5G, Artificial Intelligence, M2M, Internet of Things

Development of Smart Sustainable Cities

and

Linkage with EMF

Rakesh Kumar Bhatnagar
Senior ITU EMF Consultant

Challenges we face

- Rural to Urban migration
- Traffic Congestion
- Pollution
- Waste Management
- Drinking Water shortages
- Power
- Irrigation
- Transportation
- Crimes
- Health Care

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

HOW TO ADDRESS THESE CHALLENGES

- Need to create Smart Infrastructure to manage complexities of public services, reduce expenses, increase efficiency and improve the quality of life.
- Smart Infrastructure may be in the verticals
  - Automotive sector - Intelligent Transport System
  - City Surveillance
  - Waste management
  - Water management
  - Power
  - Health
- Integrated command & Control centre, DC & DR, Platform to manage data, devices, communication network, gateways etc.
- Use M2M/ IoT and ICT to make all the verticals smart and provide data in real time.
- *Goal : To improve the quality of life.*

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

5G, Artificial Intelligence, M2M, Internet of Things Development of Smart Sustainable Cities Have a Role to play

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

5G : A Unifying Connectivity

Mobile connectivity beyond 2020

Everything on wireless & Extended and enriched wireless services

1. **Enhanced Mobile broadband –**
   - **UHD video (4K, 8K) 3D video**
   - **Virtual Reality (VR), Augmented Reality (AR),**
   - **Tactile Internet, Cloud gaming, Broadband kiosks,**
   - **Real time simulation & training**
   - **Remote class room**

2. **Mission critical services (Ultra reliable & low latency communication) –**
   - **Industrial Automation,**
   - **e-health, hazardous environments, rescue missions, etc.**
   - **Self-driving vehicles**
   - **Drones**
   - **Vehicular communication**

3. **Massive Machine type communication / Massive IoT :**
   - **Smart home**
   - **Smart city**

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

ITU activities on IoT and Smart Cities

- ITU-T Study Group -20: Development & implementation of International Standards
- U4SSC: ITU, UNECE and other UN bodies created U4SSC. Released KPIs for the Smart sustainable cities to establish the criteria to evaluate the ICT's contributions in making cities smarter and more sustainable
- ITU-T FGDPM: Research & pre standardization work on data processing & management

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

ITU-T SG 20

Study Period : 2017-2020

WP1/20

Q1/20: End to end connectivity, networks, and interoperability, infrastructures and Big Data aspects related to IoT and SC&C

Q2/20: Requirements, capabilities, and use cases across verticals Q3/20: Architectures, management, protocols and Quality of Service

Q4/20: e/Smart services, applications and supporting platforms

WP2/20

Q5/20: Research and emerging technologies, terminologies and definitions

Q6/20: Security, privacy, trust and identification

Q7/20: Evaluation and assessment of Smart Sustainable Cities and Communities

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Artificial Intelligence (AI)

- Artificial Intelligence (AI) is transforming the role of ICT in decision making using data-driven models that can impact people in all walks of life.

- AI has the potential to solve some of the most pressing challenges that impact countries and drive growth & development in all core sectors like health care, agriculture, manufacturing, apart from its role in various public service applications such as financial services, education urban development.

- As AI proliferates and AI find more and more use cases for practical implementation, there is a need for evolving standard AI stack which will improve trustworthiness levels, bring interoperability, protect digital rights and evolve ethical standards in AI.

- The foundation block for AI, will identify it as an open infrastructure that unbundles identity, signature, money exchange, document and data exchange allowing development of various apps and solutions.

- This can help in developing pigeonholes for security; trustworthiness; digital rights and ethical standards etc that industry can exploit and develop country specific AI apps or for the world in general.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

- **AI standards can help in identifying the gaps and challenges towards developing the standards in different areas of AI;**

- **Develop these AI standards with country specific requirements and formulate the framework for AI country stack.**

- **Need to address different aspects of AI i.e.**

  - **functional network architectures;**
  - **AI architecture;**
  - **data structures required;**
  - **the type of interfaces and protocols;**
  - **Technologies employed;**
  - **Systems deployed;**
  - **Trustworthiness;**
  - **Interoperability Standards;**
  - **Digital rights and Ethical standards in AI;**
  - **Preserving algorithm openness;**
  - **technological mapping and leveraging AI for national missions and any other aspects.**

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

IoT

- IoT is the interconnection of uniquely identifiable embedded computing devices.
- Any device can be connected – not just computers , but various sensors and monitors, too
- Connectivity of IoT could be over Mobile Broadband, Fixed Line, WIFI and Proprietary Technologies

