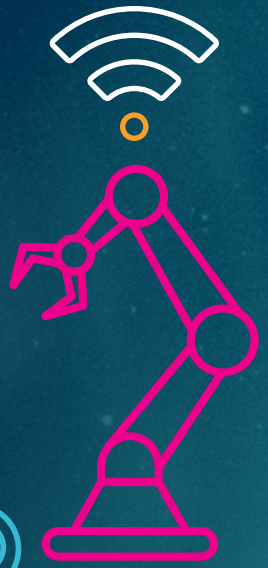
5G Brief:
The Manufacturing Opportunity



5G

79 Commercial **5G launches**

7% Population **penetration**

20% Global Connections **by 2025**

2020-2025 **The industry is investing heavily in 5G**

Mobile operators are expected to spend:

80% of mobile CapEx **or** **$1.1 trillion** worldwide on 5G networks

Source: GSMA

IoT will be an integral part of the 5G era

The number of global Internet of Things (IoT) connections will more than double to almost 25 billion

ABI Research expects digital factory revenues to hit $375 billion USD in 2030, up from $59 billion USD in 2019, with the most growth in programmable logic controllers, machine tools and asset tracking. Currently, there are 260 million digital factory connections, with, ABI notes, “230 million of those connections made via a fixed line”. By 2023, there will be as many as 5.5 billion digital factory connections, with most supported by new mobile infrastructure.

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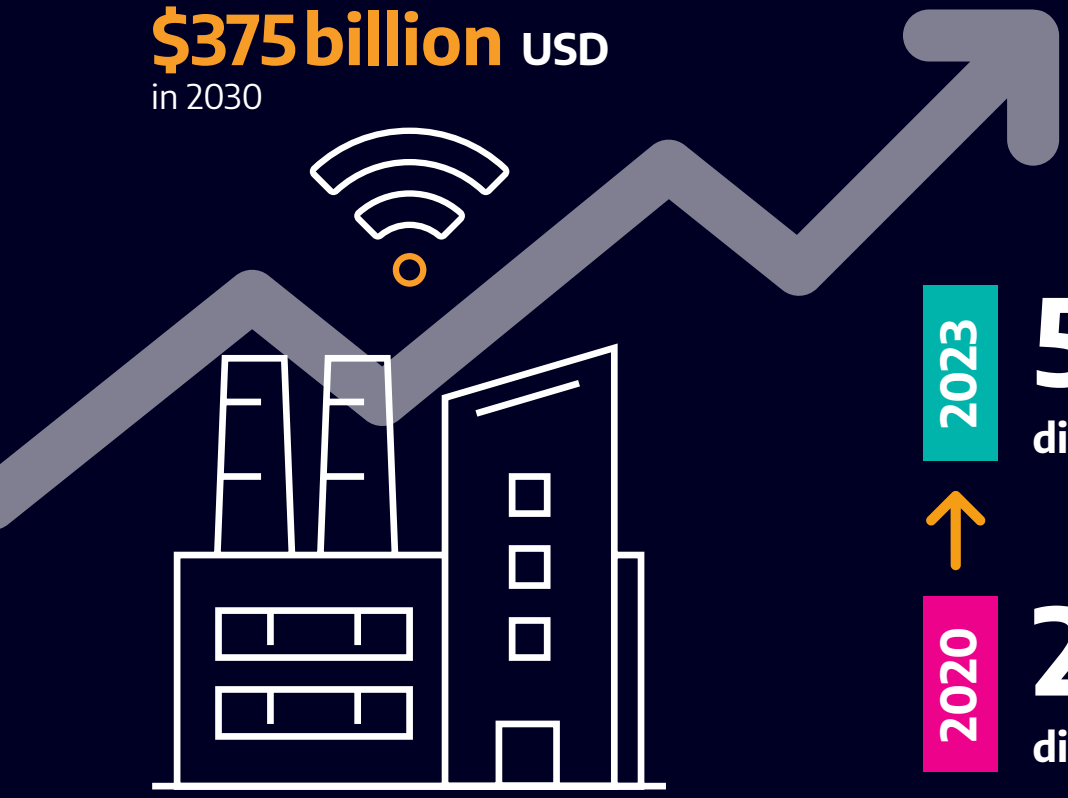
$375 billion USD

in 2030



Mobile operators identify manufacturers as a top target for 5G

Today, mobile operators see the manufacturing sector as one of the biggest enterprise market opportunities for 5G. According to GSMA, a phased approach that first targets high-priority verticals will be important to test technical implementation and business model options for B2B networks before expanding to a wider range of industries.

