Alliance 5G Industrielle & Vodafone – „Panorama europeen du déploiement de la 5G dans le secteur fabrication de Automobile »

10.12.2025

European overview of 5G deployments in automotive manufacturing

Vodafone VBI,

Joerg von Criegern,
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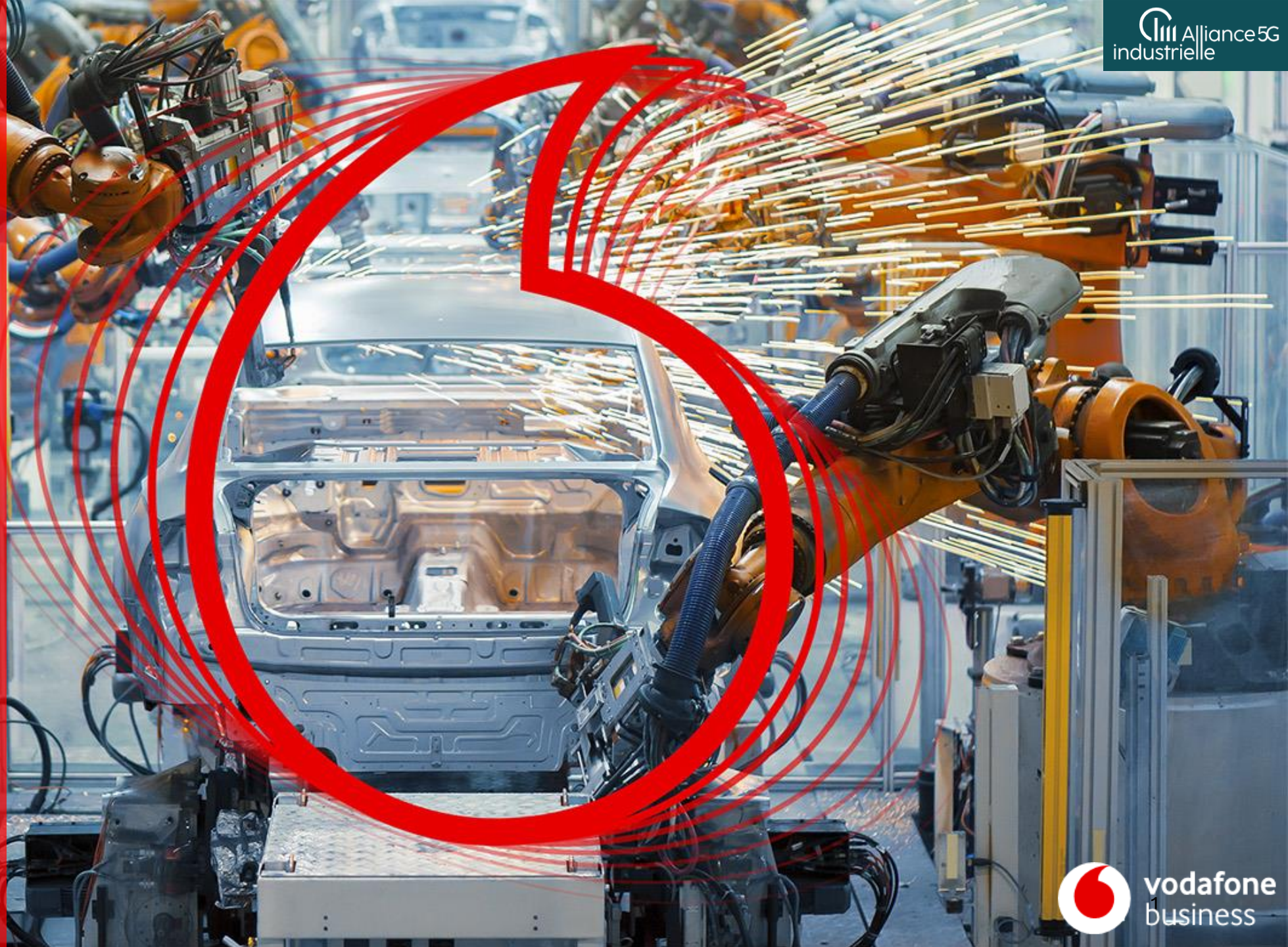


Content

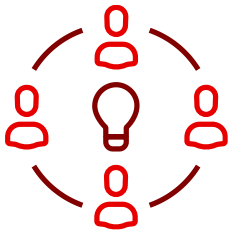
Section	Topic
01	Introduction – Vodafone 5G Mobile Private Networks
02	5G deployments in automotive manufacturing
03	Outlook – what's next

