5G for Smart Sustainable Cities

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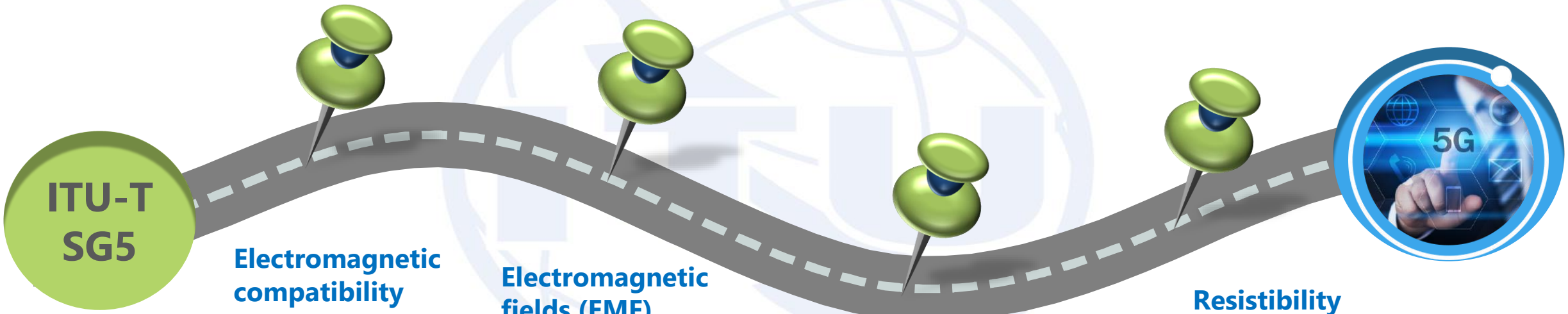
***5G** will usher in a new era of driverless cars, smart buildings and much more. 5G cellular and wireless networks will be more densely connected. They will be catalyst for Internet of Things (IoT) innovation and technologies.*

Setting Environmental Requirements for 5G

International Standards | Supplements | Technical Reports



Electromagnetic compatibility (EMC)

ITU-T K.Suppl.10

Electromagnetic fields (EMF)

