

Radiocommunications and Artificial Intelligence (AI)

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- **Three main areas of activity** organized in "**Sectors**":

- Development
- Radiocommunications
- Standardisation



- **Radiocommunications:**

Telecommunications carried out through radio waves : satellites, radio, television, mobile telephony, wireless networks, radar, etc.

- The ITU Radiocommunication Sector is responsible for **the international management of the radio-frequency spectrum and the satellite orbits.**

ITU-R study groups

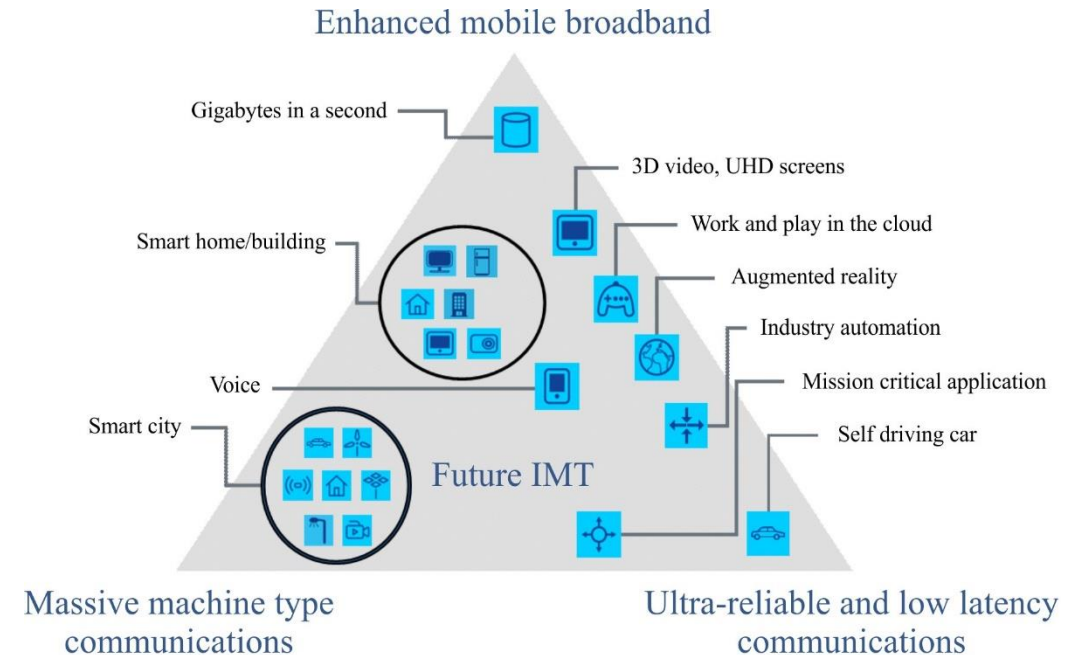


- Study Group 1 (SG 1): Spectrum management
- Study Group 3 (SG 3): Radiowave propagation
- Study Group 4 (SG 4): Satellite services
- Study Group 5 (SG 5): Terrestrial services
- Study Group 6 (SG 6): Broadcasting service
- Study Group 7 (SG 7): Science services

AI and IMT-2020 (5G)



- **IMT-2020/5G** will provide necessary connectivity for **AI** by supporting smart cities, smart homes, 3D video, augmented reality, work and play in cloud, industry automation and self-driving cars
- **AI** will make **IMT-2020/5G** more intelligent empowering 5G network slicing, cloud networking, virtualization and self-organizing networks



M.2083-02

Most recent ITU-R publications on IMT-2020/5G :

Recommendation ITU-R M.2083: *IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond*

Report ITU-R M.2320: *Future technology trends of terrestrial IMT systems*

AI and Internet of Things (IoT)



- ITU-R is studying **IoT** (Machine Type Communications) where objects will be connected through IMT networks, dedicated networks and short-range radio devices (SRDs)
- **AI** will contribute to processing and analysis of big data generated by **IoT**
- In turn, IoT will be the main part of massive data availability which is an important contributor to **AI**



AI and Internet of Things (IoT) (continued)

Some examples of AI related IoT applications:

- Traffic and transportation system management
- Smart parking system:
- Smart freight and inventory management
- Active Implantable Medical Devices (AIMD)

Most recent ITU-R publications on IoT:

Resolution ITU-R 54: *Studies to achieve harmonization for SRDs*

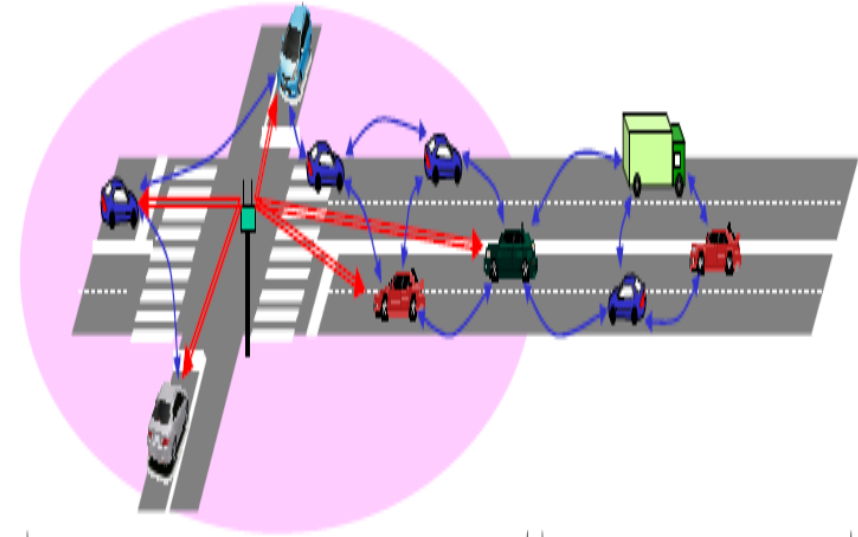
Resolution ITU-R 66: *Studies related to wireless systems and applications for the development of the Internet of Things*

Recommendation ITU-R M.2002: *Objectives, characteristics and functional requirements of wide-area sensor and/or actuator network (WASN) systems*

AI and Intelligent Transport Systems (ITS)



- ITU-R developed several outputs on **ITS** connectivity and advanced **ITS** radiocommunications, which would be a key enabler of self-driving cars
- **AI** will contribute to analysis of **ITS** data for vehicle control and traffic prediction
- Self-driving cars will be one of the main **AI** applications



Most recent ITU-R publications on ITS:

Report ITU-R M.2228: *Advanced intelligent transport systems radiocommunications*

Rec. ITU-R M.1890: *Intelligent transport systems*

ITU-R Land Mobile Handbook

Vol.4 – Intelligent Transport System

AI and Intelligent Transport Systems (ITS) (continued)

Some AI-related applications of the ITS

Application	Use case
Speed management	Regulatory/contextual speed limits notification
	Traffic light optimal speed advisory
Cooperative navigation	Traffic information and recommended itinerary
	Enhanced route guidance and navigation
	Limited access warning and detour notification
	In-vehicle signage
Location based services	Point of interest notification
	Automatic access control and parking management
	ITS local electronic commerce
	Media downloading

Application	Use case
Driving assistance – Cooperative awareness	Emergency vehicle warning
	Slow vehicle indication
	Intersection collision warning
	Motorcycle approaching indication
Driving assistance – Road Hazard Warning	Emergency electronic brake lights
	Wrong way driving warning
	Stationary vehicle – accident
	Stationary vehicle – vehicle problem
	Traffic condition warning
	Signal violation warning
	Roadwork warning
	Collision risk warning
	Decentralized floating car data – Hazardous location
	Decentralized floating car data – Precipitations
	Decentralized floating car data – Road adhesion
	Decentralized floating car data – Visibility
	Decentralized floating car data – Wind

AI and Satellite applications



- **AI** is applicable to many aspects of the satellite ecosystem, including system manufacturing, in-orbit management and image processing.
- In the transportation sector, satellite information and capabilities can be combined with IoT sensor data to enable streamlined operations for shipping and airline activity.
- **AI** will facilitate next-generation satellite systems to be autonomous, with a dynamic resource manager that will be capable of making decisions and adjusting coverage, capacity and spectrum as needed.