Devices supported by IoT

- Home electronics: Smart TVs & Media servers.
- Home appliances: Fridge, Oven, Laundry, Garage door and Gate.
- Smartphones and Smart wearables
- Security and surveillance
- Automotives (Cars, Bikes & etc)
- Aircraft and Drones
- Monitoring implants heart and pacemakers
- Biochip implants – human and animals (wild life inclusive).
- Infrastructure
  - Utility grids
  - Telecommunications
  - Waste management
- Cloud systems
- City to City
- Nation to Nation
- Global

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Standardization of SSCs

- ITU-T SG20: IoT & its applications including smart cities & communities (SC&C)
- ISO/IEC JTC 1: Identify the ICT-specific standardisation requirements based on an understanding of the needs of Smart Cities.
- ISO 37120 Sustainable development & resilience of communities - Indicators for city services & quality of life.
- SO/TR 37150: Smart community infrastructures - Review of existing activities relevant to metrics.
- ISO 37101 Sustainable development & resilience of communities - Management systems - General principles & requirements.
- ISO 37102 Sustainable development & resilience of communities – Vocabulary
- ISO/TR 37121 Inventory & review of existing indicators on sustainable development & resilience in cities
- ISO/TS 37151 Smart community infrastructure metrics - General principles & requirements
- ISO/TR 37152 Smart community infrastructures -- Common framework for development & operation

Linkage with EMF

Answers to FAQ

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Are testing standards in place for 5G devices and networks?

- Many initial 5G deployments will be at frequencies similar to existing 3G/4G mobile networks and so the same mobile device compliance measure – the specific absorption rate (SAR) – and limit value will also apply to 5G devices.

- For 5G devices operating in frequency bands higher than those used by current mobile phones, new test procedures are being developed and standardization activities have been initiated by the International Electrotechnical Commission (IEC) Technical Committee 106.

- A Technical Report provides guidance on test methods that can be used now and will be used as the basis for a final international technical standard to be completed by 2021.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Are testing standards in place for 5G devices and networks?

- Many initial 5G deployments will be at frequencies similar to existing 3G/4G mobile networks and so the same mobile device compliance measure – the specific absorption rate (SAR) – and limit value will also apply to 5G devices.

- For 5G devices operating in frequency bands higher than those used by current mobile phones, new test procedures are being developed and standardization activities have been initiated by the International Electrotechnical Commission (IEC) Technical Committee 106.

- A Technical Report provides guidance on test methods that can be used now and will be used as the basis for a final international technical standard to be completed by 2021.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Does 5G mean an antenna on every street corner and inside all buildings? What will that mean for the visual environment?

- ✓ The coverage and capacity objectives of 5G combined with advanced antenna technologies means that some new antennas are likely to be required.
- ✓ Where possible an operator will place these antennas at an existing site and at other times new locations will be required.
- ✓ Mobile networks today consist of a mix of macro-cell sites to provide wide area coverage and small cells to improve localised coverage and increase capacity
- ✓ These are termed heterogeneous networks.
- ✓ 'Small cells' is an umbrella term for operator-controlled, low-powered radio communications equipment (base stations) that provide mobile and internet services within localised areas.
- ✓ Small cells typically have a low visual impact and have a range from ten metres to several hundred metres.
- ✓ Mobile network macro-cells typically serve larger areas.
- ✓ Over the next few years, the number of small cell installations will increase. Small cells can be used for both coverage and capacity objectives.
- ✓ As small cells are close to the users of mobile phones, it means that the phone will operate more efficiently, improving the available data rate and reducing the exposure of the user.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Will 5G network antennas look like what we already see in towns and cities, on rooftops and in fields?

- Many of the antennas used for 5G will look like those already present in the environment.
- Advanced antenna technologies such as beam-forming require the use of arrays of antennas to optimize the delivery of the wanted radio signal to connected mobile devices.
- Conventional antennas provide coverage like how a floodlight illuminates a wide area.
- The new antennas are like a flashlight providing coverage where it is needed and reducing unwanted signals.
- Smart antennas increase capacity and improve efficiency.
- A conventional base station antenna transmits a radio signal to a wide area regardless of how many users are connected.
- Smart beam forming antennas transmit radio signals only to connected users reducing interference and exposure.
- Beamforming involves combining the signal from multiple antennas to improve performance. However, operation at higher frequencies means that the size of many of the antennas is expected to be like that of existing installations.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

What will be the size of compliance zones around 5G network antenna sites?