ITU-T K.Suppl.9
ITU-T K.Suppl.14
ITU-T K.Suppl.16

Energy feeding & efficiency

ITU-T L. 1220
Draft ITU-T L.1221
ITU-T L.1222
ITU-T L. Suppl.36

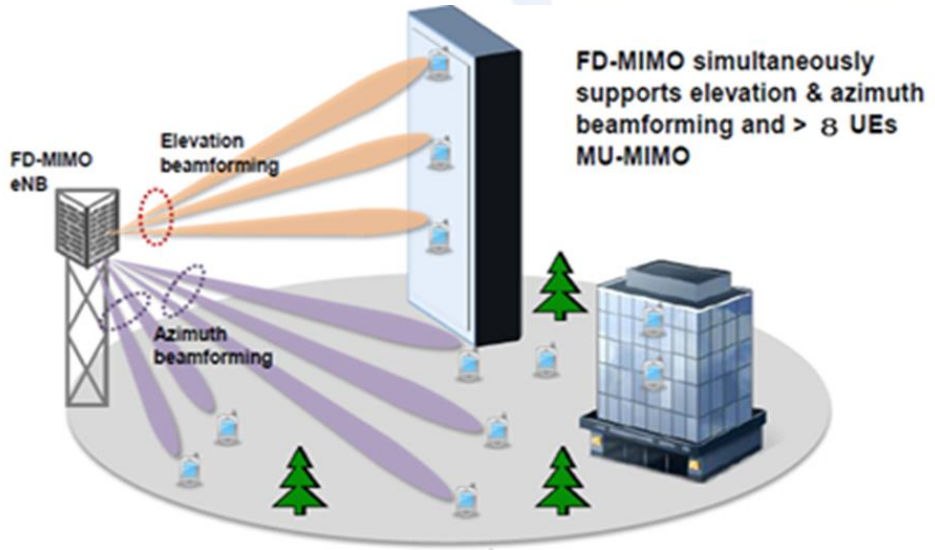
Resistibility

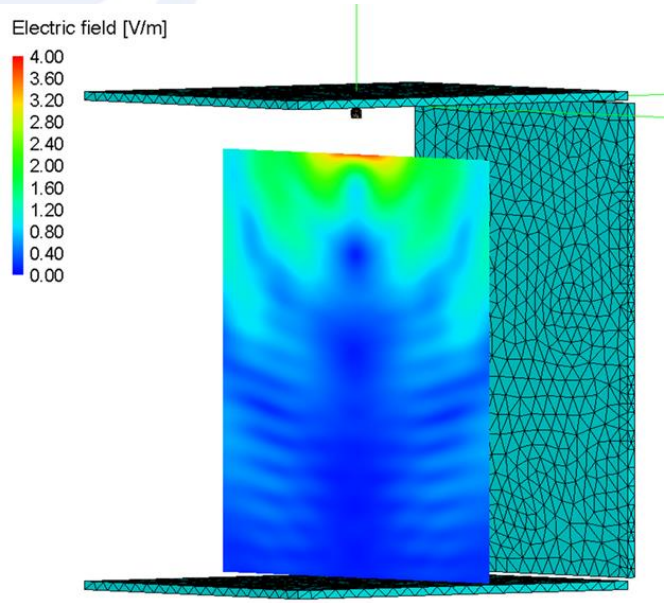
ITU-T K.Suppl.8

ITU-T K. Suppl. 9
5G technology and human exposure to RF EMF

Contains an analysis of the impact of the implementation of 5G mobile systems with respect to exposure level of EMF around radiocommunication infrastructure

- **Higher frequencies and higher throughput**
- **Smart antennas:** will minimize RF-EMF exposure level by improving antennas' efficiency.
- **Small cells:** can improve network coverage and capacity. Since small cells transmit data at a lower power level, they can also improve the performance of mobile handsets by lowering their power output.
- **Internet of things (IoT):** EMF exposure will usually be much lower than from other devices and systems



