

# Wireless X Labs

2017 Global MBB Forum  
Show Cases





# Wireless Connected Factory

*Joint Demo with:*



**BOSCH**

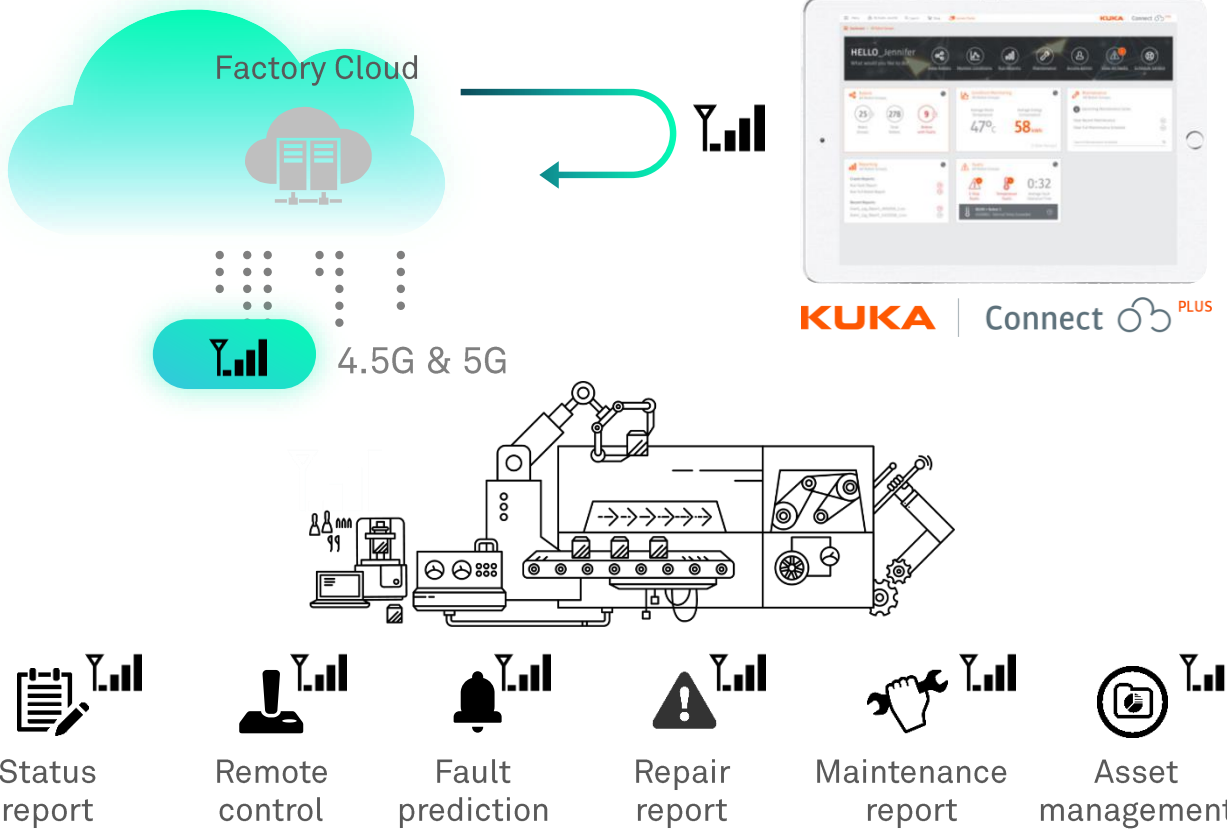
**ABB**

**KUKA**

**HIKVISION**

*Special Interest Group:*

BOSCH ATMO | ABB | KUKA | GEELY | HIKVISION |  
EFORT | BECKHOFF



## Description

- "KUKA Connect" is an all-new cloud-based software platform that allows customers to easily access and analyze KUKA robot data on any device, anywhere at any time.

## Value

- When all the factory components are fitted with wireless sensor equipment, the automated management process will become automated and enjoy greater efficiency and economy.
- MNOs' network can support ubiquitous access. This case indicates that wireless technologies are already applied within a factory/warehouse environment.



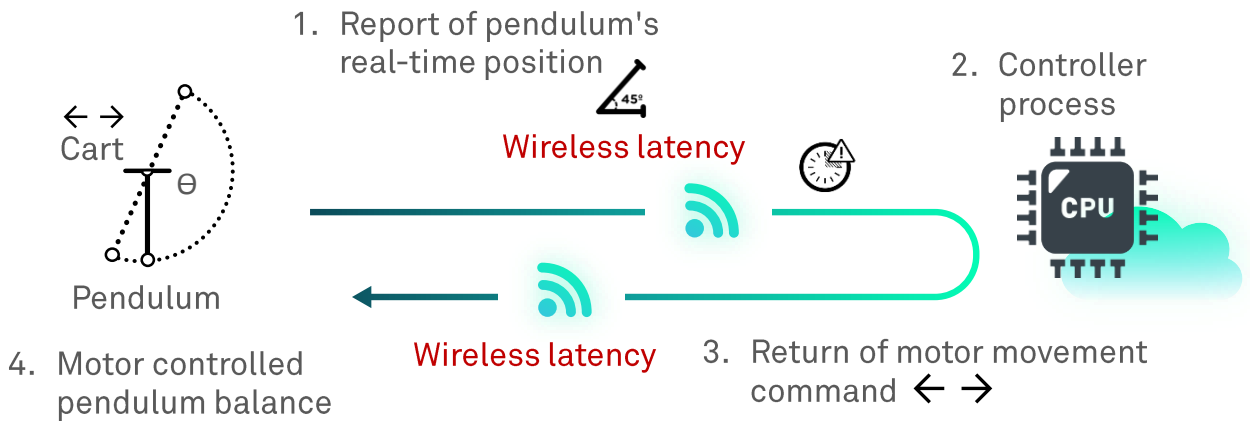
Factory access  
(NB-IoT, 4G, 5G...)



Mobile cloud  
(Storage, computing, ERP...)

# Low Latency & Machine Control

## Wireless controlled **INVERTED PENDULUM** system



- Due to the latency of the wireless system, the report of the pendulum's position is not accurate. The system requires extra/additional time for convergence and balance.

### Description

- The inverted pendulum is a classic problem in dynamics and control theory and is widely used as a benchmark for testing control algorithms. Variations on this problem include multiple links, allowing the motion of the cart to accept new commands while maintaining counterbalance.