01

Vodafone 5G MPN – Introduction

Vodafone Business at a glance

Global leaders



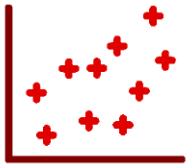
connections

6 million enterprises

1,400 multinationals

190 countries

with 2/3/4/5G, LPWA satellite and fixed capability



service revenue in FY23

connected with Vodafone on the road today

Vodafone Experience with Mobile Private Networks

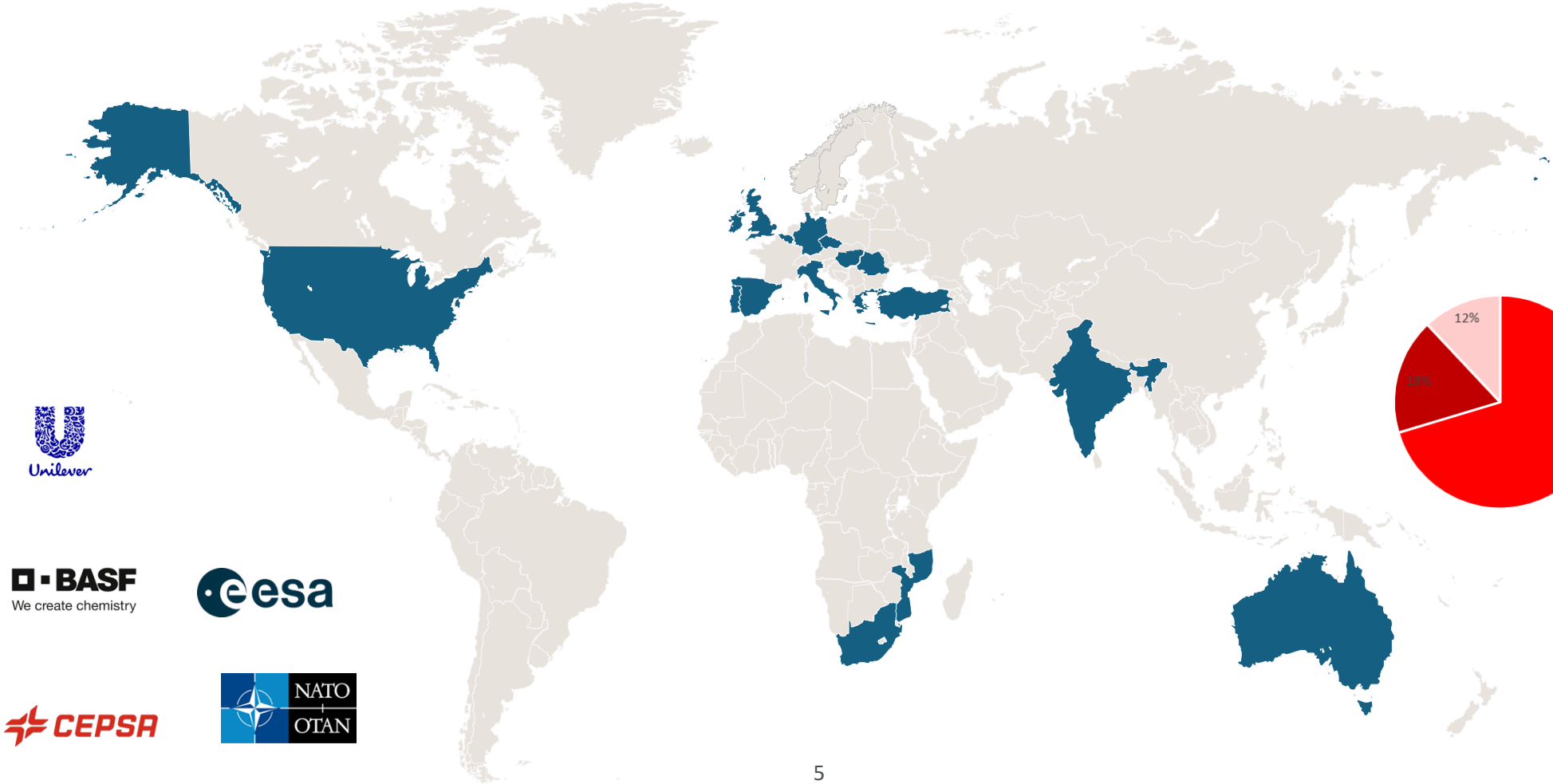
Global, cross-industry customer MPN deployments as of 2025

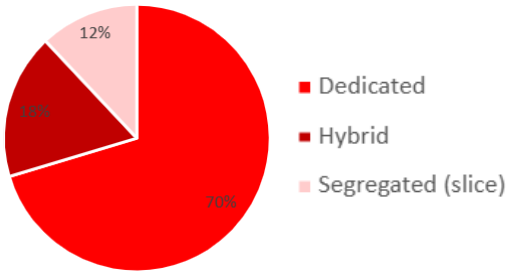
169 Commercial Deployments

+100 Customer Contracts

+80 Unique Customers

19 Countries





Vodafone portfolio for Mobile Private Networks

Professional Services

Site surveys, design, installation and end-to-end testing

Management Plane

Enables customers to have end-to-end visibility across the MPN network and devices, and across multiple instances (e.g. plants/ports)

Network Connectivity & Optional Dedicated MEC

- Dedicated, hybrid and virtual mobile networks
- 4G / 5G
- Spectrum
- Proactive Monitoring
- Security

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- Dedicated MEC onsite or in Vodafone data centres

Solutions

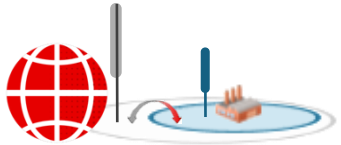
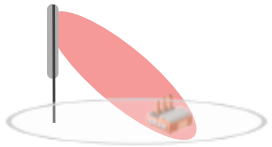
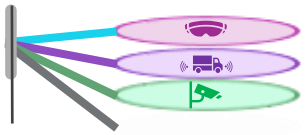
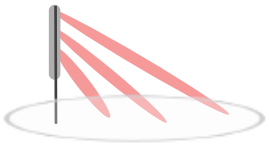
- Collaborative Worker
- Safe Worker
- Visual Inspection