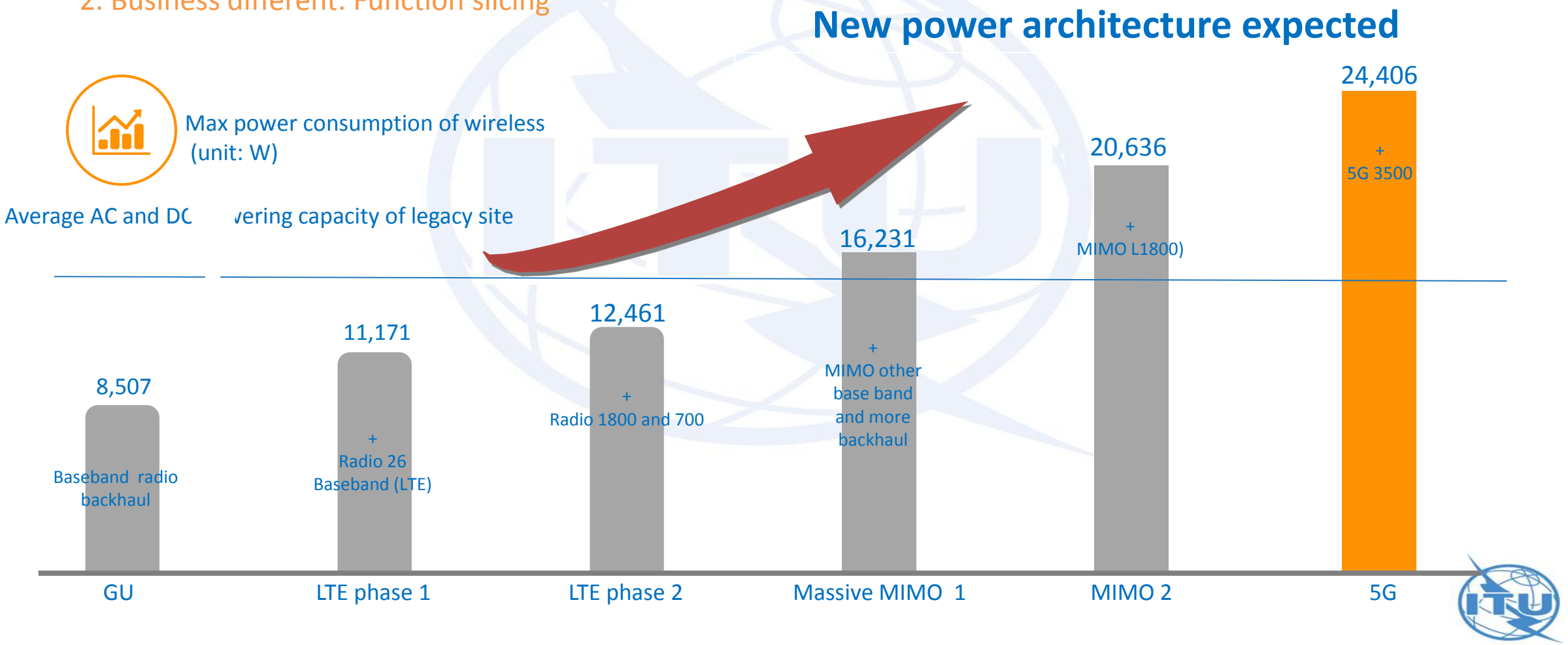


ITU-T K.Suppl.14
The impact of RF-EMF exposure limits stricter than the ICNIRP or IEEE guidelines on 4G and 5G mobile network deployment

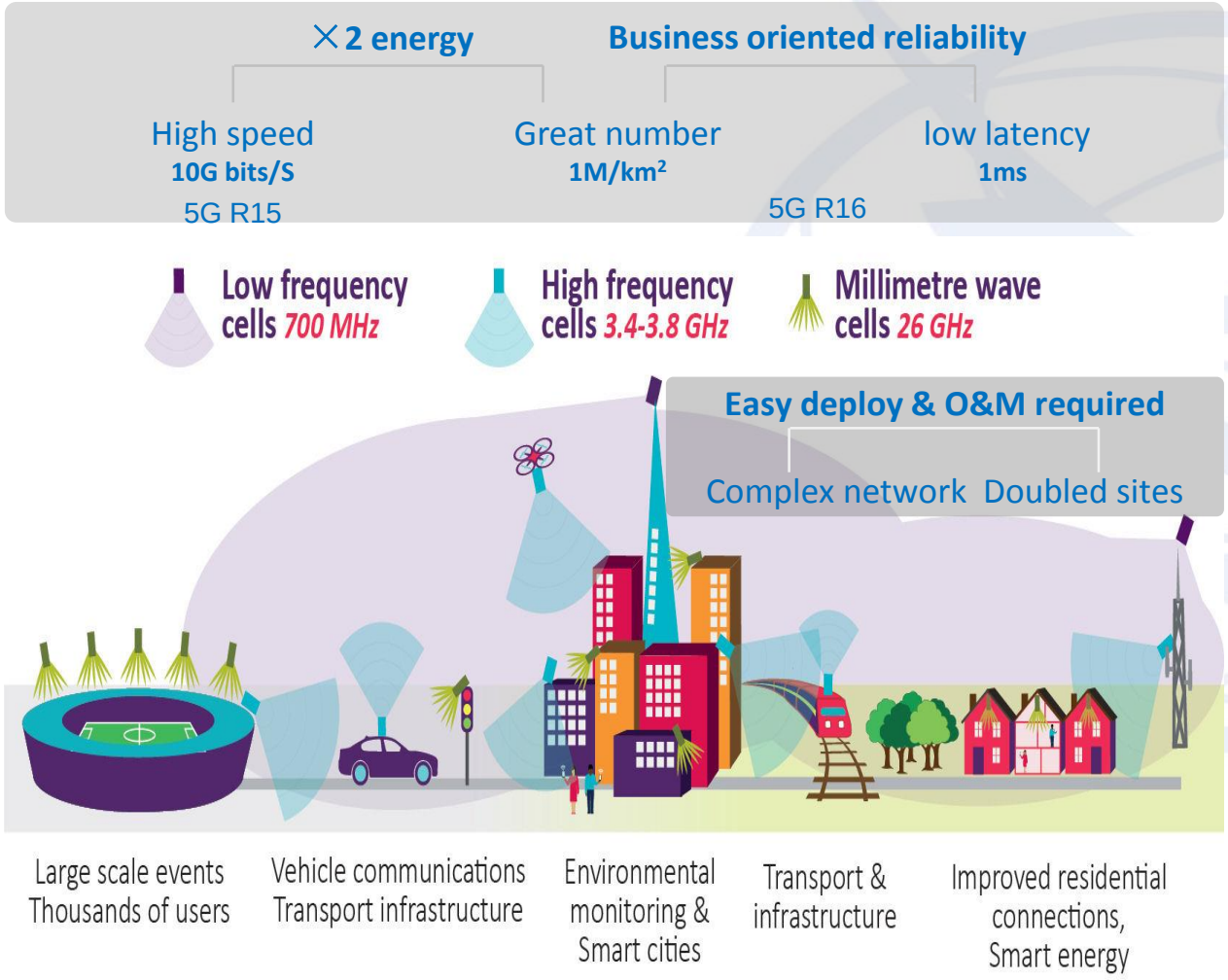
- Provides an overview of the challenges faced by countries, regions and cities when deploying 4G or 5G infrastructures.
- Includes a case study on Poland
- Based on inputs and contributions from, inter alia, Poland, India, Ericsson, Nokia, China Telecom, Huawei, Uganda, Cisco, GSMA and Vodafone, Telstra, Korea, Belgium, etc.

