

# HOW TO DESIGN AND TEST FOR 5G

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Connected World. Connected Experiences.



# THE 5G PROMISE

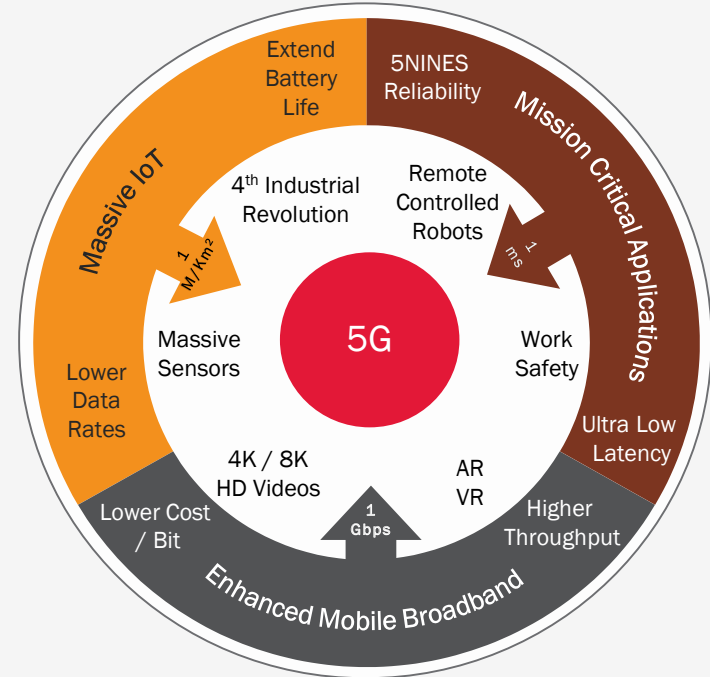
## NEX-GEN NETWORK NEEDS

- Broadband Speeds (Video Monitoring, Remote diagnostics) – eMBB
- Data to stay local (for Security/ Privacy reasons)
- Ultra Low latency (AR/VR, Real Time Process Control) – uRLLC
- High Reliability (Robotic Control, Drones) – uRLLC
- Dense deployments for IoT and Mobility (sensors) – mMTC

## PRESENT NETWORKS HAVE LIMITATIONS

- Wi-Fi networks cannot meet the reliability requirements
- Wireline LAN is expensive to setup/reconfigure
- LTE can't meet the Latency & Throughput requirements for Critical IOT use cases

## HOW CAN 5G HELP?



# DESIGN CONSIDERATIONS FOR 5G

## E2E Network “Slices”

- Virtual “data pipes” with desired latency & through-put
- Fat slice for CCTV offload
- Thin slice for Smart meter

## 5G “Private Network”

- Optimized operations & automation for enterprise deployments
- More reliable than Wi-Fi
- Cheaper than wireline
- Faster than 4G

## Mobile Edge Computing (MEC)

- Content Caching & Localization at Edge
- Enhanced user experience, Video, AR / VR, Gaming, Location Services

## Scalable / Elastic Network

- SDN/ NFV for on-demand services
- Example: Network adaptation to support a live broadcasting of a day event

## Power Saving

- Improved device battery life with “network sleep cycles”

## Network Exposure for Applications

- IoT Applications like Patient Monitoring or Fleet Management can query & influence traffic latency / through-put

## Global Roaming

- Devices like “refrigerators” and “cars” can re-locate to other geos
- Served via e-UICC (e-sim)

## Massive IoT

- Support very high number of devices for high density deployments

## Standards based IoT devices

- “Off the shelf” devices conforming to 3GPP standards for IoT applications across the spectrum.

## 5G DESIGN KEY STRATEGIES

Partnerships with technology power houses

Trial labs to verify and optimize product and network design

Verticalized Industry Consortiums to optimize implementation for respective vertical

Open source adoption without risking security

Network Analytics with ML utilities for self optimization and self healing

# TEST CONSIDERATIONS FOR 5G

## Device Certification

- Ensure compliance with standards and carrier requirements

## Network Validation

- Ensure reliable and secure data pipe
- Ensure inter-operability, roaming

## 5G IoT Application Test

- Test use cases for verticals - Healthcare, Unmanned Aerial Vehicles, Asset Tracking, Factories of Future
- ..
- Verify End-to-end latency, Burst, Survival time, jitter etc

## Performance and Capacity Testing

### Validate with different IoT traffic models

- Deterministic periodic communication
- Deterministic aperiodic communication
- Non-deterministic communication

## KEY STRATEGIES FOR 5G TEST



Device Test Labs  
with test tools

Multi-vendor  
E2E lab to validate  
services

Base line Test packs  
for each vertical

Traffic Generators  
for IoT Traffic



# 5G FOR SPECIFIC VERTICALS – SMART FACTORY AND V2X

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# ADOPTING 5G INTO SMART FACTORY – A ROADMAP

## 5G Network Innovation Lab (for Pharma Customer)

Build, Validate and Deploy Use Cases at Faster Pace

### 5G NETWORK INNOVATION LAB

- ▣ Located in Munich

#### Use Cases

- ▣ Showcase Private LTE/5G
- ▣ Sandbox Environment for Use Cases
- ▣ Network Connectivity with other Labs