Most recent ITU-R publications on Satellite applications:

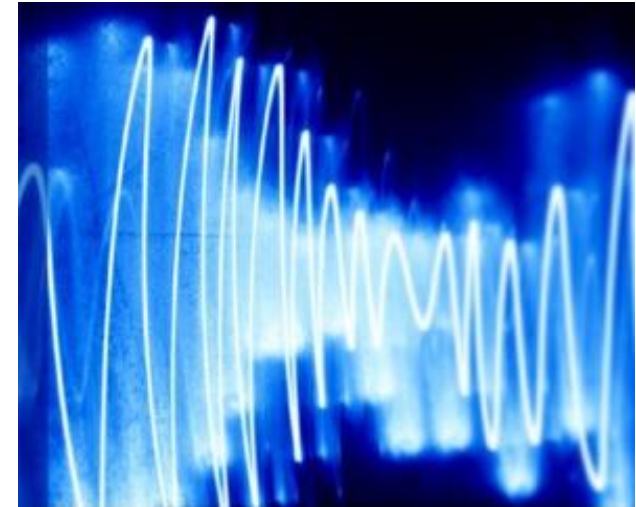
[Report ITU-R S.2357](#): *Technical and operational guidelines for earth stations on mobile platforms communicating with geostationary space stations in the fixed-satellite service in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz*

[Report ITU-R S.2361](#): *Broadband access by fixed-satellite service systems*

AI and Spectrum Monitoring



- Spectrum monitoring has always been the eyes and ears of spectrum management processes to facilitate planning, maximize efficiency, minimize interference and eliminate unauthorized and improper use of the spectrum.
AI may be the next computer-aided techniques enhancing the automation of spectrum monitoring tasks which become more and more complex with the development of new radio technologies.
- As such, **AI** may bring new solutions and opportunities for instance for the signal recognition, the real-time monitoring of multiples auto-signalling equipment and devices, and/or the identification of sources of interference.



Most recent ITU-R publications on Spectrum Monitoring:

Resolution ITU-R 22: *Improvement of national radio spectrum management practices and techniques*

Report ITU-R SM.2355: *Spectrum monitoring evolution*

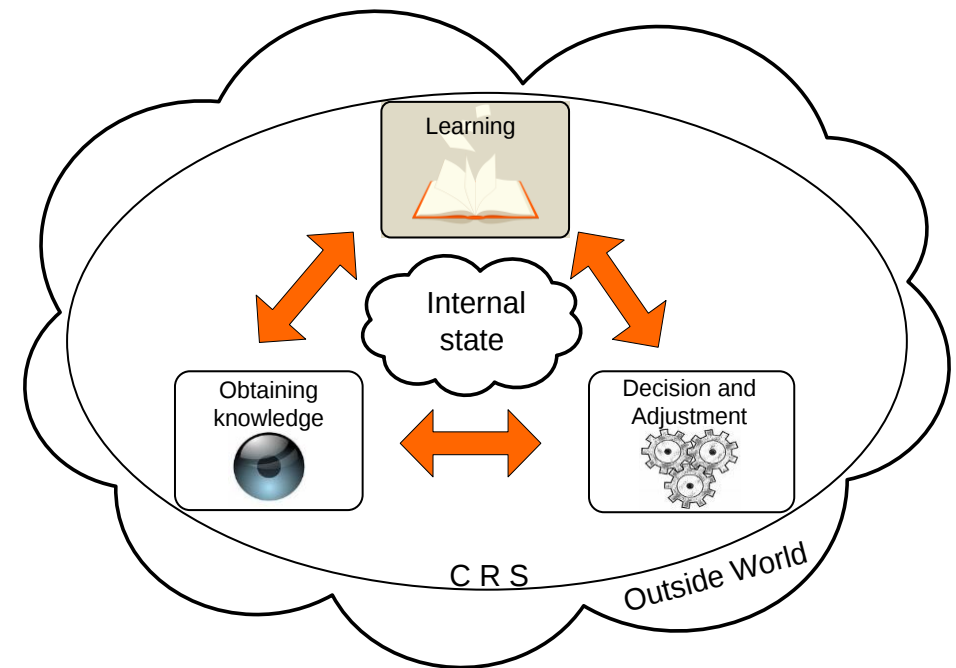
AI and Cognitive Radio System (CRS)



CRS is characterized by three capabilities:

1. to **obtain the knowledge** of its radio operational and geographical environment, its internal state, and the established policies, as well as to monitor usage patterns and user preferences;
2. to dynamically and **autonomously adjust** its operational parameters and protocols according to the knowledge; and
3. to learn from the results of its actions in order to further **improve** its performance.