- Smart antennas for 5G networks produce lower time averaged exposure for the same source characteristics than conventional antennas.
- Where regulatory authorities allow the use of updated assessment methods, this can result in smaller compliance zones.
- The size and shape of compliance zones will be evaluated and implemented according to international technical standards.
- New approaches to assess RF compliance provide greater accuracy and are applicable to all mobile technologies.
- Smart antenna technologies produce a number of narrow beams that change with call requirements.
- These changing beams require new approaches to assessing compliance as existing methods would significantly overestimate the size of the compliance zones

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

- Mobile network antennas are typically directional.
- Compliance zones extend in front of the antenna and a small distance above and below.
- If an antenna could be accessible to the public, then there are signs and barriers to advise them of the antenna, and how to proceed safely.
- The antennas are positioned so the public cannot access these areas.
- Access and shutdown procedures for maintenance workers may be agreed between the mobile operator and the landlord of a rooftop or the operator of streetlights when the antenna is installed.
- Mobile networks are designed to use only the power needed to provide quality services.
- Too much power would cause interference and affect all users.
- One of the goals of 5G is a substantial increase in network energy efficiency. Some of features being considered include reducing the power of transmitters when they are not in use and implementing sleep modes.
- Another approach is to reduce the amount of signaling needed to maintain connectivity.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Is 5G dangerous for the environment?

- The same limit values that protect people also protect the environment.
- There is no scientific reliable evidence of a risk to animals and plants exposed to radio signals at levels below limits in the international guidelines.

Will large numbers of small cells mean an increase in exposure?

- No. Small cells are used by current mobile networks to provide localised coverage or capacity and their use will expand with 5G.
- They may be mounted on streetlights or inside buildings, where over 80% of mobile usage occurs in developed markets.
- Measurements done on 4G small cells in a few countries found that levels in nearby areas remained well below the international safety guidelines and about the same as the level due to the macro network.

How do you respond to the petitions calling for 5G to be stopped?

- The science mentioned in these petitions is already well known to the international scientific community and has been evaluated by independent expert groups who consistently conclude that the international guidelines protect all members of the public and the environment.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

- The Internet of Things (IoT) demonstrates the coordination of multiple machines, devices and appliances connected to the Internet through multiple wired and wireless networks.
- These include everyday objects such as smartphones, tablets and other consumer electronics, and machines such as vehicles, equipped with IoT connectivity that allows them to send and receive data.
- Machine-to-machine (M2M) refers to services that are enabled by the communication between two or more machines.
- Mobile IoT technology connects machines, devices and appliances wirelessly to deliver services with limited direct human intervention.
- A wide variety of monitors and sensors are now being equipped with wireless connectivity enabling smart wireless applications in healthcare, agriculture and services such as water and electricity.
- A key design expectation of IoT enabled devices is that they will operate at low powers with battery life of up to 10 years in some applications.
- This is possible because they will only transmit small amounts of information, using very low power and the transmissions will not be continuous.
- The transmission interval and the amount of data will depend on the application.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

- Commercial wireless networks for IoT applications have already been deployed in some countries.
- Mobile IoT refers to low power wide area (LPWA) 3GPP standardized secure operator managed IoT networks in licensed spectrum.
- Existing cellular networks have evolved to deliver service to new devices providing complete IoT connectivity.
- 5G will support massive IoT and enable applications based on ultra-reliable, low-latency communications.

Are testing standards in place for IoT devices and networks?

- IoT devices operating above 30 MHz and below 6 GHz will be covered by existing international technical compliance testing standards for wireless devices and networks.
- Where the devices are operating at higher frequencies, they will be covered by the updated testing standards that are under development for 5G devices.
- Some IoT devices will be exempt from testing because their very low power combined with intermittent transmission,

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Some toys now have radio transmitters installed, are these safe?

- These transmitters are regarded as safe as they are required to comply with relevant exposure limits.
- The radio transmitters in toys are generally low power and short range and many use familiar technologies such as Wi-Fi and Bluetooth

Some of the devices may be powered by harvesting energy from the radio signals all around us. If that is possible, what does it mean for my exposure?

- As the level of RF signals in the environment is low this is only suitable for devices with very low energy requirements.
- The ability to extract energy from ambient radio signals has a major advantage in reducing the need for batteries or significantly extending battery life.
- A specialised circuit converts some of the ambient RF energy into electrical power to charge a battery.
- This may be useful for very low power devices, such as sensors that could be positioned in large numbers to monitor the environment or traffic, and which transmit small amounts of data at intervals.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

How will 5G support the Internet of Things?