There isn’t 4G Power Standard. Why do we Need 5G Power Standard?

1. Power consumption is different: 2-3-4-5G, quantitative change to qualitative change
2. Business different: Function slicing



How to optimize Energy Consumption in 5G Networks



Key topics

AC capacity limit

How to limit power peak requirement from grid with limited AC capacity

Remote powering

How to feed the large power equipment on the tower from up to 100m away

Different important business

How to keep business from being interrupted

PAV classification

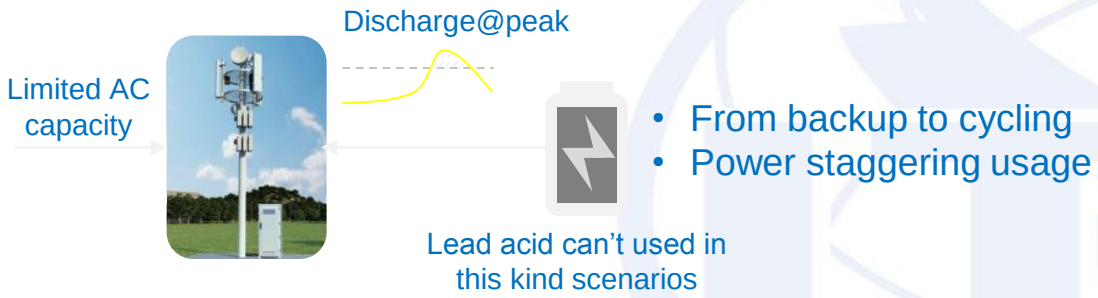
How to determine if a site is suitable for critical business such as IoV, telemedicine etc.

5G power standard ongoing

Sustainable power feeding solutions for 5G network

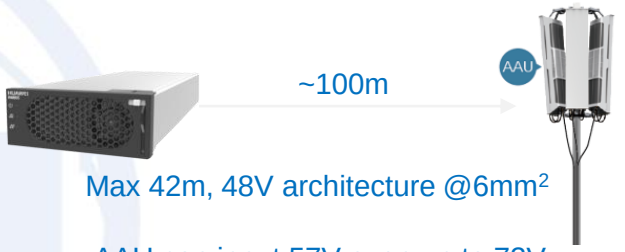
New Architecture will be Considered in 5G Power Standards

AC mains power requirement can be limited, Li-ion battery will become more prominent