3 – 6 Months

## PRIVATE LTE BASED ON LSA BAND

### Challenges Addressed

- ▣ Lower OPEX
- ▣ Highly Secure
- ▣ No CSP Dependency

### Use Cases

- ▣ Digital Logistics and RFID
- ▣ Digital Plant (step 1)
- ▣ Augmented / Mixed Reality

9 – 12 Months

## EDGE CLOUD (MEC) AND NETWORK SLICES

- ▣ Enhance user experience
- ▣ Create Optimal Network slices

### Challenges Addressed

- ▣ Lower Latency
- ▣ Local Caching
- ▣ QoS

### Use Cases

- ▣ Field Connectivity 4.0
- ▣ myPlant – Search and Asset Info
- ▣ VR : Safety Training
- ▣ Predictive Maintenance
- ▣ AgBalance Livestock
- ▣ Personalized Nutrition

12 – 18 Months

## STANDARDS BASED 5G NETWORK

### Challenges Addressed

- ▣ Full Spectrum of 5G Capabilities available
- ▣ uRLLC, eMBB, mMTC – all use cases supported by same network

### Use Cases

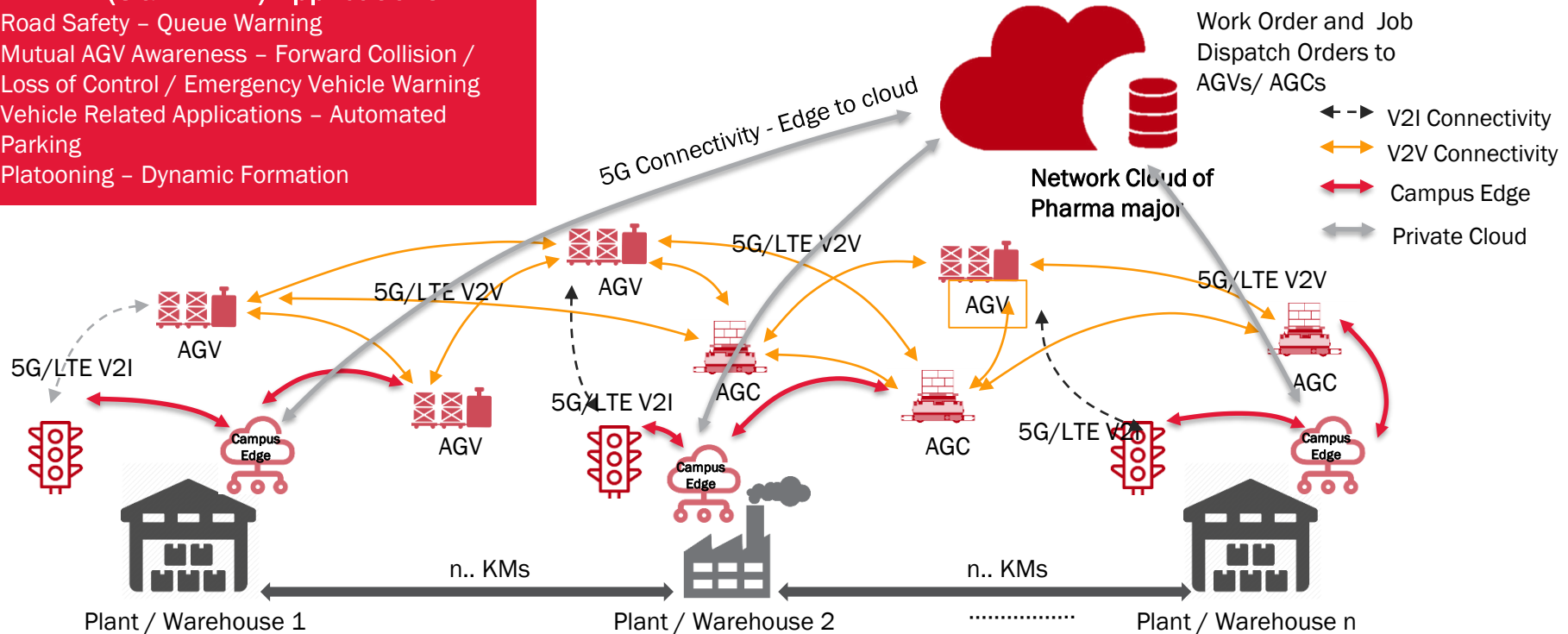
- ▣ Mixed Reality enabled Maintenance Management
- ▣ Collision Avoidance System – using uRLLC
- ▣ MHE Efficiency monitoring
- ▣ Connected Sensors for Utility Management
- ▣ Dispenser Maintenance Optimization
- ▣ Field Connectivity 4.0
- ▣ Telemedicine
- ▣ Digital Plant (step 2)

18 – 24 Months

# DISRUPTING WITH 5G – CONNECTED AGVS

## V2X (3GPP R14) Applications

1. Road Safety – Queue Warning
2. Mutual AGV Awareness – Forward Collision / Loss of Control / Emergency Vehicle Warning
3. Vehicle Related Applications – Automated Parking
4. Platooning – Dynamic Formation





A hand holding a pen, with a city skyline in the background.

# THANK YOU.

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