Inverted pendulum in daily applications



Self balancing scooter



Rocket launching



Walking robot

### Value

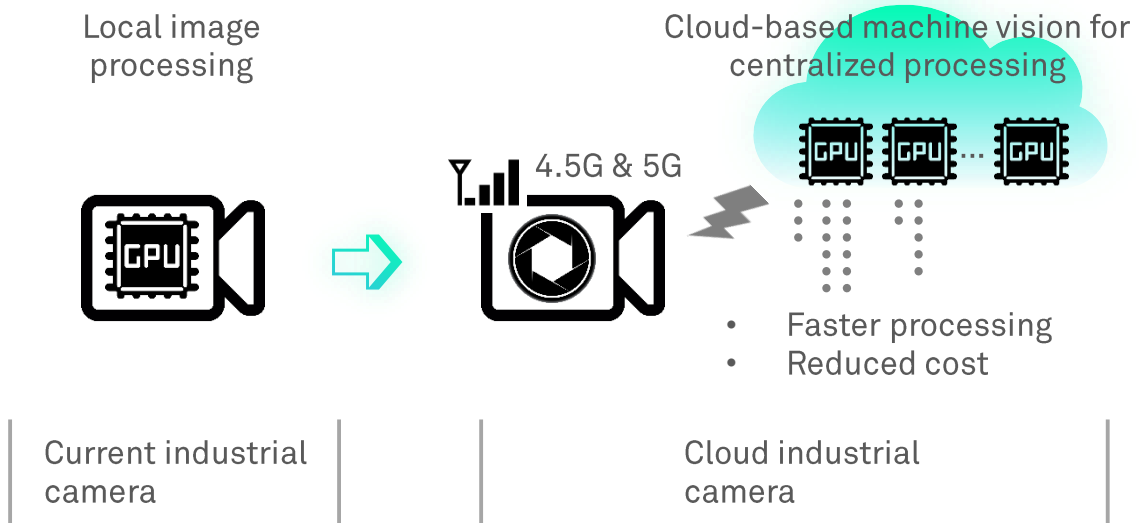
- By switching between high & low latency of different systems, it is easy to understand how important a lower latency system is in factory applications.



Shorter latency is a key network differentiator.



The reduced latency of 4.5G & 5G will enable more factory applications.



## Description

- Industrial camera is the eye of the machine. While robotic arms can grab objects, product appearance fault detection relies on the industrial camera's machine vision capability.
- Replacing local image processing cameras with cloud-based ones will reduce cost (60%), prevent the risk of cable winding, and improve positioning/recognition efficiency.

Phase	Latency require	Data rate
Phase 1: Position locating (1.3M pixel)	500 ms	62.4 Mbps
Phase 2: Fault detecting (2M pixel)	100 ms	480 Mbps
Phase 3: Ultimate appearance fault detecting	50 ms	2 Gbps

## Value

- Higher data rate enables 'clearer' machine vision while lower latency ensures speed and accuracy.
- MNOs can benefit from increased connections & cloud services.

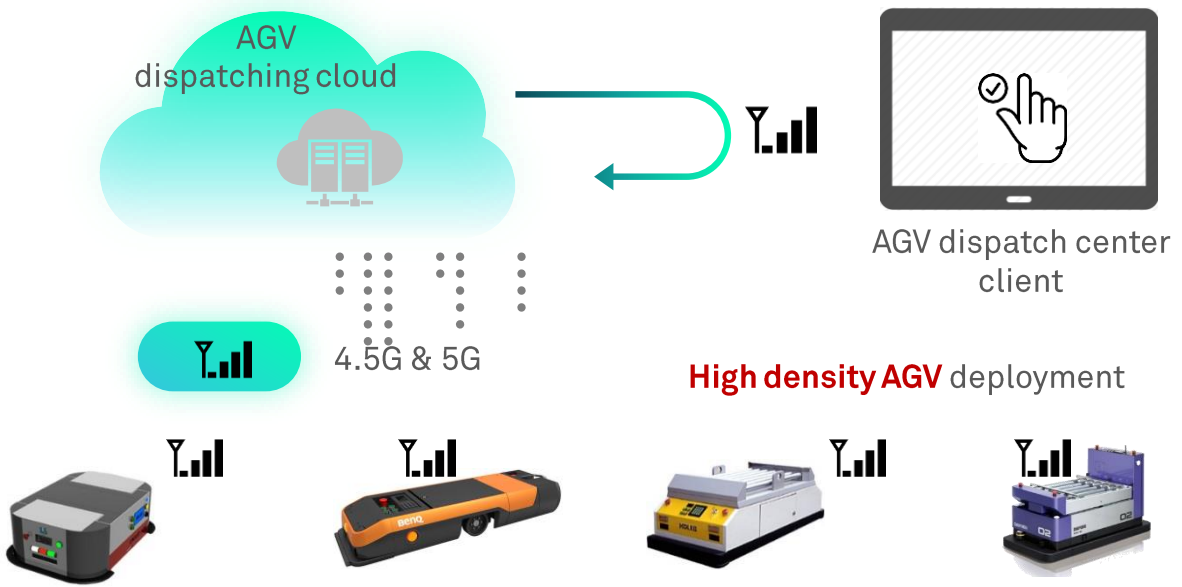


Higher bandwidth and lower latency network (5G uRLLC, eMBB..)



Cloud-based Machine Vision (Storage, computing...)





## Description

- An automated guided vehicle (AGV) is most often used in industrial applications to move materials in the warehouse or between assembly lines. Generally, the computer controls the route.
- The current AGV uses WiFi networks. However, low-density deployment and hard handover often lead to AGV's protective pausing and result in poor operation efficiency.

## Value

- 5G networks, with its promises for large capacity and low latency, can support multiple AGV connections and intelligent dispatching under high-density deployment.