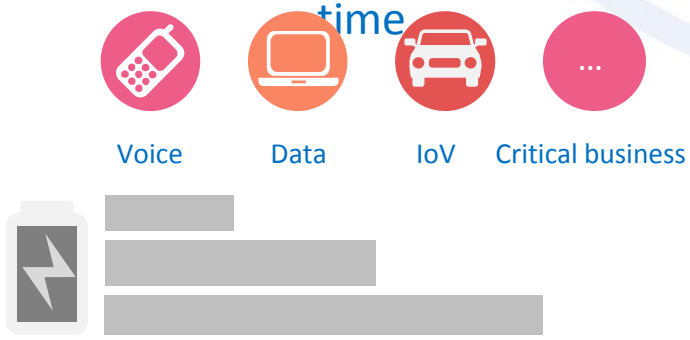


- From backup to cycling
- Power staggering usage

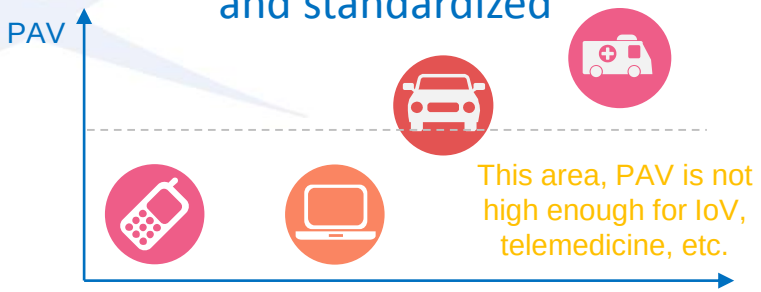
Higher output voltage is required



Power system communicates with the main equipment, enabling different business to have a different backup time



PAV is a visible KPI for site management. The PAV requirements for key businesses have to be determined and standardized

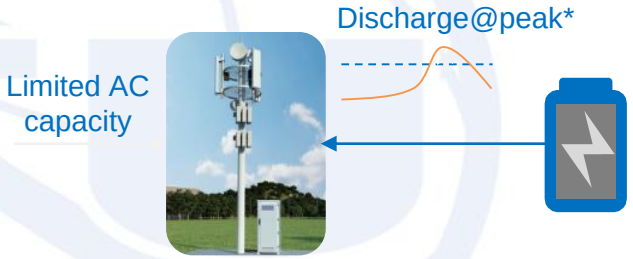


AC Capacity Requirement Limit & Li-ion Battery Application

AC mains power capacity is not enough in half of GUL site

- On average, 30% of the existing grid access cables need to be transformed or expanded for 5G deployment. (with over 30,000 sites surveyed in Germany, England, Holand, Spain, China, Indonesia, Philippines, etc.)
- The AC capacity of 158 (**49%**) sites is not enough in 320 sites in G carrier of P country in Massive MIMO project. It will up to 229 (**72%**) sites if 5G deployed if the solution is in traditional way, 53 transformer in the sites need to be upgraded.

Li-ion battery + smart power can help reducing 90% of AC mains modernization



- Form backup to cycling
- Power staggering usage

53 sites → **5 sites**

Site Transformers to be upgraded

Based on P carrier Massive MIMO + 5G project analysis

* Lead acid can't used in this kind scenarios

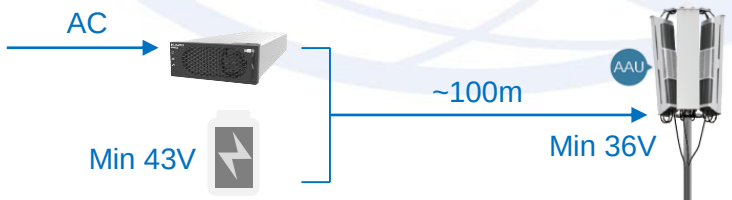
DC Cable Limit and System Voltage

Traditional 48V system can’t support 5G in average powering distance

- The power consumption of 5G AAU is higher than 1000W
- Work voltage of AAU: 36V to 57V
- Powered by 8.2mm2 cable, cable loss exceed 20% (60m, when battery is discharge in the last phase)
- Thick cable (> 10mm2) can’t connected to the terminals of AAU directly, and thick cable is much costly

