements
Latency	1 ms	4 ms	0.5 ms to 500 ms
Reliability	99.9999%	99.9999%	Traffic Influence
Communication service reliability	/	1 day and more	1 day to 10 years
Jitter	/	4 ms	8 ms to 50µs
Uplink data rate	10 Gbps	1.3 Gbps	Several Gbps
Downlink data rate	20 Gbps	2.6 Gbps	Several Gbps
Positioning	Several decimetres	Several metres	Between 0.2 m and 10 m

Source: GSMA 5G Deterministic Networks for Industries Whitepaper

Next steps

To find out more about how 5G can help transform manufacturing, join the GSMA Connected Manufacturing and Production community, which explores how better connectivity can enhance all aspects of the manufacturing value chain, machine operations, raw material extraction, refining, supply chain, component production, assembly, to smart warehousing.

To learn about the GSMA and our work in the manufacturing industry visit this web site

To find out more about joining the Connected Manufacturing and Production Community please email us

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