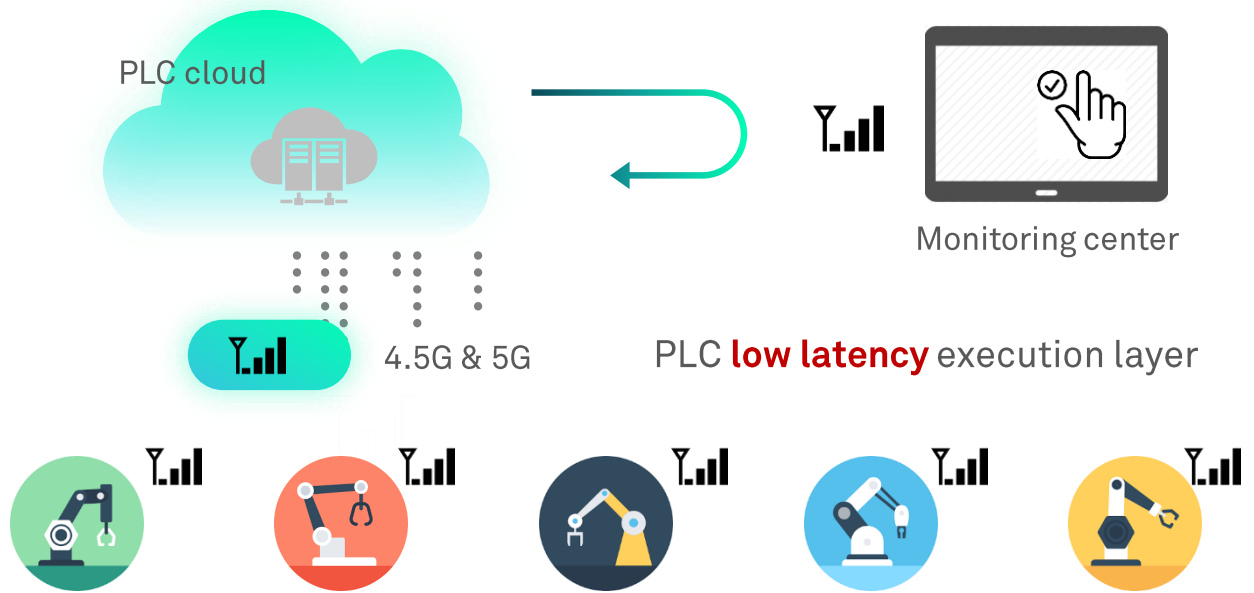
Phase	Density per 50*100m
Phase 1: 4G AGV	350
Phase 2: 5G AGV	>500



Low latency, high density, anti-interference, & seamless handover



Mobile cloud (Storage, dispatching platform...)



## Description

- A programmable logic controller (PLC) is the primary management mechanism of automated factory equipment. PLC is currently an independent PC hardware and software solution. There are numerous issues with the current system, such as high complexity, limited robot task upgrade, and huge backup cost, etc.

## Value

- Wireless cloud PLC meets the openness and flexible requirements of industrial automation control. MNO's cloud infrastructure can host PLC.

Phase	Data Rate	Latency
Phase1: Soft real-time	<10 Mbps	10~100 ms
Phase2: Hard real-time	<10 Mbps	1~10 ms
Phase3: Isochronous real-time (IRT)	<10 Mbps	<1 ms

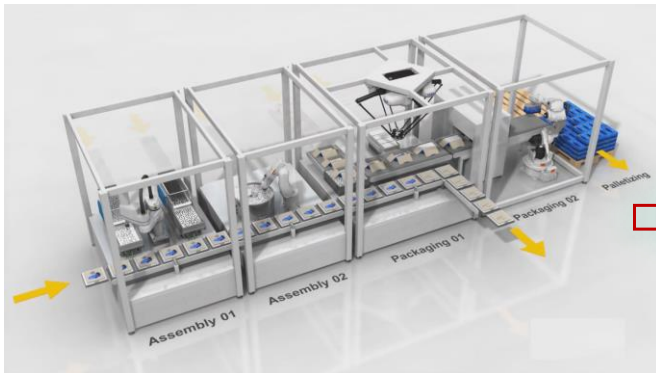


Low latency access  
(4G, 5G...)

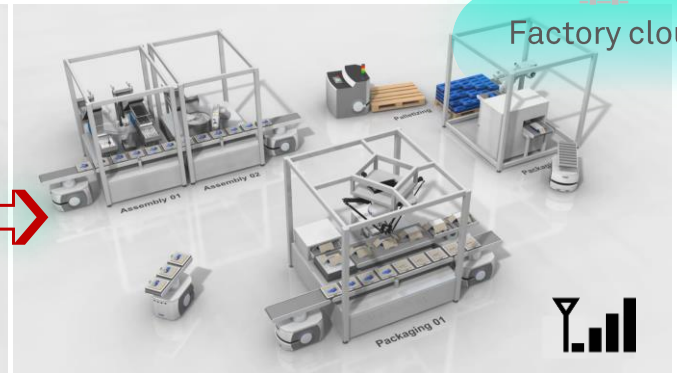


Mobile cloud  
(Storage, Soft PLC...)

Assembly line



Flexible island



## Description

- From fixed product lines to flexible islands, flexible manufacturing enables a new generation of factories to be more adjustable and efficient.

## Value



Flexible manufacturing

50%

Greater flexibility

20%

Energy saving

- Cloud computing creates improved efficiency. Data accumulation and algorithm optimization on the cloud can also facilitate distributed applications and promote machine intelligence.
- Operators will start with cloud storage and cloud computing in factories and subsequently move to front end cloud applications.



Wireless access  
(NB-IoT, 4G, 5G...)



Mobile cloud  
(Storage, computing, ERP...)