Higher output voltage is required

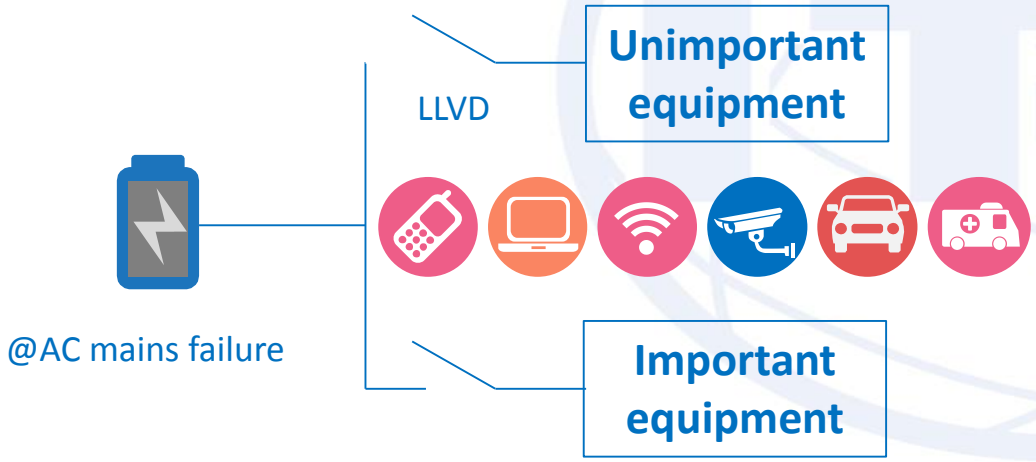
- AAU can input 57Vdc even up to 72Vdc, powering distance will be prolonged to 200m. 57Vdc or 72Vdc will be considered in 5G power standard
- Up to 400 Vdc architecture can support powering from N km away. Standards are available: ITU-T L.1200. Local regulation is not available in most countries. Not safe voltage used in telecom installation



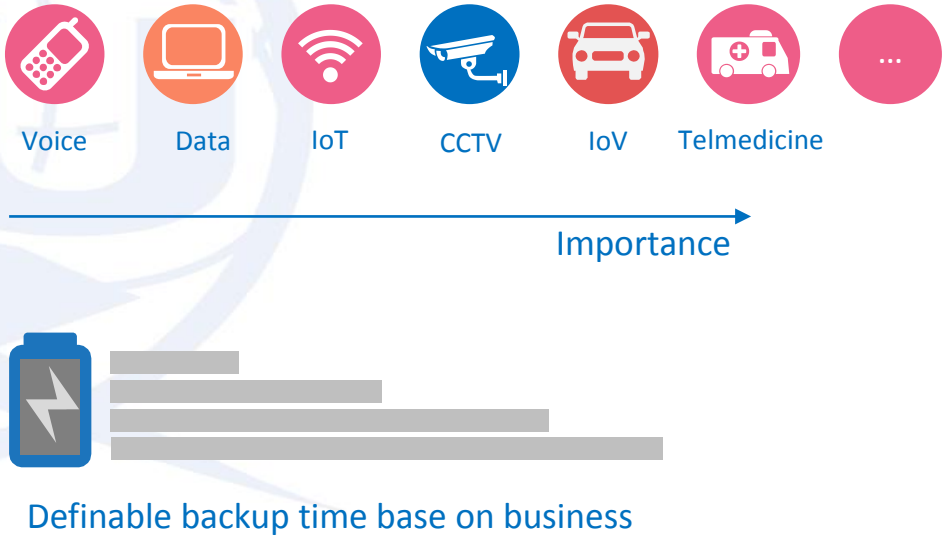
Max **56m**, 48V architecture @**8mm²**
>200m, 57Vdc constant voltage@8mm²

Business Oriented Backup Solution is Expected

Traditional power systems have a 2 steps shutdown, sliced critical business of 5G lacks the same protection



