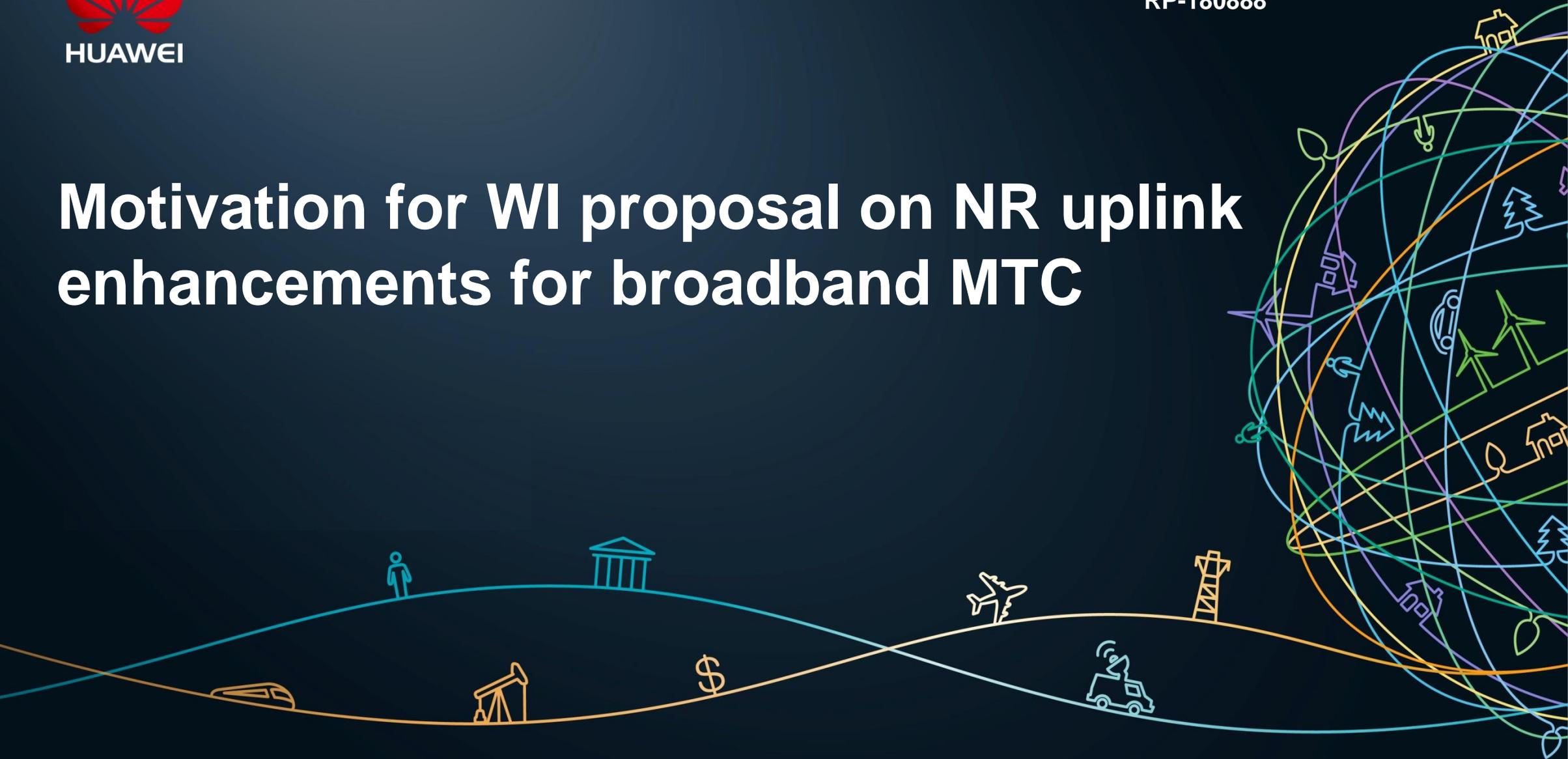




Motivation for WI proposal on NR uplink enhancements for broadband MTC



Introduction

- **NB-IoT adequately addresses many use cases of the LPWA market**
 - Enhancements are being proposed for Rel-16 to expand the use cases for the LPWA market, e.g. improving mobility, latency, etc. (RP-180371/RP-180372)
- **NR broadband MTC should explore diverse MTC use cases not overlapping with the LPWA market addressed by NB-IoT, e.g., use cases with massive number of connections and large uplink data traffic**
 - **Video surveillance is one use case of broadband MTC**
 - **To optimize support of such use cases: enhancements for uplink capacity/ number of connections, etc.**



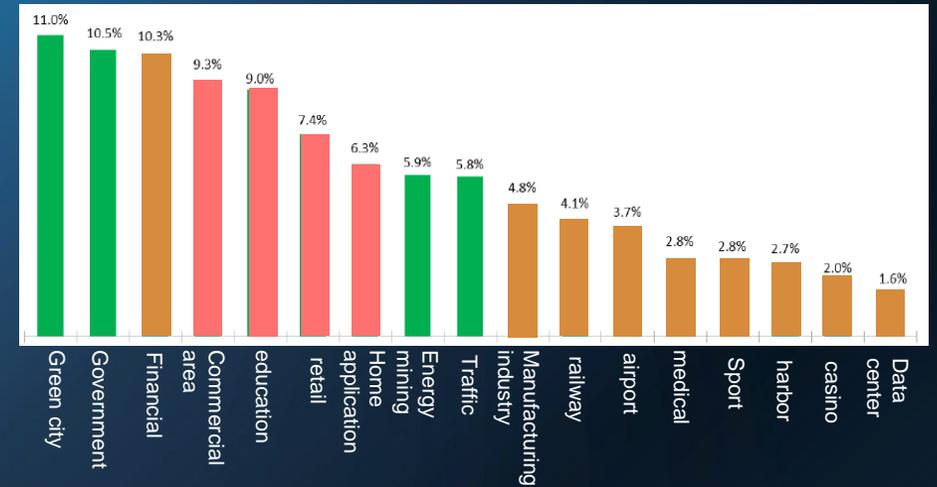
Video surveillance industry with massive connections is an emerging business opportunity for wireless communications

The **annual shipments** of surveillance cameras will reach **160 million**, and the demand for networking cameras is continuously rising.



In 2016, the number of surveillance cameras in operation reached **200 million**, and it is expected to reach **500 million by 2021**.

The market is **diverse**, but nearly half of it is for heavy-weight industry and outdoor monitoring.



Public cellular network **Dedicated network** **Hybrid network**

For small enterprises, operators can be a wholesale CCTV service provider.

For large enterprises, outdoor, medium-area coverage.

Other cases, partially dedicated network, and partially public cellular network.

Wireless video surveillance meant to meet essential demand with low cost

- Fiber-only solution cannot be deployed in numerous video surveillance scenarios
 - Wireless solution becomes essential to meet these challenging demands
- Wireless solution is competitive for cost-sensitive enterprises (no cost for renting tower)
 - Wireless backhaul may reduce the cost by **about 60%** compared to fiber backhaul
- Other advantages of wireless solution: **better scalability, fast deployment**