Managed Services

ITIL Aligned 24/7 help-desk, Pro Active Monitoring, Change Management and SLAs

Customer Focused Approach >>

Mobile Private Network – Deployment models
The public-private continuum

MPN Isolated/Dedicated	MPN Private Roamer	MPN Slice	Network Slice	Quality On-Demand	MPN Managed Service
					
Customers that want autonomy, high throughput, low latency and high availability, but devices do not leave the private network	For mobile customers that require the ability for devices to roam off the private network onto the public network, with optional global mobility	Priority access based on reserved capacity for specific use cases on a campus or stadium, optionally including dedicated coverage/capacity	Priority access based on reserved capacity for specific use cases in local, regional or national coverage areas	Customers that use the public network, and request prioritised access over other users based on application type, based on QoD APIs	Customers can migrate their existing Private Network to a Vodafone managed service, Vodafone SIMs, Management Plane and other services
Extreme SLA on campus	SLA for high performance	SLA based on traffic type	SLA based on traffic type	Service offer to customer	SLA based on acceptance

Vodafone Managed Services

Vodafone Security Services

Vodafone SIM Services

Vodafone Performance monitoring

Vodafone Management Plane

Vodafone Professional Services

Vodafone Device Management

Vodafone Digital Solutions

Vodafone Multi-Access Edge Compute

Vodafone Analytics & Cognitive Operations

Vodafone Cloud Services

All the private networks we deploy come with multiple managed services and solutions that we offer our customer, thus reducing the complexity of deploying and managing sites.

Our value proposition
Scale – Services – Ecosystem

Scale

Our global footprint, multi-vendor catalogue, pedigree in IoT, experience running carrier grade networks and partner markets gives us the flexibility to meet customers where they are – with the runway to extend to slicing and roaming scenarios

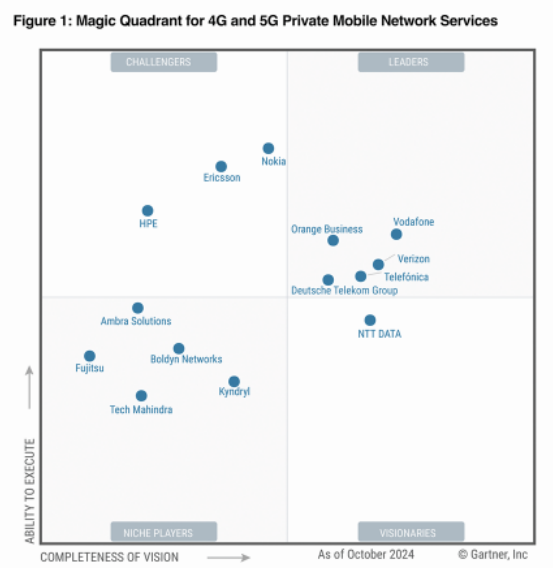
Services

We leverage our expertise from public networks to provide a full suite of services covering design, build, secure and manage; as well as self-serve options

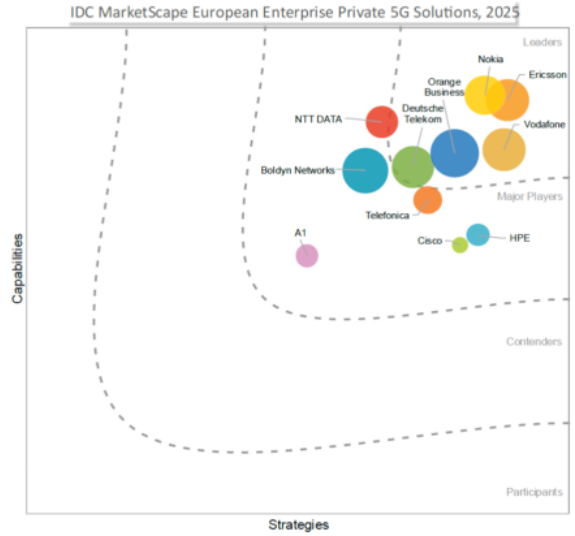
Ecosystem

We bring all the components our customers need to realise their use cases – devices, edge compute, pre-integrated applications and well architected MPN reference templates.

Analyst view on Vodafone 5G MPN – Recognized as market leader by Gartner, IDC, Forrester



Gartner: *"Apart from network equipment specialists,* ***Vodafone has the highest market awareness****". Additionally, it has the* ***widest distribution of deployed sites across multiple countries****, particularly in Europe."* January 2025 Gartner



IDC: Vodafone's "bold strategy and vision", extensive capabilities in terms of footprint, MPN architectures, and partnerships with vendors*."* IDC

IDC MarketScape: European Enterprise Private 5G Solutions, 2025

Forrester : "Vodafone is best suited for Europe-based MNCs and large enterprise orgs in manufacturing*, education, energy, and transportation industries that are* ***looking for a full stack provider with flexible pricing and delivery models****."*

