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HIGH-LEVEL EVENT 2024

Joint ITU-D FNS and ITU-T SG15 workshop

Challenges and solutions for broadband infrastructure deployment in developing countries, rural and remote areas

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ITU-D FNS

Challenges and solutions for broadband infrastructure deployment in developing countries, rural and remote areas

Part 1
Measuring digital development
ITU Strategic Goal of Universal Connectivity by 2030

Walid Mathlouthi
ITU - Head of the Future Networks & Spectrum Management Division (FNS)

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ITU-D FNS
Future Networks and Spectrum Management
Who we are - What we do - Why we matter

- Reliable Connectivity to Everyone

  Products and services such as assessment studies, publications, workshops, guidelines, and best practices on telecommunication/ICT infrastructure including wireless and fixed broadband, connecting rural and remote areas, conformance and interoperability, spectrum management, transition to digital broadcasting, the effective and efficient management and proper use of telecommunication resources within the mandate of ITU.

- The objective of the Network & Digital Infrastructure program

  Is to assist ITU Member States and ITU-D Sector Members and Associates in maximizing the use of new technologies for the development of their information and communication infrastructures and services and building global telecommunication/ICT infrastructure. It will be reached through: Increased usage of connectivity by citizens for socio-economic activities; Efficient spectrum management by professionals using advanced technics and Adoption of modern ICT infrastructure, based on international ICT standards by governmental bodies.

Our work

- Resilient and Green ICT infrastructure
- Spectrum Management and radio monitoring
- Broadband Satellite communications (LEO/MEO/GEO)
- AI and Digital Public Infrastructure
- Broadband Mapping: Connectivity Tools and Analysis for schools, refugee camps, etc.
- Emerging Technologies

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Measuring digital development

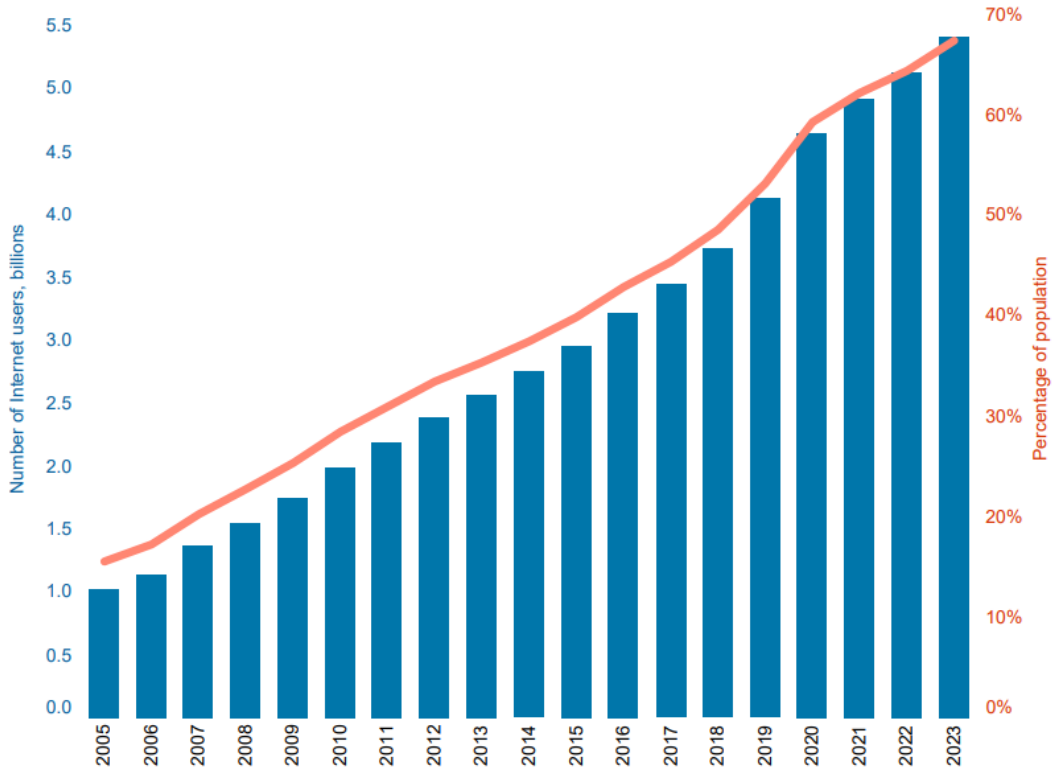
1/3 of the world's population is still offline

- Worldwide number of internet users grew at an average rate of 9.8 % yearly over nearly the last 20 years

- At the end of 2023
  - 67 % of the world's population, or 5.4 billion people had access to the Internet
  - 33 % of the global population, or 2.6 billion people was still off-line