- Areas of metropolis are forbidden from excavation

Case : Qianmen,
Chongwen district,
Beijing, China



- Some areas with non-rigid pavement are difficult to deploy fiber

Case : People' s
park, Zibo, Shandong,
China



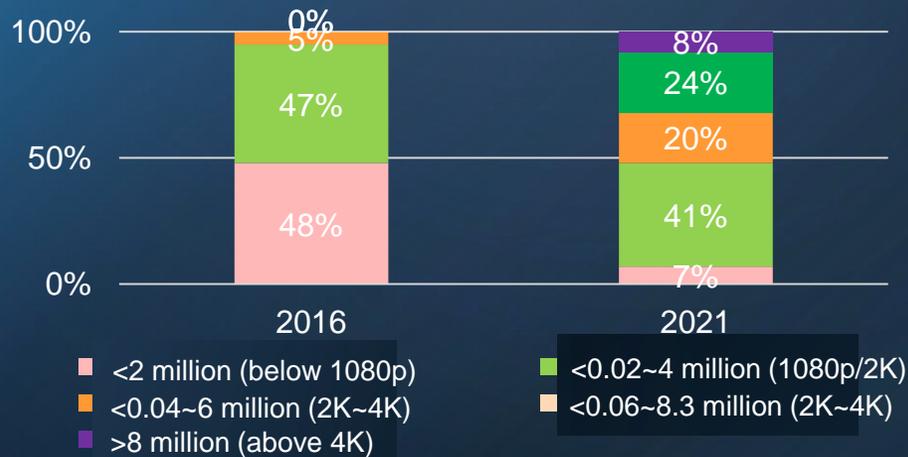
- Cities lack of fiber resources

Case : Public security
project of Tuoketuo,
Inner Mongolia, China



Enhancing uplink capacity and reducing the per-bit cost are critical for enabling massive data required by wireless video cameras

By 2021, the resolution of **90%+** cameras will be higher than 1080p, and **24%** of them will be 4K. Thus, the demand for bandwidth is substantially increasing.



Resolution	720P	1080P	2K	4K
Average bitrate (H.264)	2Mbps	4Mbps	8Mbps	16Mbps
Average bitrate (H.265)	1.5Mbps	2Mbps	4Mbps	8Mbps

● Note: 1) For **real-time** surveillance with guaranteed quality, the bandwidth required will be **1.2~1.8 times** of the average bitrate. 2) Huawei's most **advanced H.265 codec** based IP camera can reduce the average bitrate to **1Mbps @1080p**

The number of surveillance cameras in dense urban areas is set to increase rapidly in the next few years, reaching **100+ cameras/km²**

Public security departments require **24/7 real-time** video surveillance, including 1080p video in dense urban settings

The number of video surveillance cameras in central areas of Shenzhen, China, translates to average: **~80 cameras/km²**

For NR Rel-15, in dense urban scenario, uplink 2T16R, 20MHz, FDD, the average number of cameras supportable per km² is about **40**.

Improve uplink capacity of broadband MTC

General UL enh.

Slow-varying channels

Video characteristics

Uplink Capacity increase

SU/MU MIMO enhan.

Accurate link adaption

Interference coordination

Overhead reduction

Scheduling optimization

New UE categories



Objectives of WI on broadband MTC

- Evaluate the capacity of NR Rel-15 to support video monitoring service in typical scenarios, including definition of the traffic model, simulation assumptions (e.g., assumptions on UE positions), performance metrics (e.g., number of connections per cell), etc.
- Specify techniques for enhancing the uplink capacity/number of connected broadband MTC UEs with high data rate (e.g., Mbps), including but not limited to video surveillance UEs.
 - Enhancement of uplink capacity (e.g., optimized uplink MIMO and interference coordination schemes) considering more accurate uplink channel state acquisition [RAN1]
 - Overhead reduction for slow-varying channels [RAN1]
 - Optimized scheduling mechanism to adapt to service characteristics [RAN1, RAN2]
 - Mechanisms to improve performance for the users with poor link quality [RAN1]
- Specify techniques to reduce UE cost respect to typical eMBB UEs
 - New UE category definition to support lower UL/DL peak data rate requirement [RAN2, RAN4]
 - Reduced downlink complexity [RAN2, RAN4]



Conclusion

- **Enhancing uplink capacity and reducing the per-bit cost are critical for enabling reliable communication of massive numbers of wireless video cameras with high data rates**
- **Rel-16 broadband MTC should include optimizations for such use cases**





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