# Digitalized Low Airspace

*Joint Demo with:*

**eHANG**

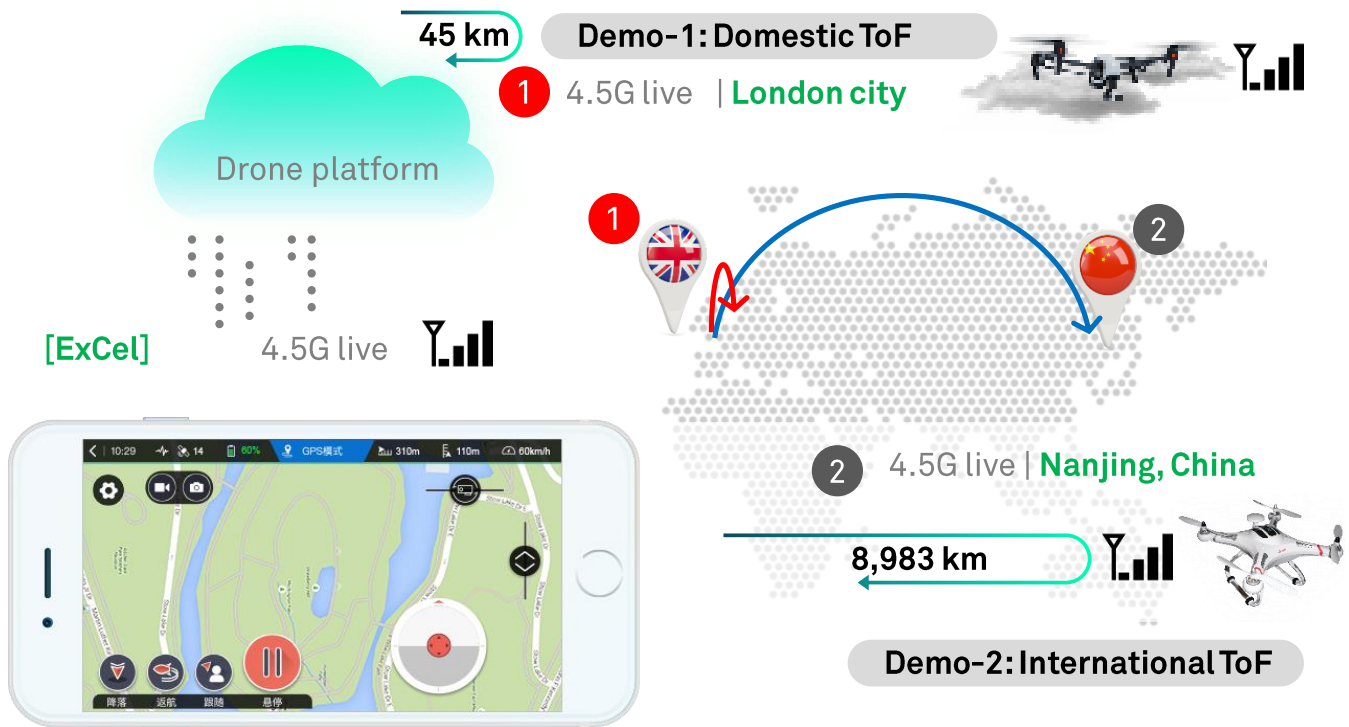
**TopGun**

**EWATT** 易瓦特

**CHUSHAN**  
TECHNOLOGY

*Special Interest Group by:*

CACC | CMCC | JD | eHANG | TOPXGUN | EWATT |  
UVS | OXAiAIRCRAFT | SkyEye | U Cloud | Rongqi  
Intelligence | Skysys



## Description

- Low airspace coverage: Realize 300 meter airspace wireless coverage to enable connected drones' business applications (multimedia, transport, agriculture, and security, etc.).

<b>Data Type</b>	<b>Command and control (C&amp;C):</b> For remote sensing, real time driving, identification, flight authorization etc. <b>Application data:</b> Video, image, and other sensor data
<b>Height</b>	Maximum 300 m
<b>Technology</b>	Low-airspace coverage plan & optimize, joint signal processing
<b>Requirement</b>	Phase-1: Uplink 1K video 6 Mbps, 50 ms latency, 120 m flight height Phase-2: Uplink 4K, 360 degree 30 Mbps, 20 ms latency real-time control, 300 m flight height

## Value



Most current 4.5G networks can support <120 m drone services.

10 GB DOU/drone



In terms of revenue, each drone generates an add. 10 GB DOU.

# The Coming 3D Transportation



AEROMOBIL	AIRBUS	AURORA	EHANG	E-VOLO	TERRAFUGIA
Flying car	PopUp	eVTOL	184	Volocopter V200	Transition
Slovakia	France	USA	China	Germany	USA

## Description

3D traffic: Today's urban road traffic is often extremely busy. How to resolve the difficulties of road congestion? Passenger-carrying UAV solutions such as Flying Taxi provides a short to middle-range daily transportation choice to help build a future Sky City.



DUBAI

*Dubai's transportation authority announced that by 2030, unmanned sky transport will account for 1/4 of all transport*

## eHANG 184

- Key technology: Tele-operated flight & high-precision positioning
- Network demand:  
UL / DL 100 Mbps (4K Cameras \* 4, LiDARs) | Latency: 20 ms | Flight height: ~300 m



Passenger

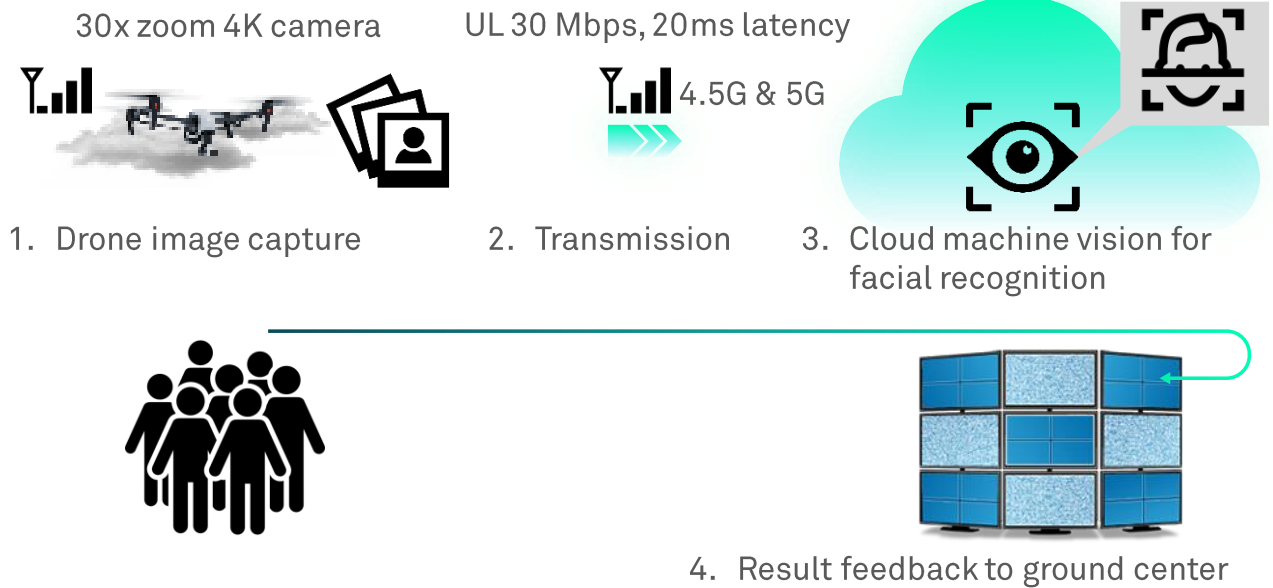
1



240 kg (net weight)  
+ 120 kg (load)



Flying distance  
41 km



## Description

Public safety drones:

- In 2016 at the Rio Olympic Games, drones were used to ensure security in highly-crowded areas by providing real-time monitoring data;
- In 2017, Sichuan police use drones named "Eagle Eye" (equipped with 4G modules) to transmit real situation data back to the ground command center.

