A 6G VISION
What will 6G offer to vertical industries & future perspectives
ICS
Home of 5 and 6GIC

Regius, FREng
Professor
Rahim Tafazolli
Director Institute for Communication Systems (ICS), 5GIC & 6GIC
ART OF POSSIBLE

WINNER OF ROYAL ACADEMY OF ENGINEERING (RAEng) 2021 FOR BEST INDUSTRY-ACADEMIA COLLABORATION
IMT 2030 (6G): INTEGRATED COMMUNICATIONS & SENSING

WHY
- ENVIRONMENT
- SOCIETY
- ECONOMY

HOW
- ULTRA HIGH ENERGY EFFICIENCY
- RELIABILITY PRIVACY & TRUST
- DIGITAL DIVIDE
- FULL 5G CAPABILITY
- CLEAR USE CASE
- CLEAR BUSINESS CASE

WHAT
- 4D VIDEO (TELEPORTATION)
- INTELLIGENT SURFACES
- SENSING
- NET OF NETWORKS

* R. TAFAZOLLI, FUTURE WIRELESS WORLD, TEDx 2015
**INTEGRATED COMMUNICATION AND SENSING (ICS)**

Figure 1: 6G vision supported by new cross-functional research and development programme

**6G RESEARCH CHALLENGES**

- **4-D video (teleportation)**
- **Making invisible things visible**
- **Enhanced Edge to User Environment**
- **Direct satellite-to-user through beam forming satellite MiMo**
- **Large Intelligent Surfaces**
- **Ultra (massive) Antenna arrays for distributed (hybrid) MiMo**

**New service possibilities through extending human senses in a fusion of the virtual and physical worlds**

**Infrastructure research to deliver coverage ubiquity for the new services**

- **Super fine time synchronisation**
- **Ultra high accuracy geolocation**
- **Exceptionally low latency**
- **AI and Quantum**
- **Sensing (terahertz)**
- **“Memoryful” networking**

**Multi-disciplinary research into key enabling technologies eg new materials, synthetic biology**

**INTEGRATED COMMUNICATION AND SENSING (ICS)**
Future Networks: Basic Principle

SENSING: EYES

SEMANTICS & AI: BRAIN
(INFERENCE & LEARNING)

SYNCHRONISATION: HEARTBEAT

VIRTUALISATION (SOFTWAREIZATION): FREEDOM
Towards Ubiquitous 3D Open and Resilient Network (TUDOR)
SENSING

- Enhances efficiency at all layers of communications: Radio, network protocols & system
- Improves energy & spectrum efficiency
- Enable smarter applications

Two broad categories of Sensing:

- System (network) level
- User level (ambient information)
**System-Level Sensing & Communication**

- **Traffic Sensing**
  - Interference Management
  - Camera

- **Earth Observation/Sensing**
  - Various applications incl: Security
  - Various cameras

- **Traffic Location and Mobility Sensing**
  - Resource Management, Beam Forming & Tracking

- **EM Sensing**
  - Intelligent Surfaces with Metamaterial
  - Coverage Extension

- **Change of Environment (Channel) Sensing**
  - Camera Radar/Lidar
  - Channel Equalization

- **Various applications incl: Security**

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**Thursday, 20 April 2023**
INTERACTIVITY BETWEEN AND WITHIN

VIRTUAL AND PHYSICAL WORLDS
Interactivity in Cyber World with Ambient Senses around a User

Live and interactive teleportation of multiple objects from different network locations

Enabled by High Quality Time Synchronisation
New Generation of Use cases enabled with Interactivity

ENABLED BY LOW LATENCY AND RELIABILITY

- CONNECTED VEHICLES
- MANUFACTURING
- GAMES/ENTERTAINMENT
- HEALTH
- EDUCATION
- ...

ENABLED BY LOW LATENCY + TIME SYNCHRONISATION

- HIGH SPEED DRIVER-LESS AND COOPERATIVE DRIVING
- INTERACTIVE COOPERATIVE MANUFACTURING
- INTERACTIVE AGRICULTURE
- INTERACTIVE ENTERTAINMENT
- INTERACTIVE TELECARE
- INTERACTIVE TELE-EDUCATION
- .......
USER-LEVEL SENSING & COMMUNICATIONS

ACTIVITY DETECTION AND LOCATION ESTIMATION (SUB-CM) AND REAL-TIME TRACKING

THz IMAGING
Teleportation

VR + SYNCHRONISATION + USER LEVEL SENSING INFORMATION
IMT 2030: Integrated Communication and Sensing in 3D Network of Networks

**Coverage**
- Digital inclusion,
- Environment sustainability
- EE coverage extension
- Network of Networks

**Synchronisation**
- 4D video, physical & virtual worlds
- Interactivity Driverless transportation
- Interactive e-Health,…..
- Interactive robotics

**Sensing**
(Human and environment and Network sensing)
- Geo-location
- Environmental information
- Natural interactivity between physical & virtual worlds
- Resources efficiency
- Many new smart services,

**Teleportation:**
- VR + Synchronisation + User Level Sensing

Ultra Energy Efficient Coverage Extension
THANK YOU