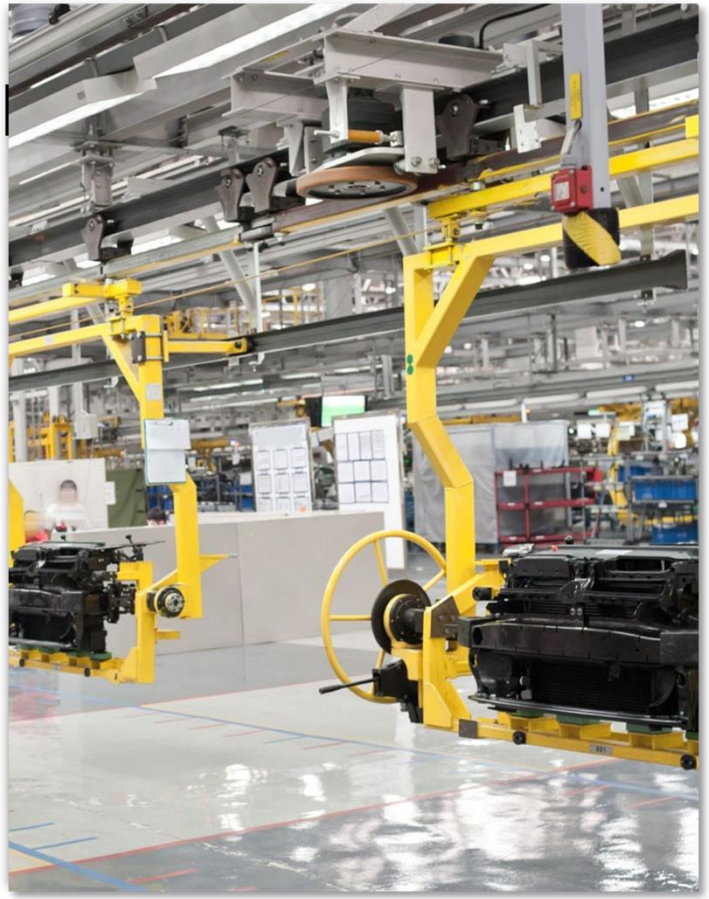
Forrester Wave, Private 5G Services, Q4 2025, FORRESTER

02

5G deployments in automotive manufacturing

Use case requirements – Real life customer shopfloor examples

No.	Use Case Name	Latency	Bandwith	Mobility	Traffic patterns	Service enabler*
1	Fire & Gas alarms	> 10 ms	< 10 Mbps	No	30% DL/70% UL	mMTC
2	Video surveillance	< 10 ms	< 100 Mbps	No	20% DL/80% UL	eMBB, uRLLC
3	Mission Critical Push to Talk	> 10ms	< 100 Kbps	Yes	50% DL/50% UL	uRLLC
4	Equipment tracking	> 100 ms	< 100 Kbps	Yes	20% DL/80% UL	mMTC
5	AGV: Logistic processes with autonomous vehicles	< 10 ms	< 100 Mbps	Yes	70% DL/30% UL	eMBB, uRLLC
6	Remote expert Support	> 10 ms	< 100 Mbps	Yes	50% DL/50% UL	eMBB
7	Real-time video analytics of critical assets	< 10 ms	< 100 Mbps	No	80% DL/20% UL	eMBB, uRLLC
8	Real time maintenance traceability with smart tools	> 10 ms	< 100 Kbps	Yes	20% DL/80% UL	mMTC
9	5G connected (v)PLC for remote supervision & control	< 10 ms	< 10 Mbps	Yes	70% DL/30% UL	uRLLC
10	Real-time & AR/VR augmented design collaboration	< 10 ms	< 100 Mbps	Yes	70% DL/30% UL	eMBB, uRLLC



* 5G Service enablers: **mMTC**: massive machine-type communication; **eMBB**: enhanced mobile broadband; **uRLLC**: ultra-reliable low latency communications

Mobile Private Networks | Automotive customer case studies

Ford

Public case study

- Ford (Dunton Technical Centre, Essex), TWI
- Public initiative to introduce 5G to enhance EV manufacturing.
- 5G MPN to monitor & control welding machines
- AR, visual inspection

BMW

Public case study

- BMW plant in Germany
- 5G dedicated MPN, deployment to test precise positioning
- Start outside, then extended to indoor to
- Precise positioning, AGVs, manufacturing efficiencies.

Skoda

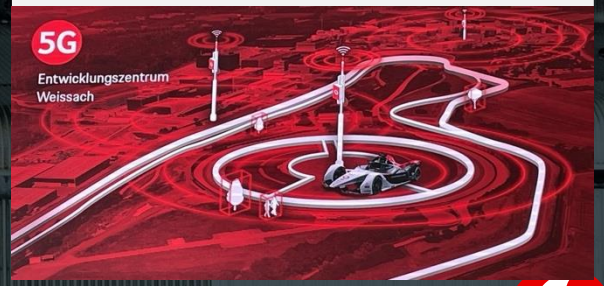
Public case study

- Factory in Mladá Boleslav
- Dedicated 5G MPN, Indoor & Outdoor
- Vodafone CZ spectrum
- Benefits: reliability, cost reductions and quality increase
- Connected tools
- AGVs, AR, robots

Porsche

Public case study

- 5G Hybrid MPN for Porsche manufacturing plant in Italy
- Part of outdoor test track
- Development of E2E applications (on premise and in Cloud)
- V2X, telemetry, and in-car infotainment.