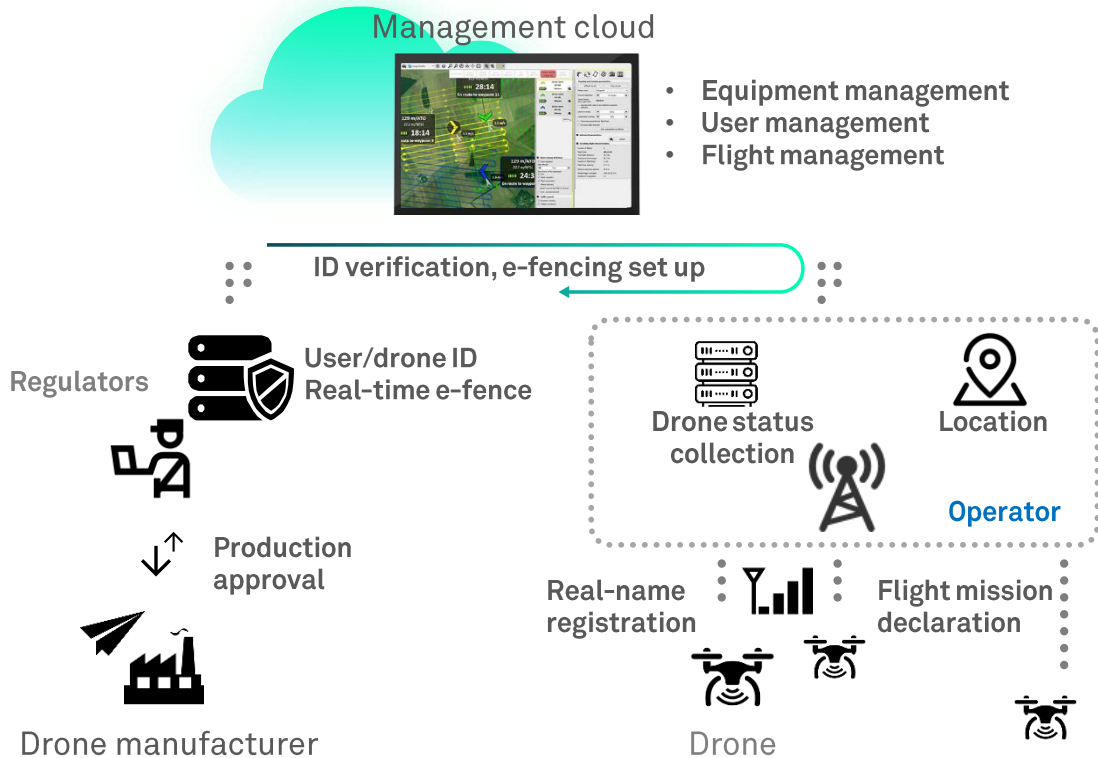
Phase	Data Rate	Latency	Mobility
Phase 1: People tracking	UL 6 Mbps 1080p	10–100 ms	40 kph
Phase 2: Car tracking	UL 30 Mbps 4K	1–10 ms	120 kph

## Value

- Like WTTc (Wireless Cameras) services, drone + machine vision can be used for public safety, site inspection, power line inspection, etc. MNOs have many opportunities and advantages in terms of connection and cloud computing.



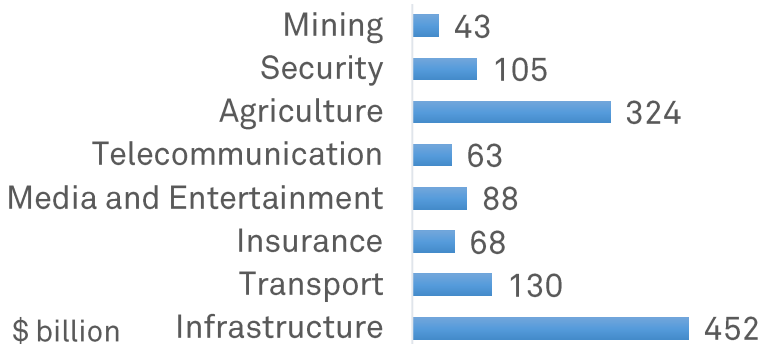
# Drone Safety & Management



## Description

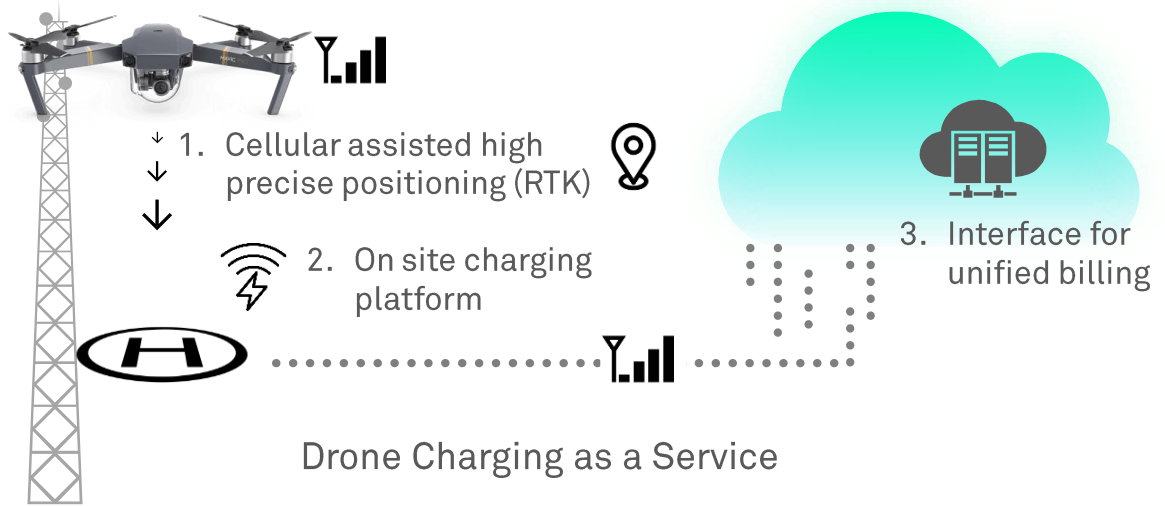
- **Equipment Management:** Supervision standards, network access permission, & sales record (IMEI, SN matching);
- **User Management:** SIM based real-name registration, using operator's existing real-name registration system;
- **Flight Management:** Pre-flight & in-flight authentication, & real-time e-fence update based on reliable cellular location verification