- 5G is optimized to support the Internet of Things (IoT) in three major areas.
- Low data rate IoT applications such as sensors or identification trackers with long service lifecycles and that may need to be connected over very long distances will use recently developed 3GPP technologies.
- As standards evolve, 5G will make it possible to manage large numbers of such connected objects even more effectively.
- 5G can support new high speed IoT applications, for example 4K cameras and control of drones.
- A new opportunity enabled by 5G is critical IoT applications requiring unparalleled reliability (99.999%) and extremely low latency (1 ms minimum).
- Example applications include connected vehicles, health equipment and industrial applications such as remote control of machines.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Will large numbers of connected objects increase exposure to radio signals?

- Even if there are many connected objects in the future, levels of exposure to radio waves will not change significantly as connected objects will be very low power and will transmit only intermittently.
- In general, the quantity of data to be exchanged will be very small.
- It is very important for many connected objects (IoT) applications that use of energy is minimized to extend battery life.
- Portable and wearable devices are a sub-category of IoT devices intended for use close to the human body.
- The radio transmitters in wearable devices generally operate at very low power to conserve battery life and often use familiar technologies such as Wi-Fi and Bluetooth.
- Generally, the devices only transmit at intervals and over short distances, for example, to a nearby smartphone, tablet or laptop, and therefore, exposure is very low.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Is it safe to wear wireless devices continuously?

- The international exposure limits for the public have been designed to be protective even in the case of continuous exposure, 24 hours a day, 365 days per year.
- The radio transmitters in wearable devices generally operate at very low power to conserve battery life and often use familiar technologies such as Wi-Fi and Bluetooth.
- Generally, the devices only transmit at intervals and over short distances, for example, to a nearby smartphone, tablet or laptop.
- Some devices will be exempt from testing because their low power or intermittent transmission means that they are certain to comply with the relevant exposure limits.
- Other devices are tested using international technical standards to ensure compliance.

Are testing standards in place for wearable devices?

- Wearable devices operating above 30 MHz and below 6 GHz will be covered by existing testing standards for wireless devices.
- Where the devices are operating at higher frequencies, they will be covered by the testing standards that are under development for 5G devices.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

What about children wearing RF transmitting devices, for security or entertainment?

- The radio transmitters in such devices are generally very low power and relatively cover short range.
- When tested they are required to comply with national or international exposure limits.
- When watching a video, the device is mostly receiving information and only transmits information for brief periods.
- Other types of devices such as personal trackers also transmit for short periods of time.

We see devices advertised for use with babies, for example, sleep monitors. Are they safe?

- The radio transmitters in baby monitors are generally low power and relatively cover short range.
- When tested they are required to comply with national or international exposure limits.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Are smart watches safe to use when driving?

Driver distraction is a risk factor for accidents and role of mobile phones is the subject of extensive research and regulation.

- **Activities that involve drivers taking their eyes off the road are not desirable.**
- **Some governments recommend that calls should not be taken while driving.**
- **There is little published research assessing the specific impact of smart watches on driver distraction.**
- **In many countries it is illegal to use a mobile phone while driving unless used with an appropriate hands-free kit.**
- **A hands-free device can reduce the physical effort to make and receive calls, however, it alone does not make using a mobile phone while driving safe.**
- **Drivers should always keep both eyes on the road and not read, write or send messages or look at the Internet. Also, they should not email or take notes during a call while driving.**
- **Operators should make efforts to promote compliance with national laws and responsible mobile phone use by drivers.**

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

Are smart watches safe to use when driving?

- Driver distraction is a risk factor for accidents and role of mobile phones is the subject of extensive research and regulation.
- Activities that involve drivers taking their eyes off the road are not desirable.
- Some governments recommend that calls should not be taken while driving.
- There is little published research assessing the specific impact of smart watches on driver distraction.
- In many countries it is illegal to use a mobile phone while driving unless used with an appropriate hands-free kit.
- A hands-free device can reduce the physical effort to make and receive calls, however, it alone does not make using a mobile phone while driving safe.
- Drivers should always keep both eyes on the road and not read, write or send messages or look at the Internet. Also, they should not email or take notes during a call while driving.
- Operators should make efforts to promote compliance with national laws and responsible mobile phone use by drivers.

Rakesh Kumar Bhatnagar, bhatnagarrk@gmail.com, +91 9868133450/ 9350836103/ 7011550321

QUESTIONS, if any before
Session Closure or even later

bhatnagarrk@gmail.com
+91 9868133450/ 9350836103/ 7011550321