Use cases with location-specific network coverage requirements (such as smart factories, smart ports and industrial campuses) as well as operations reliant on ultra-low latencies are top of the operator list. As more standalone 5G networks are deployed over the next few years, this will enable ultra-reliable low latency networks (URLLC), network slicing and multi-access edge computing (MEC).

5G URLLC delivers very low and precise latency with strict guarantee levels. This makes it attractive to manufacturers who want to cut the wires, maintain productivity and avoid triggering safety stops in industrial automation and human-robot interaction.

2023

5,500,000,000

digital factory connections

↑

2020

260,000,000

digital factory connections

Monitoring 5G performance reliability for manufacturers

Industrial control, automation systems and robotics

Today automation in production depends on connected programmable logic controllers (PLCs) installed very close to the machines they control and connected to a physical network. 5G has the potential to replace physical Ethernet networks in factories and allow PLCs to be virtualized in the cloud through ultra-reliable low latency communications (URLLC).

Benefit: 5G will play a central role in enabling mobile robotics, for example, automated guided vehicles and remote controlled robots in real time at a fraction of the current cost. Automated guided vehicles in warehouses would be another use case. Low latency, high data capacity, and ultra-high reliability will all be crucial.

Performance required: For remote-controlled robotics, very low latency is essential as a delay of just a few tenths of a millisecond between the input and action makes controlling the robot very difficult. Substantial data traffic will be generated when transmitting and receiving data to and from a central server in the cloud (quality control data, machine learning data, videos) to further build robotics capabilities and learning. With increasing reliance on image recognition and an increase in image quality, high-speed data transfer will be essential.

Source: STL Partners

Industrial automation performance requirements for 5G

Use Case (High Level)		Availability	Cycle Time	Typical Payload Size	# of Devices	Typical Service Area
Motion control	Printing machine	> 99.9999%	< 2 ms	20 bytes	> 100	100m × 100m × 30m
	Machine tool	> 99.9999%	< 0.5 ms	50 bytes	~ 20	15m × 15m × 3m
	Packaging machine	> 99.9999%	< 1 ms	40 bytes	~ 50	10m × 5m × 3m
Mobile robots	Cooperative motion control	> 99.9999%	1 ms	40-250 bytes	100	< 1 km²
	Video-operated remote control	> 99.9999%	10-100 ms	15-150 bytes	100	< 1 km²
Mobile control panels with safety functions	Assembly robots or milling machines	> 99.9999%	4-8 ms	40-250 bytes	4	10m × 10m
	Mobile cranes	> 99.9999%	12 ms	40-250 bytes	2	40m × 60m
Process automation (process monitoring)		> 99.99%	> 50 ms	Varies	10,000 devices per km²	

Source: 3GPP, ZVEI

Critical IoT devices and sensors

Critical IoT connectivity is for time-critical communication. IoT and sensor devices can be connected with 5G across the entire campus through massive machine-type communication including cameras on production lines and augmented reality headsets. These cameras could stream data in real time to the cloud and use live video analytics to monitor productivity and safety.

Benefit: Connected devices and sensors would increase production and safety. For example, a security camera could see a disturbance, identify if there is an imminent threat or danger, and dispatch a drone or alert a worker to investigate. Alternatively, the same security camera could provide a more efficient mechanism to measure cycle times and monitor process deviations. Augmented reality headsets improve efficiency and support workers in maintenance, operational processes, and training.

Performance required: Thousands of sensors and IoT devices that need to be connected at any one time will require ultra-high reliability and/or ultra-low latency at a variety of data rates with much tighter requirements for performance KPIs.

The reliability here is determined by the successful data delivery within a specified time duration with required guarantee levels. This has to be assured even in heavy traffic networks and across network domains, including the manufacturer's private network, the operator's network and edge computing. In terms of managing performance and time delays for machinery, the following have to be monitored with tighter KPIs measured accurately in real time.

