

# NEW TECHNOLOGY TRENDS IN WIRELESS



# WHY DO WE NEED TECHNOLOGY ??

- ▶ We need it to stay SAFE with the help of early disaster warning system. (NDMA)
- ▶ To be THERE with our loved ones while living continent apart. (Skype)
- ▶ To eat HEALTHIER. (NARC)
- ▶ To travel FASTER and safer.
- ▶ To TEACH our children with international standards. (E-Learning)
- ▶ To CONNECT with others. (Social Media)
- ▶ To Monitor and to Maximize the production of our factories.
- ▶ To INFINITY and BEYOND

None of this has been possible without the global research on internet. Lifting all the communication barriers, connecting everyone and bringing the best out of everything.

Now to strive for better we need to emphasize the medium and to bring in the latest technology of 5G.

# 5G

The Next Generation Mobile Networks (NGMN) Alliance defines 5G as:

“5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation toward customers and partners, through existing and emerging use cases delivered with consistent experience and enabled by sustainable business models.”

5G promise massive potential for consumers and industries by speculating a much faster network than existing technology. 5G offers a broad range of applications with great social and economic value, leading to a ‘hyper-connected society’.

# 5G USE CASES



**UHD/Multi-angle Streaming**

**N-W enabled Mobile-Hyper Cloud**



**Virtual & Augmented Reality**



**Remote HealthCare**



**Hologram Gaming Tele-presence**

Source1: NGMN 5G Initiative White Paper: A Deliverable by the NGMN Alliance 17-February-2015

Source2: SK Telecom 5G White Paper: SK Telecom view on 5G vision, Architecture, Technology, Service and Spectrum. 20-October-2014

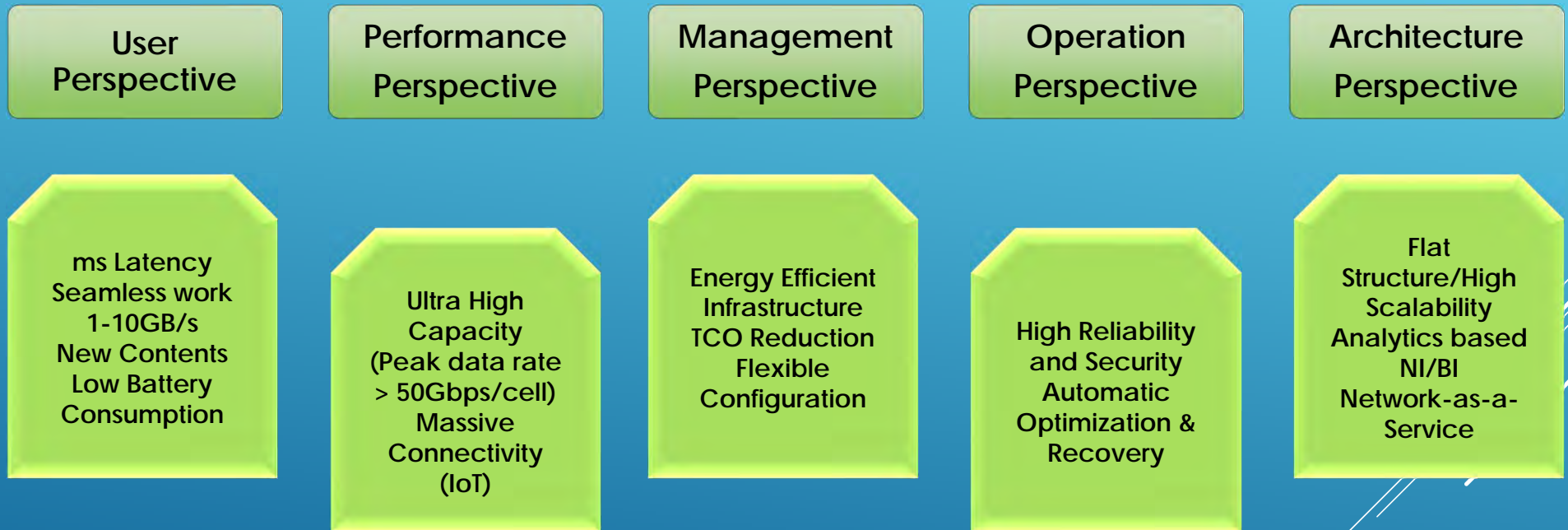
# LTE ADVANCED

- ▶ LTE Advanced is the bridge between 4G and 5G.
- ▶ It is the evolution of the original LTE technology toward even higher bandwidths.
- ▶ LTE-A promises nearly three times greater speed than the basic LTE network
- ▶ Basic building blocks of LTE-A are
  - ❑ Carrier Aggregation
  - ❑ Increased MIMO
  - ❑ Coordinated Multipoint (CoMP)
  - ❑ Relay Station
  - ❑ Heterogeneous Network or HetNet