Business oriented smart power system is expected



IoV: Internet of vehicle T-M: Telemedicine

Visible PAV and Benchmark Should be Defined

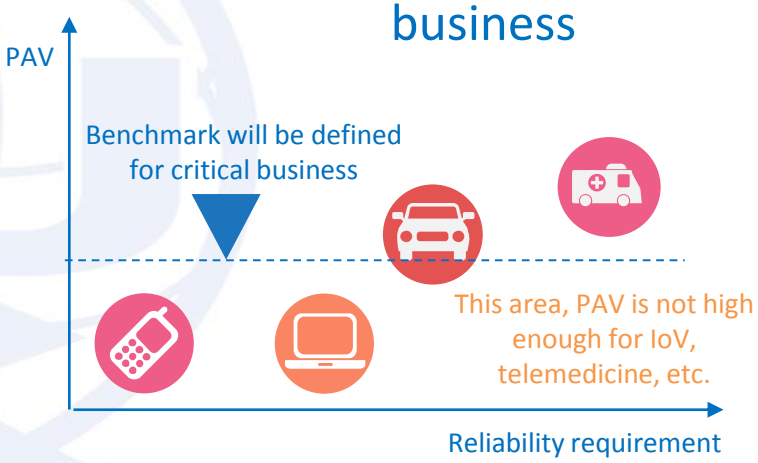
Network outage is unacceptable in a smart world

2G
date missed

3/4G
deal delay

5G
life lost

PAV should be visible and benchmarked for critical business



Business availability = PAV × slice availability

PAV: Power Availability

Recommendation ITU-T L.1220
Innovative energy storage technology for stationary use - Part 1: Overview of energy storage

This Recommendation provides an overview of energy storage technologies for stationary telecom/ICT equipment (e.g. battery systems, super-capacitor systems etc) used in telecom networks, data centres and customer premises equipment (CPE).

Draft Recommendation ITU-T L.1221
Innovative energy storage technology for stationary use - Part 2: Battery

This Recommendation introduces technologies and methods for evaluating, selecting and testing battery systems for defined applications.

Recommendation ITU-T L.1222
Innovative energy storage technology for stationary use - Part 3: Supercapacitor technology

This Recommendation contains the selection criteria for telecommunication application based on main performance parameters and the methods for proper use.

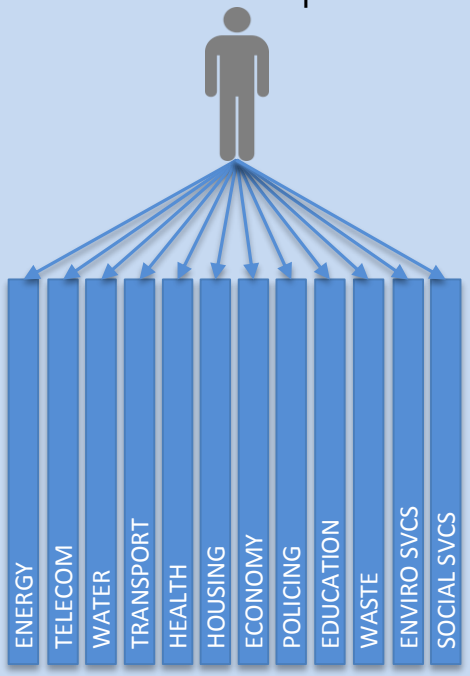
Current work items on setting the environmental requirements for 5G

- Draft Recommendation ITU-T L.5G_powering on **“Sustainable power feeding solutions for 5G network”.**
- Draft Recommendation ITU-T L.EE_5G_base_station on **“Energy efficiency Metrics and measurement methodology for 5G base stations”.**
- Draft Recommendation ITU-T L.methodology_arch on **“Methodology to assess the environmental impact of the different proposed architectures”.**
- Draft Recommendation ITU-T L.ENV-KPI-5G-ARCH on **“Environmental KPIs/metrics for 5G architectures”.**
- Draft Recommendation ITU-T L.EE_sclicing on **“Energy efficiency and slicing of IMT2020/5G”.**
- Draft Recommendation ITU-T L.ARCH_EOL_CE on **“Environmental Impact of architecture solutions with regards to End of Life and Circular Economy (CE)”.**