1. Air Interface delay
2. Cloud and application processing delay
3. Transport delay which could be edge to user equipment or IoT device or core to user equipment or IoT device

Private 5G networks and slices

Private 5G networks appeal to manufacturers considering 5G to connect critical factory production and automated processes as this gives manufacturers better control over security and architecture. Manufacturers can buy license spectrum in countries such as Germany where Bosch electronics and other manufacturers have already acquired private 5G licenses. Private 5G networks could be offered as a 'managed service' by service providers, given their expertise in designing 5G networks, but they would need to provide real-time performance monitoring, reporting and performance SLAs.

Standalone 5G also offers increased reliability and the ability to offer network slices for different types of use cases in private 5G networks as well with specified availability and latency guarantees.

Bringing 5G to manufacturers with performance guarantees

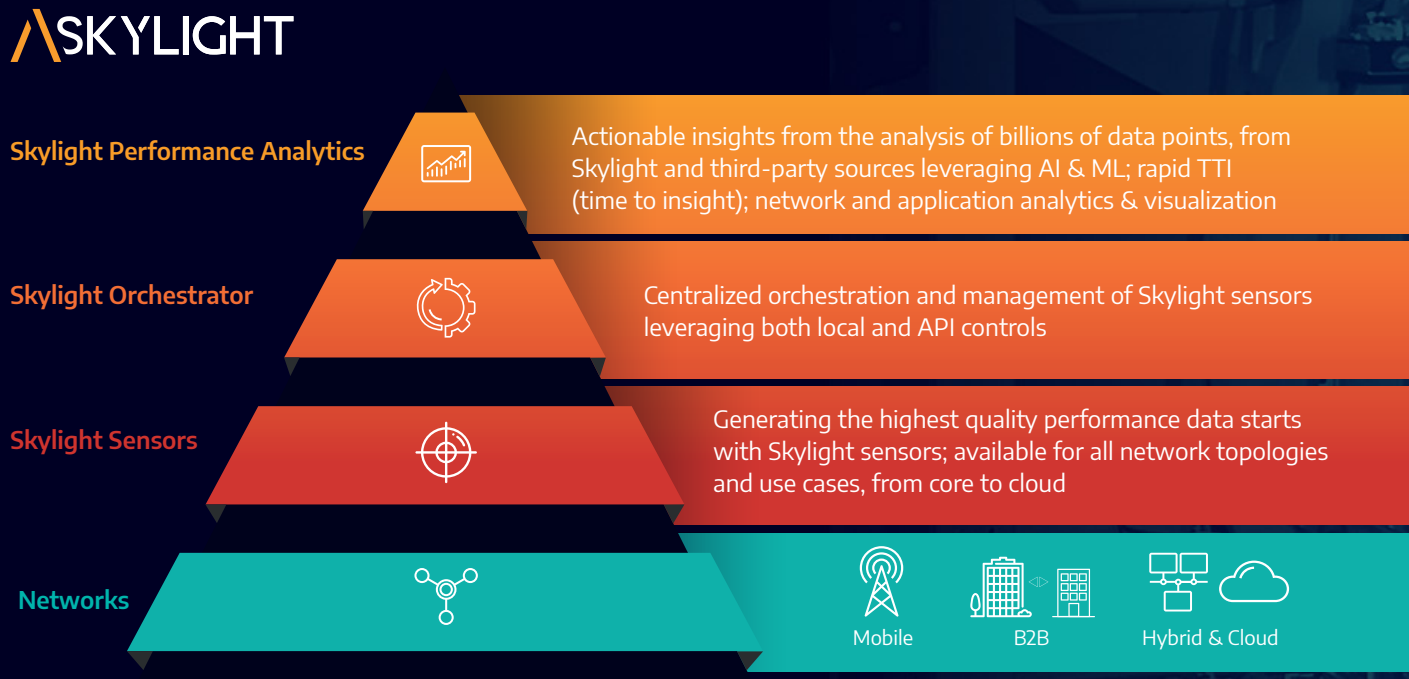
Manufacturers need to understand how their 5G networks and production are performing to productivity and safety standards and be able to monitor and secure the thousands of connected machine-type communication devices. Near real-time streaming data from IoT devices and factory networks would alert operations staff to any issues that would impact production.