# PATH TO 5G

- ▶ Basic Purpose is to continue to evolve the current LTE standard towards reaching the 5G specifications.
- ▶ The standard looking to become a rather large, all-encompassing wireless communication system that not only caters for faster data speeds, but also supports many more devices online at the same time with greatly reduced latency.
- ▶ Groups working on the early trials of 5G has come up with two views
  - ❑ **The Hyper-Connected Vision:** create a blend of pre-existing technologies covering 2G, 3G, 4G, Wi-Fi and others to allow higher coverage and availability enabling M2M/D2D & IoT.
  - ❑ **Next-Generation Radio Access Technology:** This is more of the traditional ' generation-defining' view, with specific targets for data rates and latency being identified, such that new radio interfaces can be assessed against such criteria.

# 5G REQUIREMENTS



# SPECTRUM REQUIREMENTS

## ▶ **Suitability of Existing bands**

To support a wide range of applications will require access to a range of spectrum bands with differing characteristics in order to address a wide range of requirements for coverage, throughputs and latency in the most cost efficient manner and to make effective use of the spectrum.

## ▶ **Additional Network Spectrum Requirements**

Additional spectrum allocations to support 5G requirements should be identified within the global framework provided by the ITU Radio Regulations and implemented in regional and national allocation and assignment decisions.

## ▶ **Need for backhaul network spectrum**


In addition to fixed line backhaul solutions, for some scenarios wireless backhaul solutions using in-band or out-of-band spectrum may be required.

Source1: 3GPP RAN workshop on 5G, 17-18. September 2015 :The road to 5G Orange vision and priorities for Next Generation Radio Technology

Source2: Ericsson White paper on 5G radio access: February 2015



## CONT.....

- ▶ License-exempt use of spectrum may be a useful supplement for certain applications.
  - ▶ Explore flexible utilization of MNO's licensed bands.
  - ▶ Optimized coexistence with other radio technologies and dynamic use of radio resources
  - ▶ Smart carrier aggregation to benefit from any spare frequencies.
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# CHALLENGES

## ▶ **Capacity**

Increasing cell numbers will be a much efficient way to improve the system capacity. However, it is impossible to increase the number of the current small cells by orders of magnitude due to compatibility, cost, interference, cell management and cell sites.

## ▶ **Spectrum Impact**

A global consensus is forming that 500 MHz to 1 GHz BW of additional mobile spectrum is needed for future generations. Exactly how, all available and new IMT bands will be used to achieve 1 Gb/s for an individual end user is a major challenge to design working 5G systems.

## ▶ **Energy Consumption:**

Network energy efficiency will remain very important in the future and is a key requirement for 5G.

## ▶ **Reliability and Low-Latency**

The combination of extreme reliability and ultra-low latency provides a particularly interesting challenge. This will require different trade-offs and design choices than those made for today's mobile broadband systems.

# ITU RECOMMENDATIONS

- ▶ ITU established the overall roadmap for the development of 5G mobile and defined the term it will apply to it as “**IMT-2020**”.
- ▶ With the finalization of its work on the “Vision” for 5G systems, ITU has now defined the overall goals, process and timeline for the development of 5G mobile systems. This process is now well underway within ITU, in close collaboration with governments and the global mobile industry.
- ▶ The next step is to establish detailed technical performance requirements for the radio systems to support 5G, taking into account the needs of a wide portfolio of future scenarios and use cases, and then to specify the evaluation criteria for assessment of candidate radio interface technologies to join the IMT-2020 family.

## CONT....

- ▶ The ITU is expected to start distributing the international spectrum for 5G network in 2019.
- ▶ The upcoming 5G network, according to the ITU, would be capable of transmitting data at up to 20Gbps (Gigabits-per-second), allowing the download of ultra high-definition movie in 10 seconds.
- ▶ Additionally, the network would be capable of providing more than 100Mbps (Megabits-per-second) average data transmission to more than one million Internet of Things devices within 1km sq.

# 5G IN PAKISTAN

- ▶ Pakistan has just stepped into the 4G phase and is still groping to strengthen its position. The 4G phase needs to be perfected before going on towards the 5G stage. Experts believe that Pakistan will be able to move towards 5G in the next 5 to 6 years.
- ▶ A 5G forum in Pakistan has been established in which high quality research in 5G and related technologies are to be performed through an effective coordination between academia, telecom industry, OEMS and regulators.
- ▶ This will lead to contribution in the development of international technology standards as well as commercialization of technologies such as IoT (Internet of Things) in the local market.