FORD Case Study

Ford - Summary of engagements
Vodafone and Ford deployed 5G networks across multiple sites

- Projects include UK Dunton (laser welding), Spain Valencia, Cologne (Germany)
- Cross-Project Use Case Themes
  - Vision-driven quality control with AI and edge computing.
  - Traceability and logistics via 5G radio positioning
  - Data sovereignty and security through private 5G cores
- 5G MPN chosen for ultra-low latency, high uplink capacity, mobility, and security
  - Latency & determinism: Sub-10ms for closed-loop control.
  - Uplink-heavy bandwidth: Handles multi-camera vision workloads.
  - Mobility & coverage: Seamless handovers across indoor/outdoor.
  - Security & sovereignty: Private cores and local breakout.
  - Positioning: Integrated RPS for asset visibility.

Ford UK – Factory of the future, Dunton ([illegible], Essex) — 5G MPN for EV powertrain manufacturing (laser we…

Primary use cases supported

- Quality-critical laser welding analytics: Continuous image capture and AI-assisted analysis of thousands of welds per battery/motor (up to 500k data points/minute) to detect sub-optimal welds and re-weld in-process without removing the part
- Real-time image capture and AI-driven defect detection; enables instant re-weld without removing the part
- Remote expert support & predictive maintenance: Streaming high-definition sensor/video data to experts and back to machines in near real time to minimize downtime. Continuous monitoring of welding machines and vacuum furnaces. Remote troubleshooting and AR-assisted training
- Future-ready automation pilots: Platform for untethered robots/AGVs, AR work instructions, and digital twins.
- Digital Twins & AR for Compliance - supports virtual modelling and operator guidance for process optimization.

(E:PRiME, Essex) — 5G MPN for EV powertrain manufacturing (

Business Impact & KPIs

- Scrap reduction (~15%)
- Real-time defect detection and re-weld: rework avoidance (up to £500k/year)
- OEE improvement (+8%)
- Vision/AI throughput (~500k datapoints/min)
- Quality: Near-zero defects through real-time QA
- Flexibility: Faster reconfiguration of production lines without cabling changes
- Sustainability: Lower energy waste and reduced material scrap

03

Outlook – What's next

Data Shower use cases ("OTA")

Key requirements and capabilities for automotive OTA
Vodafone point of view

Key requirements & capabilities for automotive OTA

- OTA is the key enabler for the „*Software defined vehicle*“
- ISO/SAE 24089 defines project- and infrastructure level
- Reduced exposure to cyber threats, protecting sensitive SW stack in vehicles and enhanced Security
- Dedicated, isolated networks needed to ensure fast, secure OTA updates without WiFI or public network variability and dependencies
- Reliable Performance: Private 5G delivers the low latency and high bandwidth consistently
- Cost Efficiency: Predictable costs and time consumption

Assumptions and design parameters – Real life customer scenario for OTA

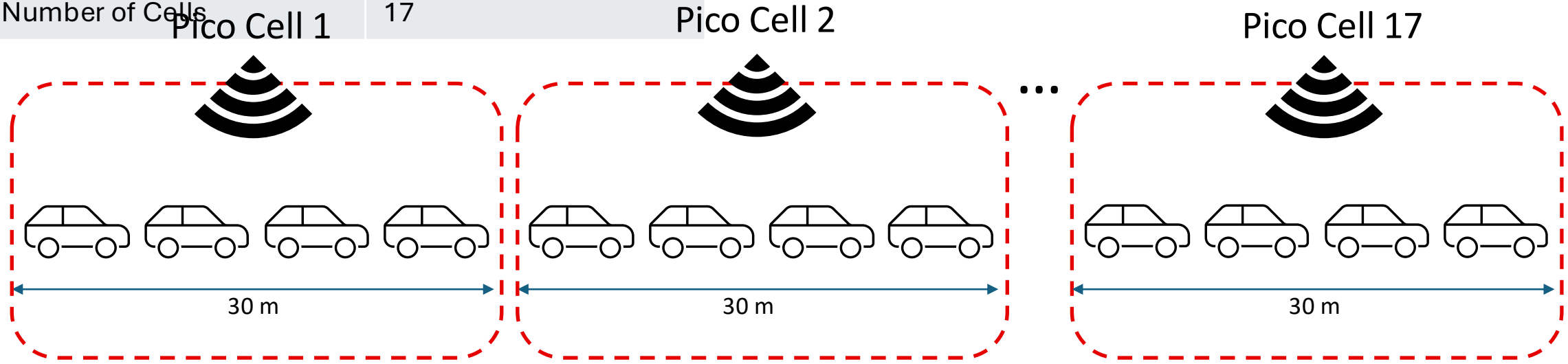
Requirements	• Simultaneous data downloads for up to **70 vehicles within 50 minutes** along the **500 m production line**. The vehicles are moving at a speed of **6m/min.** Per vehicle **70 GB** data DL.
Telematic Unit	• Data shower during the manufacturing process with limited radio capabilities of their TCU. • 100 MHz of n78 industrial spectrum with 4x4 MIMO
MPN Solution	• High-density wireless solution that can concentrate radio cell coverage for a well-defined physical area • Radios integrated to a high-capacity, redundant core network to support simultaneous data transfers for
Scaling	• Network core design will support **additional regular capacity use cases** in other areas of the shopfloor