## Value



Double the market size with safety regulated drones

From 2015 \$ 127.3 billion  
to 2020 \$ 268 billion



## Description

- Limited operating range due to short battery life is a constant drawback of drones. The current solution is to use a "backup battery", in which case the drones require human supervision and the unmanned aerial vehicle is not really unmanned.
- Key technology: wireless charging & high-precision positioning (such as cellular assisted RTK)

## Value

- Operator's tower infrastructure is designed to support Drone Charging as a Service.
- Operator benefits: ubiquitous sites, unified billing, & new revenue



Battery capacity  
**5,000 mAh**

Full charging time  
**20 minutes**





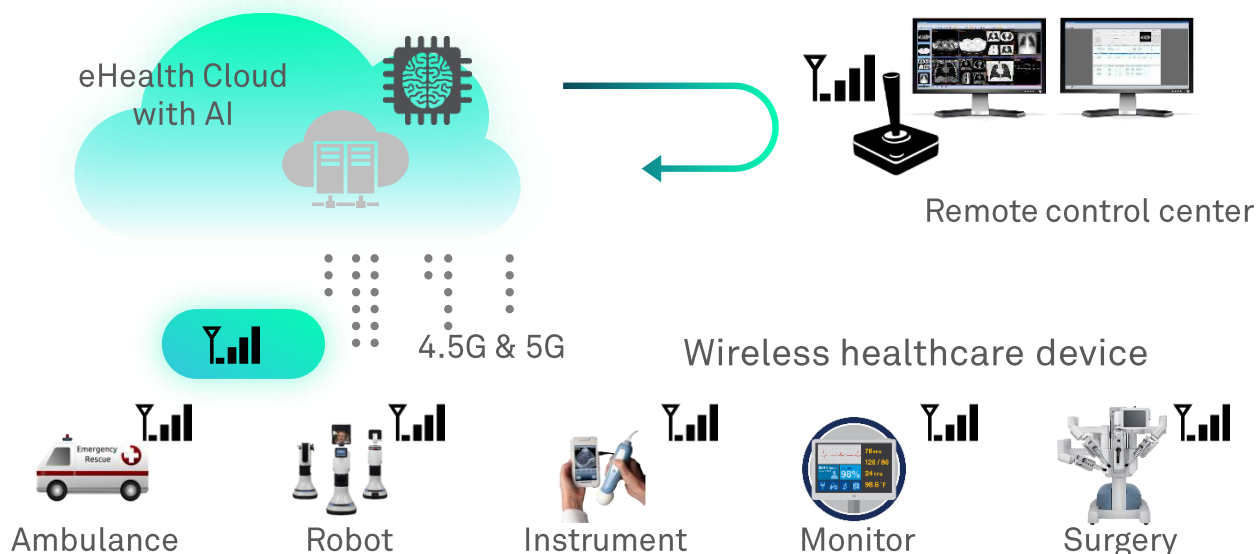
# Wireless Connected eHealth

*Joint Demo with:*



*Special Interest Group:*

Henan Telemedicine Center of China | Huashan  
Hospital Fudan University | MGI | Soochow  
University | Fosun International | YITU Technology |  
Medex Technology



## Description

- 5G enables wireless remote diagnostics and operation. Medical centers can deliver services to an area lacking in resources. Emergency situations can also be supported anytime, anywhere.

## Network Requirement

### Wireless endoscopy



Phase	Data Rate	Latency
Phase1: Light endoscope	12 Mbps	35 ms
Phase2: 360° 4K+tactile	50 Mbps	5 ms

### Wireless ultrasonography



Phase	Data Rate	Latency
Phase1: Semi-automatic, tactile	15 Mbps	10 ms
Phase2: AI-assisted vision, tactile	23 Mbps	10 ms

## Value

- In 2024, the market for connected medical devices will reach \$612 billion.



Wireless access  
(NB-IoT, 4G, 5G...)

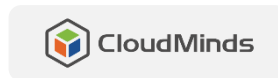


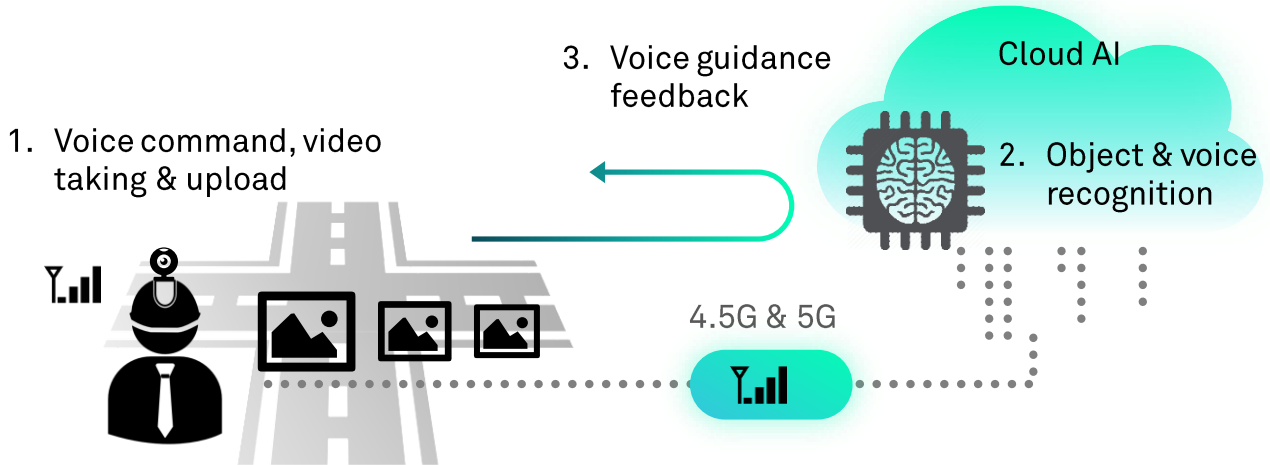
Mobile cloud  
(Storage, computing, AI...)