# CLOUD COMPUTING

- ▶ Cloud computing is an Internet-based computing that provides shared processing resources and data to computers and other devices on demand.
- ▶ It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services), which can be rapidly provisioned and released with minimal management effort.



Source 1: [https://en.wikipedia.org/wiki/Cloud\\_computing](https://en.wikipedia.org/wiki/Cloud_computing)

Source 2: <https://www.ibm.com/cloud-computing/what-is-cloud-computing>

# CLOUD CHARACTERISTICS

- ▶ **On-Demand Self-Service.**

A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

- ▶ **Broad Network Access.**

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

- ▶ **Resource Pooling.**

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model.

- ▶ **Measured Service.**

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts).

- ▶ **Rapid Elasticity.**

Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand

# SERVICE MODELS

## ► Software as a Service (SaaS)

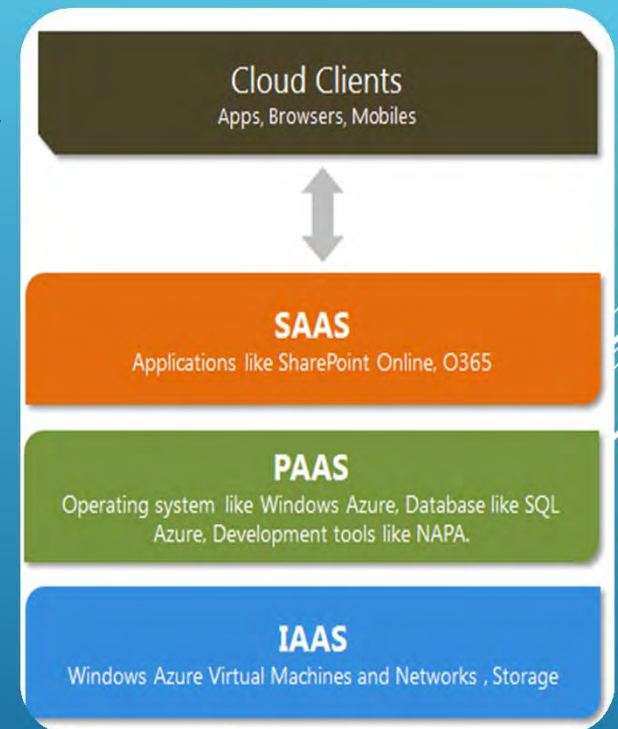
The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure.

## ► Platform as a Service (PaaS)

The capability provided to the consumer is to deploy onto the cloud infrastructure. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

## ► Infrastructure as a Service (IaaS)

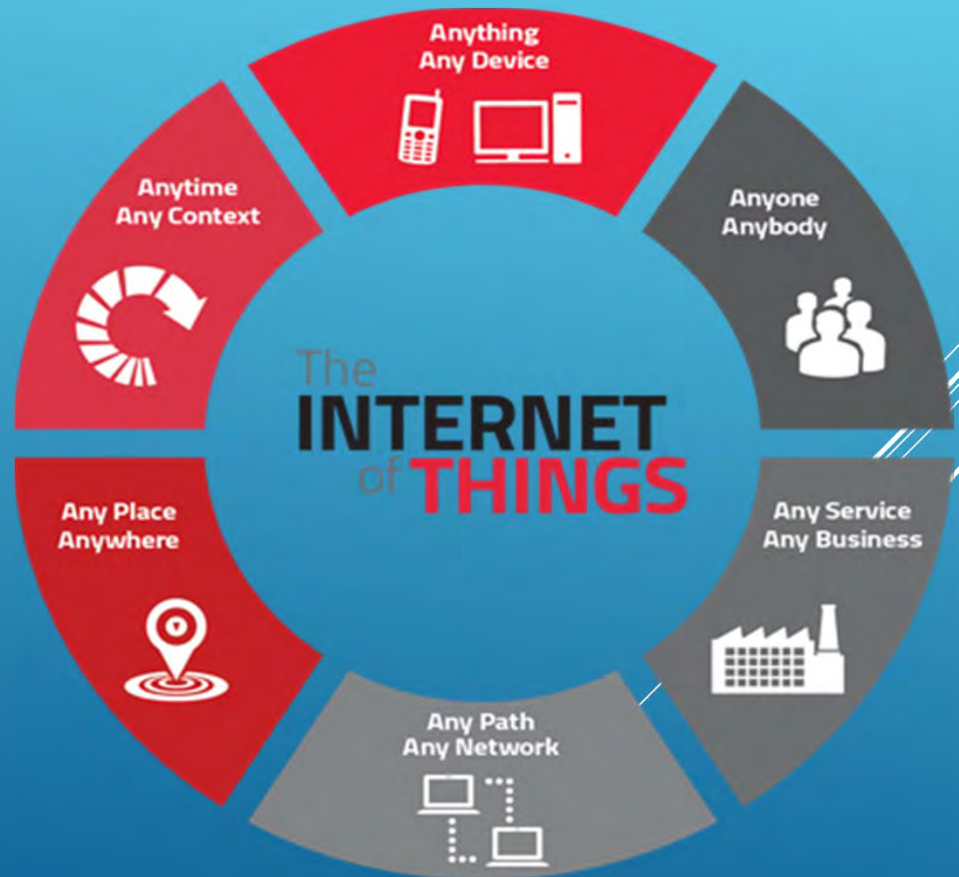
The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications.