*4 antennas at both transmitter and receiver ends

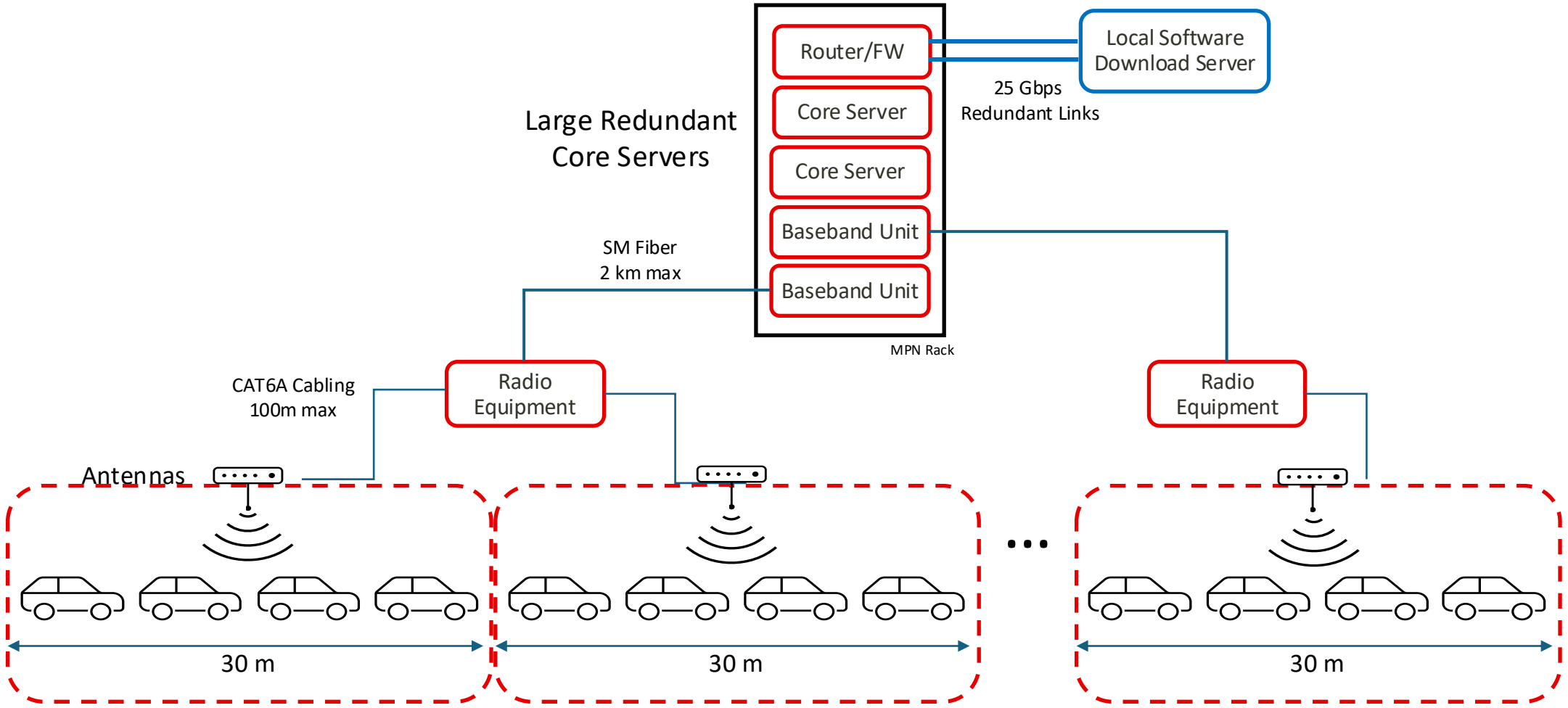
Network Capacity Requirements – Customer example

Vehicle Parameters	Value
Total Data download	70 GB
Transfer time	50 Minutes
Application layer Throughput	192 Mbps
Retransmissions & overhead	15% (conservative)
Average Vehicle Throughput	220 Mbps
Number of Cells	17

Cell Configuration	Value
Available Spectrum	100 MHz (n78)
User MIMO Supported	4x4
Cell Capacity	~940 Mbps
Simultaneous downloads	70 (total)
Aggregated Throughput	16 Gbps
Avg vehicles per cell	4