- Broadband connectivity is progressing everywhere, but at different paces

Individuals using the Internet



Source : ITU [1]

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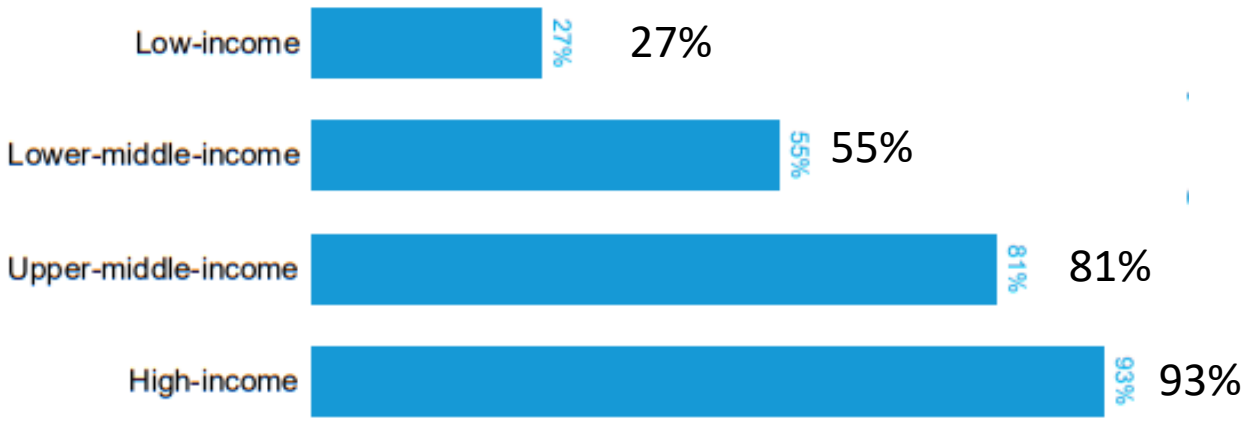
Measuring digital development

Digital divide between high-income and low-income countries

- Progress of broadband deployment depends on levels of development of the countries
- Digital disparities between high-income and low-income countries
- At the end of 2023
  - 93 % of the people in high-income countries used the Internet
  - Compared with only 27 % in low-income countries

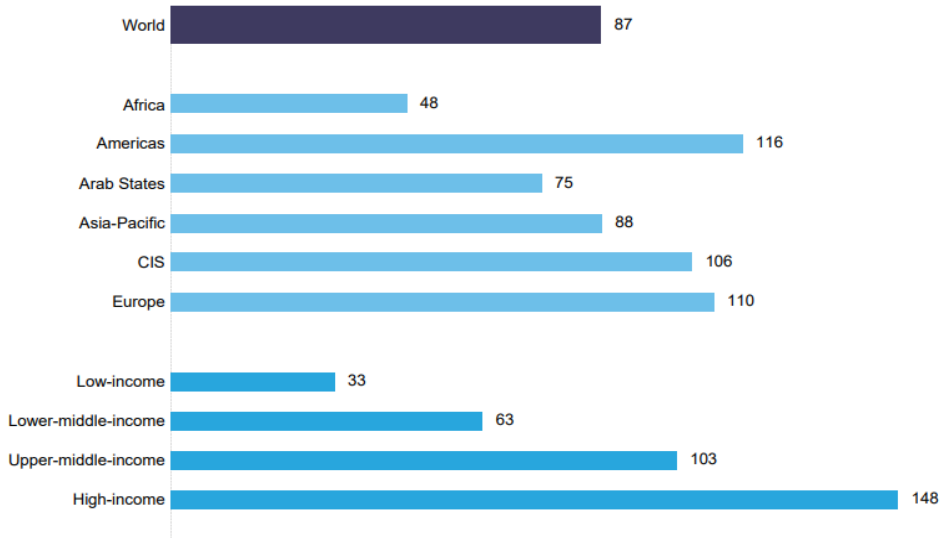
Percentage of individuals using the Internet by country income groups (2023)



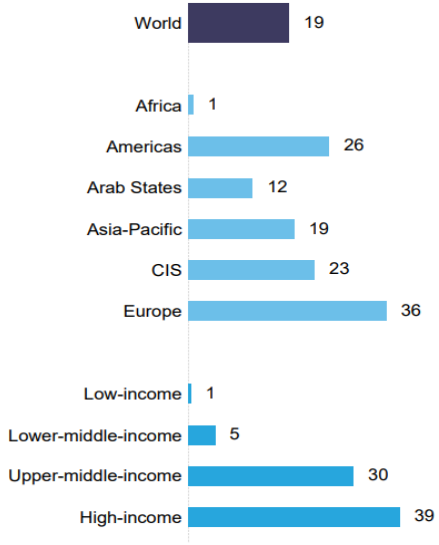
Source : ITU [1]