# INTERNET OF THINGS (IOT)

- ▶ A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.  
*Recommendation ITU-T Y.2060*



# APPLICATIONS



## ➤ SMART HOMES

- ❑ Smart Home is the residential extension of building automation and involves the control and automation of lighting, heating, ventilation, air conditioning, appliances, and security
- ❑ Smart Home clearly stands out in the ranking as highest IoT application. The total amount of funding for Smart Home startups currently exceeds \$2.5bn.

## ➤ UBER

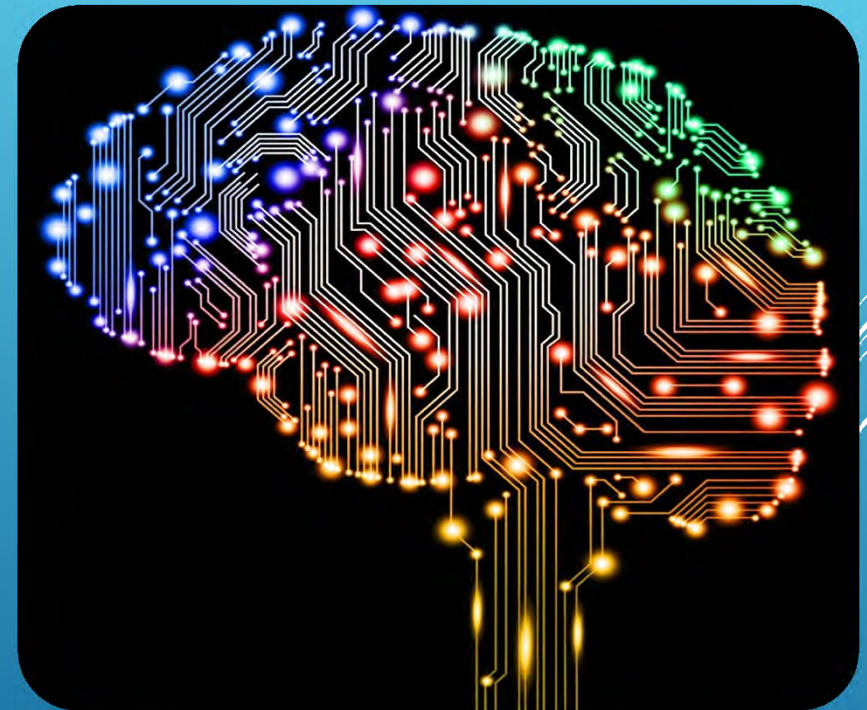
- ❑ New business and consumption model
- ❑ Drivers work when they want
- ❑ Modernizing Economy



Source: <http://tblocks.com/internet-of-things/>

# ARTIFICIAL INTELLIGENCE

- ▶ **Artificial intelligence (AI)** is the intelligence exhibited by machines.
- ▶ An ideal "intelligent" machine is a flexible rational agent that perceives its environment and takes actions that maximize its chance of success at an arbitrary goal.
- ▶ The term "artificial intelligence" is likely to be applied when a machine uses cutting-edge techniques to competently perform or mimic "cognitive" functions that we intuitively associate with human minds, such as "learning" and "problem solving".



# APPLICATIONS

## ➤ Intelligent Robots

An intelligent robot has many different sensors, large processors and a large memory. The robots will learn from their mistakes and be able to adapt to any new situation.

- Work 24/7, 365 days/year.
- Cheaper; not getting paid.
- More accurate
- Safer than sending a human into dangerous places.



## ➤ Artificial Neural Systems (ANS)

A neural network is an electronic model of the brain consisting of many interconnected simple processors. This imitates how your actual brain works.

- Learning to read postcodes
- Stock market prediction
- Debt risk assessment

Source: <http://eng-cs.syr.edu/research/artificial-intelligence>

# Examples

## Games playing Robots



## Automated Cars



## Drones



## Search Engines

THANK YOU

The image features a blue gradient background. In the center, the words "THANK YOU" are written in a white, sans-serif font. In the bottom right corner, there are several white, parallel diagonal lines of varying lengths, creating a sense of motion or a modern design element.