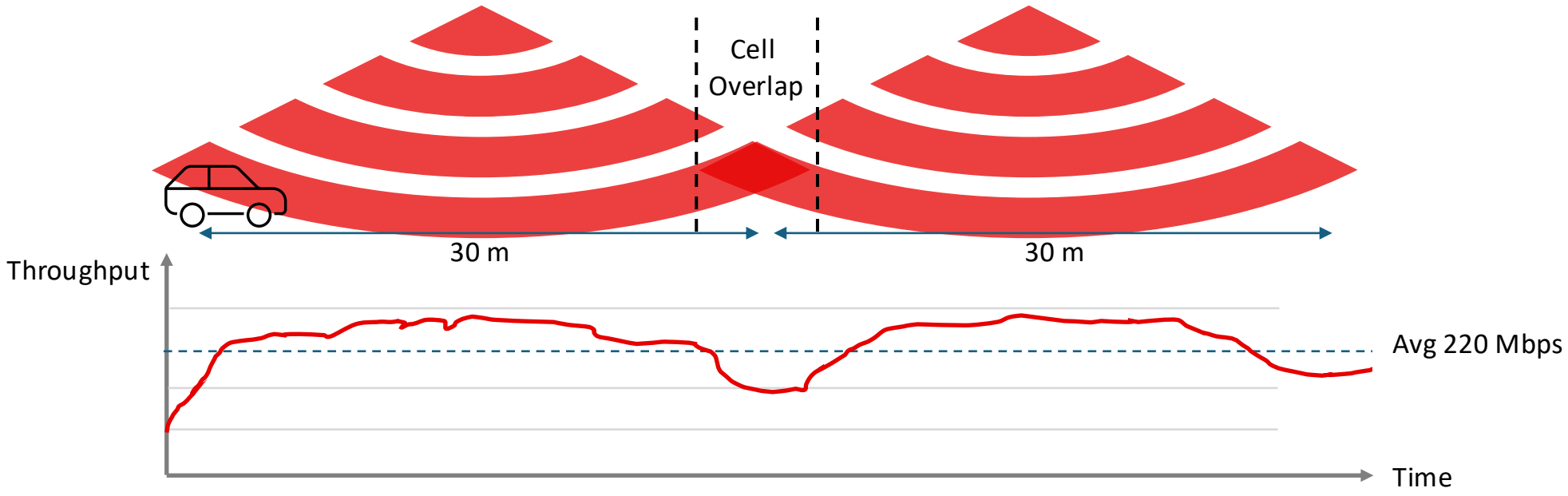


High level network architecture



Inter-cell interference while maintaining TPT
Helping customers to improve efficiencies

- High capacity in a small area needs radio solution that controls power and limits signal range
- Pico Cells suit this well as they're easy to install, work with Cat6A cabling, support PoE to reduce deployment costs, and can be placed strategically close to assembly lines to control signal spread
- Fine tuning of antenna distance and power parameters will be required to minimize traffic drop during cell overlap.

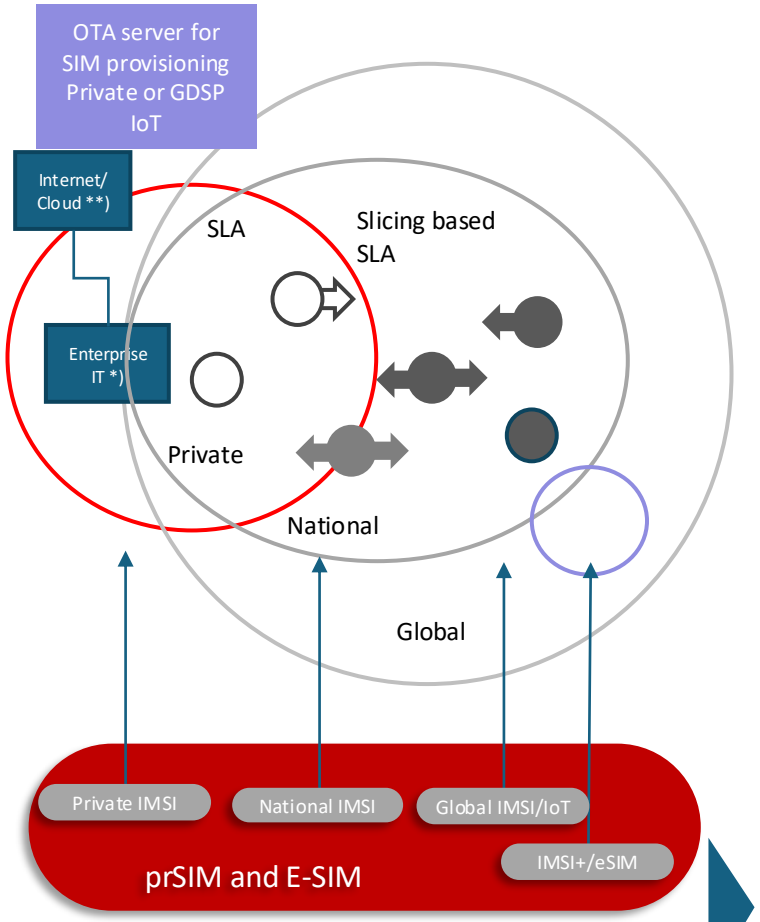


Private 5G – Roaming scenarios for OTA

2

Use-cases and mobility flows for enterprises' private assets

"**Roaming**" is a term referring to the SIM/device moving between public and private networks. The customer use case is key to identifying which is the right solution to deploy on the MPN. This can be summarised in the following table:



*) Private break out for all types
**) Public break out via Enterprise IT only
***) Inter-country mobility for Type I via enterprise VPN/WAN
****) Data only