ITU-T SG20: IoT and Smart Cities & Communities

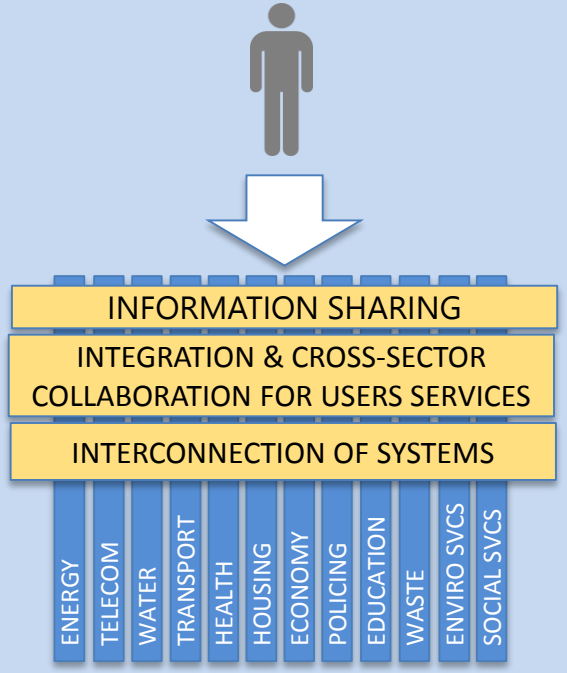
FROM

Closed & un-connected vertical silos of functionally-oriented service providers



TO

Innovative and collaborative new models that connect these vertical silos



Internet of things (IoT) and its applications

Smart cities and communities, including e-services and smart services

Internet of things identification

United for Smart Sustainable Cities initiative

U4SSC responds to **SDG 11: "Make cities and human settlements inclusive, safe, resilient and sustainable.**
U4SSC advocates for public policy to **encourage the use of ICTs** to facilitate and ease the transition to smart sustainable cities.

U4SSC is currently working on:

- Guidelines on tools and mechanisms to **finance SSC projects**
- Guidelines on strategies for **circular cities**
- **City science** application framework
- **Blockchain** 4 cities
- Guiding principles for **artificial intelligence** in cities
- **The Impact of Frontier Technologies on Cities**:
  - Artificial Intelligence and cognitive computing
  - Data processing and computation
  - Sensing technologies and IoT

Supported by:

Convention on Biological Diversity
UNITED NATIONS ECLAC
World Meteorological Organisation
United Nations Economic Commission for Africa
UNDP Empowered lives. Resilient nations.
UNECE
UNESCO United Nations Educational, Scientific and Cultural Organization
UN environment United Nations Environment Programme
UNEP FINANCE INITIATIVE
United Nations Framework Convention on Climate Change
UN HABITAT FOR A BETTER URBAN FUTURE
UNIDO
UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance
UN WOMEN
ITU

The U4SSC KPIs for SSC Project – Join Now

The U4SSC Initiative developed a set of international **KPIs for SSC** to establish the criteria to evaluate **ICT´s contributions** in making cities smarter and more sustainable, and to provide cities with the **means for self-assessments.**

Over 50 cities worlwide are already implementing these KPIs

The Case of Dubai

The Case of Singapore

Coming soon: The Case of Moscow

54 Core Indicators + 37 advanced Indicators

3 Dimensions

- Economy
- Environment
- Society and Culture

Coming soon: ITU Global Smart Sustainable Cities Index

Upcoming meetings

- **ITU-T Study Group 5 Regional Group for Latin America (SG5RG-LATAM)**
  24 October 2018, Bogotá, Colombia
- **World Smart City Forum**
  29 November 2018, Santa Fe, Argentina
- **ITU-T Study Group 5 Regional Group for Asia and the Pacific (SG5RG-AP) meeting**
  3 December 2018, Wuxi, China
- **Forum on Artificial Intelligence, Internet of Things and Smart Cities**
  3 December 2018, Wuxi, China
- **ITU-T Study Group 20 “Internet of things and smart cities & communities” meeting**
  3-13 December 2018, Wuxi, China


Bring digital to every person, home and organization to build a
fully connected, intelligent 5G City.

Thank you!

For more information please contact: tsbsg5@itu.int