# Cloud Intelligent Applications

*Joint Demo with:*





## Description

- Artificial intelligence: Mimicking human intelligence is the highest form of flattery. Such examples include machine vision, intelligent search, intelligent control, language and imaging research. 5G wireless network and cloud AI can enable AI services anytime, anywhere.

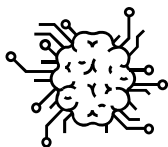
## Network Requirement



Phase	Data Rate	Latency
Phase1: 1 FOV, man assisted	> 6 Mbps	50 ms
Phase2: 4 FOV, AI navigation	> 30 Mbps	< 20 ms

Human neural network delay

100 ms



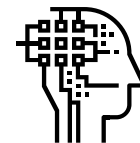
Network latency requirement

< 20 ms



AI process time is expected to decrease from 180 ms to

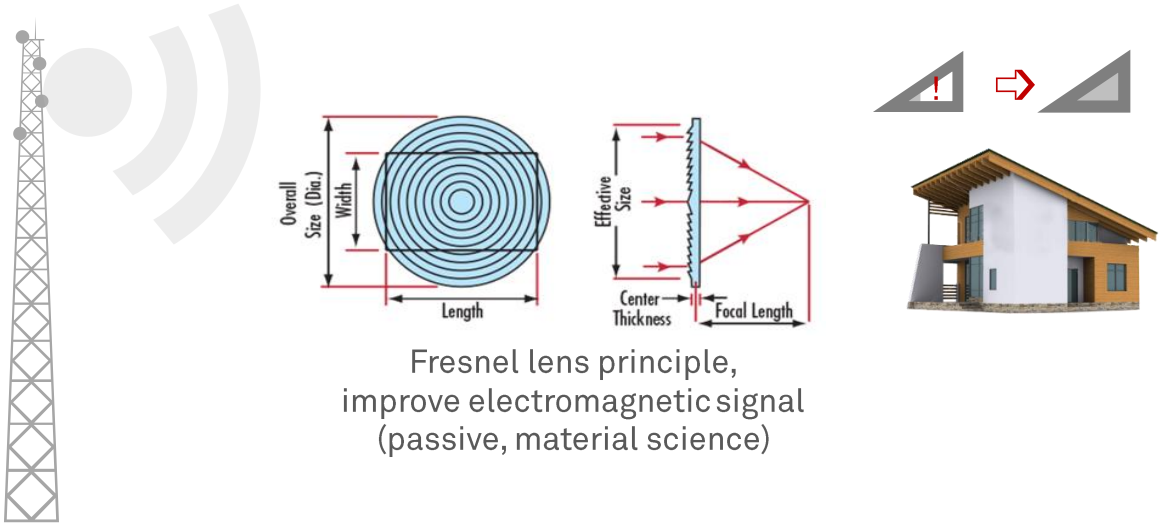
80 ms



## Value

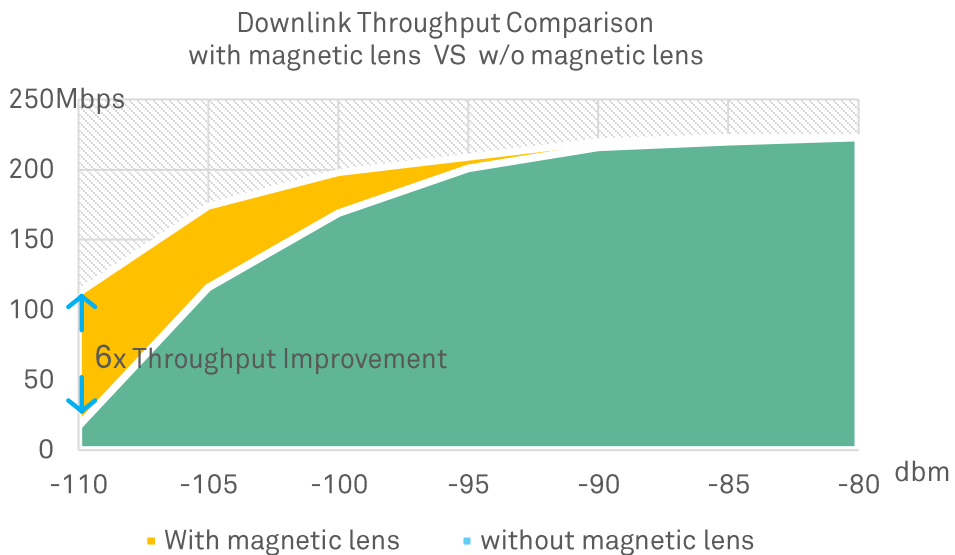
- Operators can provide connectivity for AI applications, or provide a platform for AI Big data. By 2025 (according to forecasts), AI productivity will equal an output of 1.1~1.4 billion in human labor.

# Greater Coverage with Magnetic Lens



## Description

- 5G high-frequency signal penetration capability is limited. The electromagnetic lens can harness electromagnetic wave energy to enhance the receive radio signal strength.



- According to the field test, the signal is enhanced by 10+dB after passing through the lens. By the coverage edge, the network throughput is improved up to 6 times.