Roaming type	Scenario	Example use-case	Relevance in MPN space	Needs public coverage
In only (Type I)	Mobile or fixed device in private coverage only. Can also be moved from one site to another under the same multi-site MPN. Multi-site can be also multi-country via enterprise VPN/WAN	On-site only communications, fixed sensors, machinery, robots, cobots, AGVs	35%	X
In-Out (Type IO)	Mobile device usually travels from private to public coverage on a permanent basis	Connected product (e.g. car, plane) that exits the factory after manufacturing (data-shower, automatic car marshalling and in-life service)	15%	√
In-Out-In Temporary (Type IOIT)	Mobile device travels in and out of private coverage on a temporary access basis	Workforce (contractors, partners), visitors	40% 5%	65% √
In-Out-In Permanent (Type IOIP)	Mobile device travels in and out of private coverage on a permanent access basis	Company's workforce, vehicles (logistics, security, health – ambulance sending data to the clinic, doctors taking the clinic tablet home supporting colleagues on-site, AGV Campus to Campus mobility via public space, aeroplanes in airports, trains coming to depot)	15%	√
Out-In (Type OI)	Mobile device travels from public to private coverage	Connected machinery pre-staged on vendor's premise and shipped/installed on MPN premise	5%	√
Out only (Type O)	Mobile or fixed device in public coverage only	Company's assets, usually in the IoT space (sensors, meters, others)	25%	√

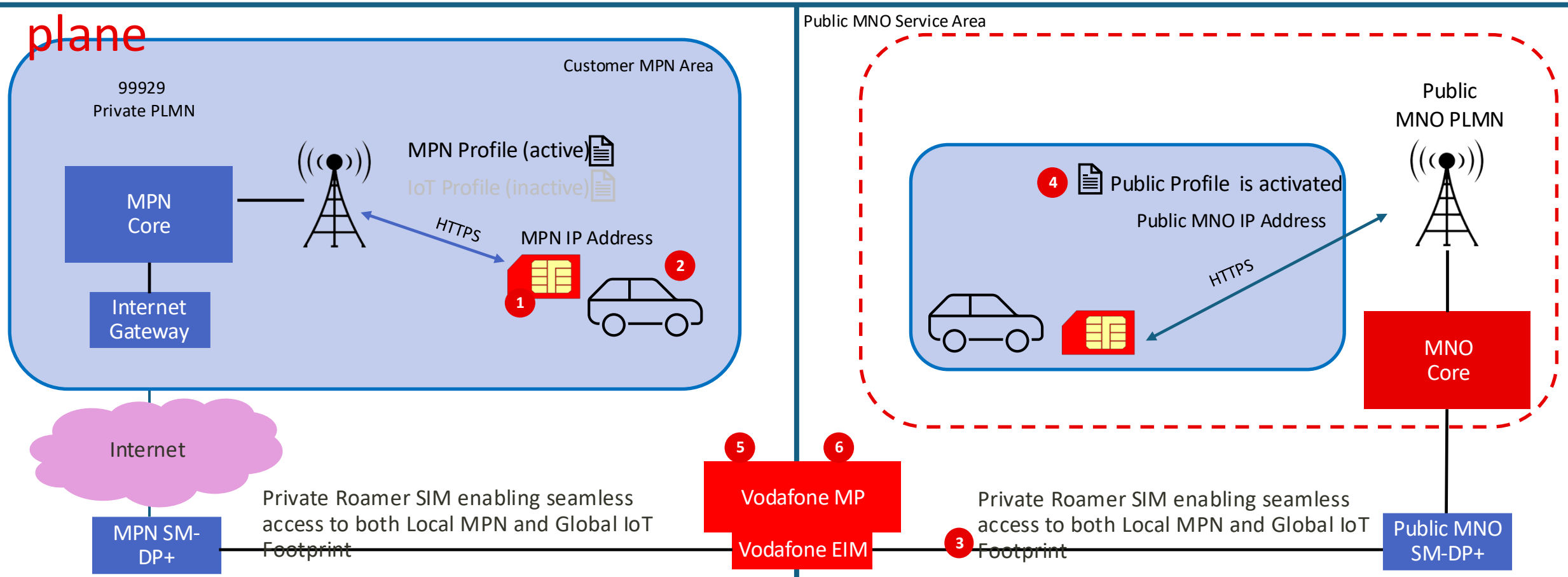
Mobility

Public

- Number of use cases that require mobility on and off the private coverage is significant
- Inbound and outbound roaming of users, vehicles and assets is an inherent expectation from an MNO
- Omdia: 75 percent of enterprises want hybrid public-private 5G solutions – and therefore the ability to roam between.
- These use cases have different requirements in terms of latency, bandwidth and SLA

OTA Profile Switching for Connected Cars

Switching MPN and Public MNO profile by Vodafone Management plane



- Telematic Control Unit (TCU) has a prebuild Vodafone MPN profile using which Car's TCU attaches successfully to MPN in its first turn ON and obtains a private IP from MPN pool (1)
- Data Shower can begin over MPN connectivity (2)
- Once MPN network utilization completed , user triggers 2nd profile download using MPN (3)

- Car leaves the private network which automatically trigger switch to public profile using EIM fallback mechanism (4)
- User can control fallback and manual switching in both direction using Vodafone Management plane (5)
- Live profile and network utilization status available on Vodafone Management plane (6)

Summary

Final thoughts on Private 5G

- **Private 5G has arrived – and is here to stay.**
- **Private 5G is a transformation lever, not an IT- or network upgrade.**
- **WiFI and Private 5G are complementary – and use case specific.**

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business

Together we can