When virtualization is added, IT teams need performance visibility of all the applications on their network and in the cloud. As applications are moved to the cloud, visibility and performance metric data are lost. Cloud visibility is business-critical for manufacturing and without the right performance monitoring solution, the benefits of 5G will not play out in manufacturing.

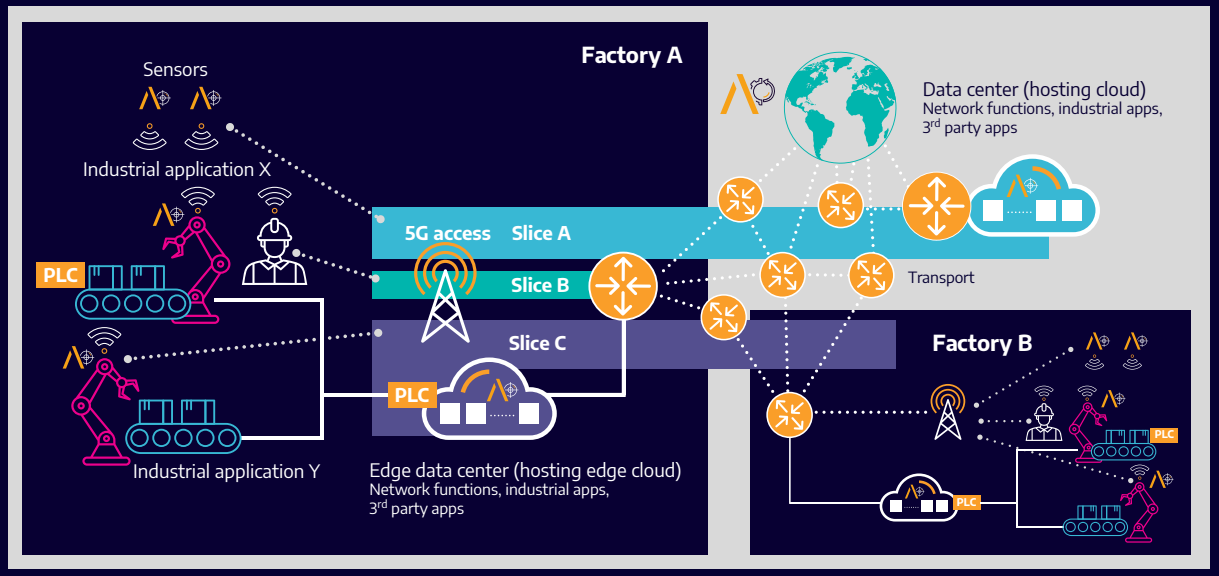
Accedian Skylight offers a single pane of glass view for passive and active monitoring of network and applications. It delivers both high-definition network testing and wire data analytics. 5G manufacturing will only be successful if ultra-low latency is achieved throughout the network and if one can ensure the network is performing as expected for both north-south and east-west traffic.

But, collecting performance data is not just an end in itself. This data needs to be processed and digested so any anomalies or degradations can be detected and fixed before they impact production. This becomes more important with 5G where the volume and complexity of data requires highly automated processes.

Advanced predictive maintenance using 5G sensors on machines requires collecting huge amounts of data to accurately predict when a machine will fail and reduce unplanned downtime. Precision monitoring the entire plant and its processes continuously and adapting processes in real-time to maximize productivity and reduce defect rates.



Accedian Skylight has the flexibility to measure performance from the underlying physical network infrastructure and extend it to each of the different 5G network slices. Performance measurements can be automated and orchestrated to adapt to the specific requirements of the industrial application requirements. Skylight also provides visibility across different vendors and technologies through Skylight performance analytics. This provides the visualization of application and network availability and performance in real time and also the insights needed to act when necessary. Skylight performance analytics also facilitates the reporting of SLAs associated with the different levels of services offered by the operator.



Skylight Orchestrator Skylight Sensors

Industry 4.0 is creating millions of new endpoints that need to be interconnected; however, existing performance management systems cannot support this quantity of data.

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