Illustration of cognitive radio system concept



AI and Cognitive Radio System (CRS) (continued)



ITU-R has studied CRS where **AI** could play an important role in intelligent/dynamic assignment of radio channels

Most recent ITU-R publications on CRS:

[Resolution ITU-R 58](#): *Studies on implementation and use of CRS*

[Report ITU-R SM.2152](#): *Definitions of Software Defined Radio (SDR) and Cognitive Radio System (CRS)*

[Report ITU-R SM.2405](#): *Spectrum management principles, challenges and issues related to dynamic access to frequency bands by means of radio systems employing cognitive capabilities*

[Report ITU-R M.2225](#): *Introduction to cognitive radio systems in the land mobile service*

[Report ITU-R M.2242](#): *Cognitive radio systems specific for International Mobile Telecommunications systems*

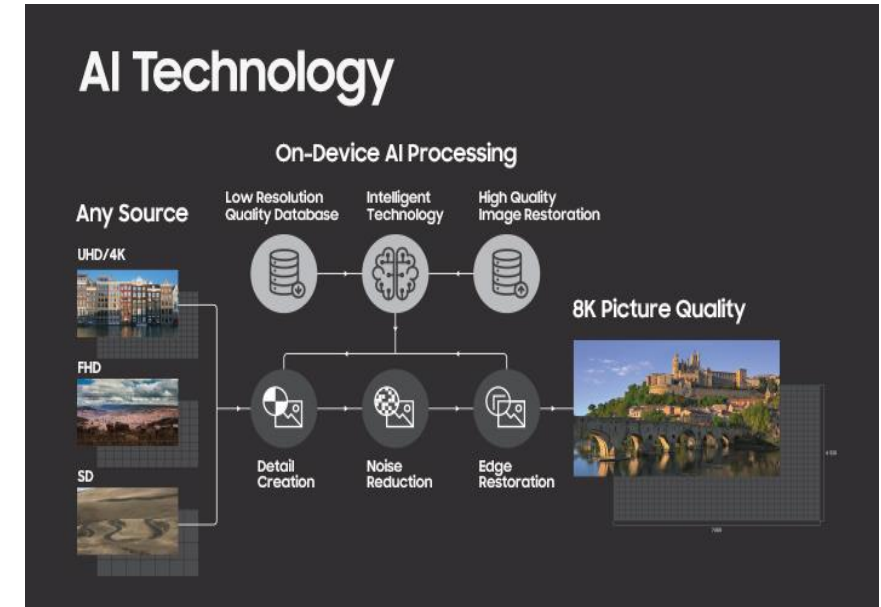
[Report ITU-R M.2330](#): *Cognitive radio systems (CRSs) in the land mobile service*

AI and Broadcasting



AI will be used in broadcasting

- **Programme production:** Data mining, big data analysis, Language translation, Text-voice/voice-text translation, Visual/speech recognition, Metadata extraction, Assisted editing, Autonomous, robotic shooting, Object tracking, Format conversion for video and sound, Semantic annotation of content, Automated summarization, System monitoring and diagnosis,
- **Audio and visual quality evaluation:** Subjective evaluation, Quality of Experience metrics
- **Programme assembling and access:** Audio and video data compression, Early warning of emergencies, disaster prevention and relief, Recommendation to audience, Access service for people with disabilities, System monitoring and diagnosis
- **Broadcast emission:** Network planning, System monitoring and diagnosis



[Report ITU-R BT.2447](#): Artificial intelligence systems for programme production and exchange

AI and

- **IMT-2020 (5G)**

IMT-2020 will provide necessary connectivity for AI. In turn, AI will make 5G more intelligent, by contributing to network slicing, cloud networking, virtualization and self-organizing networks.

- **Internet of Things (IoT)**

AI will contribute to processing and analysis of big data generated by IoT. In return, IoT will create massive data which is an important contributor to AI.

- **Intelligent Transport Systems (ITS)**

AI will contribute to the analysis of ITS data for vehicle control and traffic prediction. Self driving cars could be one of the main AI applications.

- **Satellite applications**

AI will facilitate next-generation satellite systems to be autonomous, with a dynamic adjustment of coverage, capacity and spectrum.

AI and

- **Spectrum Monitoring**

AI may be the next computer-aided technique enhancing the automation of spectrum monitoring tasks which become more complex with the development of new radio technologies.

- **Cognitive radio system (CRS)**

AI will play an important role in intelligent/dynamic assignment of radio channels to CRS, to make efficient utilization of unused parts of spectrum.

- **Broadcasting**

AI will be used in broadcasting: for Programme production, Audio and visual quality evaluation, Programme assembling and access and Broadcast emission

More information: <https://www.itu.int/en/action/ai/emerging-radio-technologies/>

Thank you