## Value

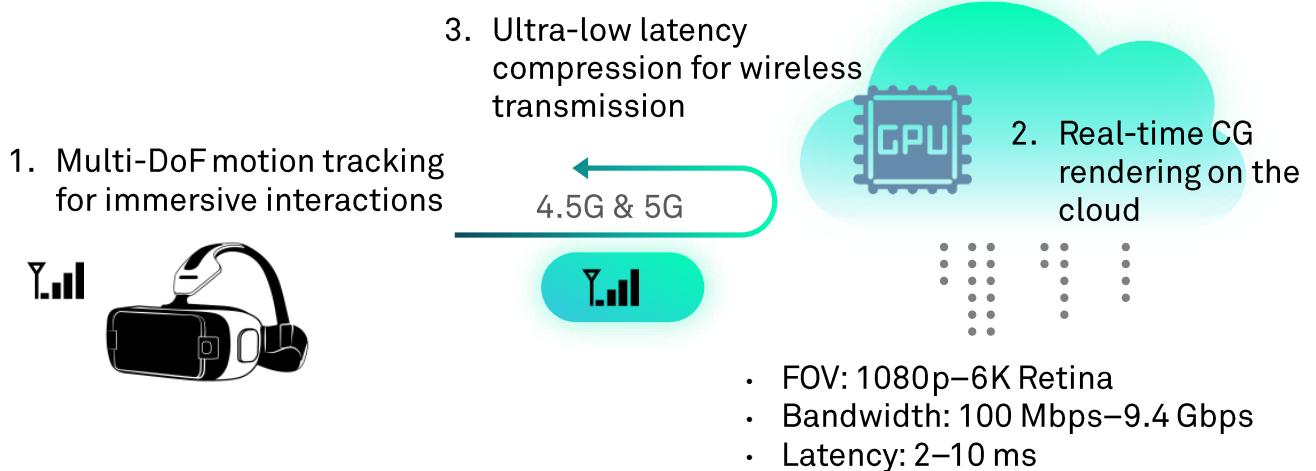
- In the 5G WTTx scenario, the electromagnetic lens can be a cost effective solution to enhance coverage and increase DOU.



# Cloud VR/AR



# Preparing for a Cloud VR/AR Future



## Description

- X Labs & ABI Research estimate AR & VR will reach \$292 billion by 2025 (\$151 billion for AR and \$141 billion for VR).
- Cloud VR will greatly reduce the cost of terminal devices by hosting all CGI contents with real time cloud rendering. This will improve VR affordability, but still ensure optimal quality and ultra-low latency.

## Network Requirement

- X Labs propose five stages to define the cloud AR/VR evolution:

Phase	Technology	Data Rate	Latency
P0-PC VR	Motion processing and rendering in a local computer	Primarily Wi-Fi connectivity	
P1-Mobile VR	Panoramic video download and motion processing in smartphone	20 Mbps	50 ms
P2-Cloud Assisted VR	Cloud-based motion processing, FOV video streaming	40 Mbps	20 ms
P3/4-Cloud VR	Cloud-based motion processing & real-time CG rendering	100 Mbps–9.4 Gbps	2–10 ms

## Value

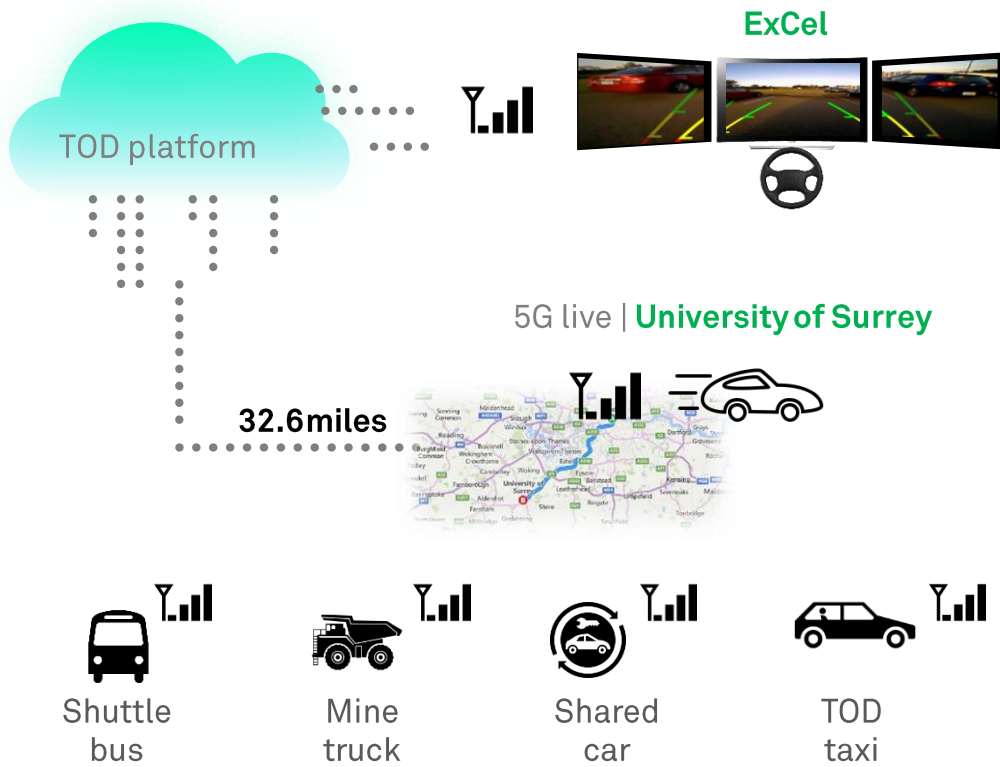
- 5G will become a necessity for a number of the most innovative and advanced AR, VR applications.
- Operators' market opportunities in Cloud VR/AR/MR: connectivity & revenue (content & platform)



# Tele-operated Driving (ToD)

*Joint Demo with:*





## Description

- ToD allows the driver to operate the car from a remote control center.
- Practical application scenarios: city fixed line, mining area truck, shared vehicles, etc.

Speed	Low Speed < 30 kmh	Medium Speed < 50 kmh	High Speed < 80 kmh
Camera resolution	1280*720	1920*1080	3840*2160
E2E delay	< 50 ms	< 20 ms	< 20 ms
Video data rate (UL)	8 *-2 Mbps	8 *-4 Mbps	8 *- 40 Mbps
Control data rate (DL)	1 Mbps	1 Mbps	1 Mbps

## Value

- The connected car market is expected to potentially be worth \$145bn by 2022 and ToD is one of the most important cases.



Fleet management  
\$21 bn



Infotainment & telematics  
\$92 bn



V2X service  
\$32 bn

- 11.2016 • founded in MBBF Tokyo
- 03.2017 • start from drone, car, VR and robot  
1<sup>st</sup> roundtable
- 07.2017 • X Labs Advisory Committee  
2<sup>nd</sup> roundtable
- 10.2017 • world 1<sup>st</sup> Low altitude airspace hub in Shanghai  
wireless connected eHealth SIG
- 11.2017 • new topic – Wireless Connected eHealth  
wireless connected factory SIG  
3<sup>rd</sup> roundtable  
...

Welcome to join



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