Measuring digital development

Mobile-broadband subscriptions per 100 inhabitants by region (2023)



Fixed-broadband subscriptions per 100 inhabitants by region (2023)



Source : ITU [1]

- Usually shared by several people in a household, fixed subscriptions penetration rates are much lower than for mobile subscriptions
- Far higher inequalities in access to fixed connections across countries than for mobile connectivity
- Fixed connections are common in high-income countries (39 subscriptions per 100 inhabitants), but are almost non-existent in low-income countries

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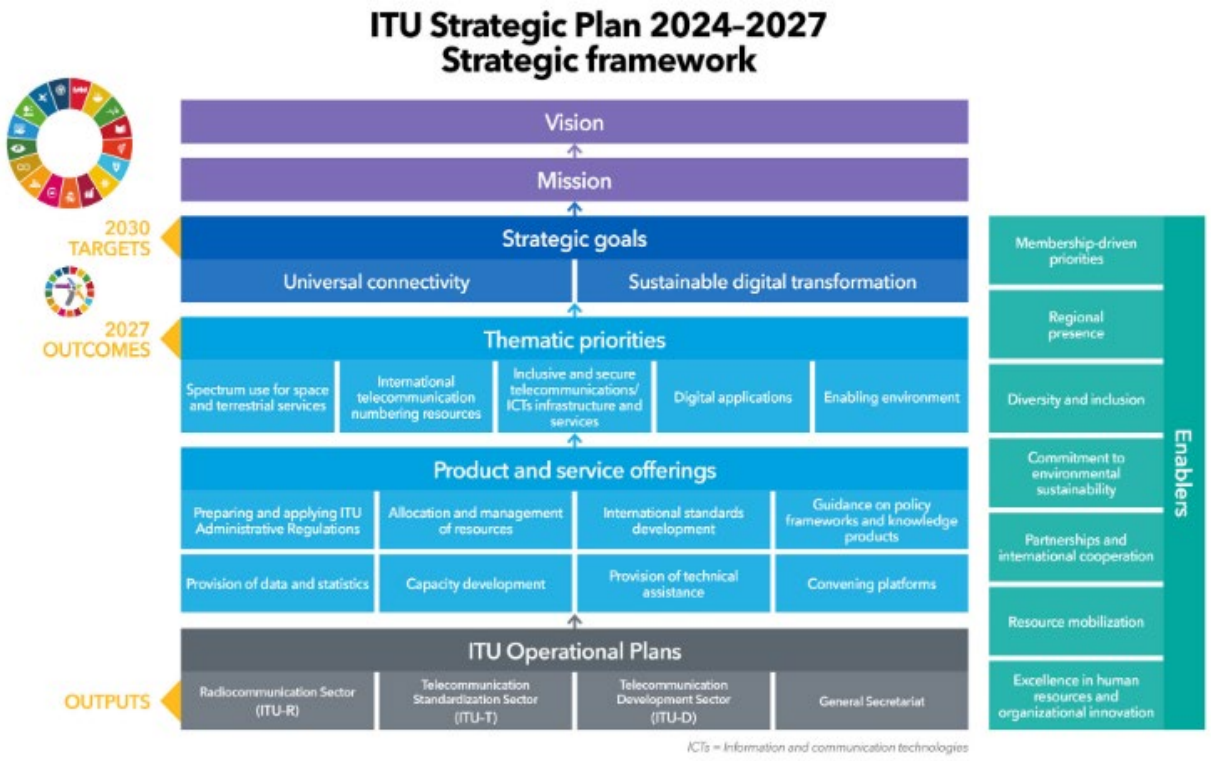
ITU Strategic Plan 2024-2027 - Goal 1

Universal Connectivity by 2030



Source: ITU

- Connecting the unconnected 2.6 billion people still living without the Internet is a truly challenging task

- Addressing the digital disparities between high-income and low-income countries as well as between urban and rural areas requires:
  - Engagement with and commitment from all local stakeholders
  - Resources mobilization
  - Innovative and affordable broadband connectivity solutions
  - Reliable business models

Universal Connectivity by 2030

Challenges to deploy broadband connectivity in developing countries, rural and remote areas

- Lack of infrastructure, reliable electricity sources, power grid and poles, towers, roads
- Lack of skilled labour force, technical experts, qualified installers and maintenance staff.
- Technological and economic considerations, Sparse population density, costs of deployment and return of investment: Require considerations of alternative business models
- Affordability: cost of devices and equipment, Conformance and Interoperability etc.

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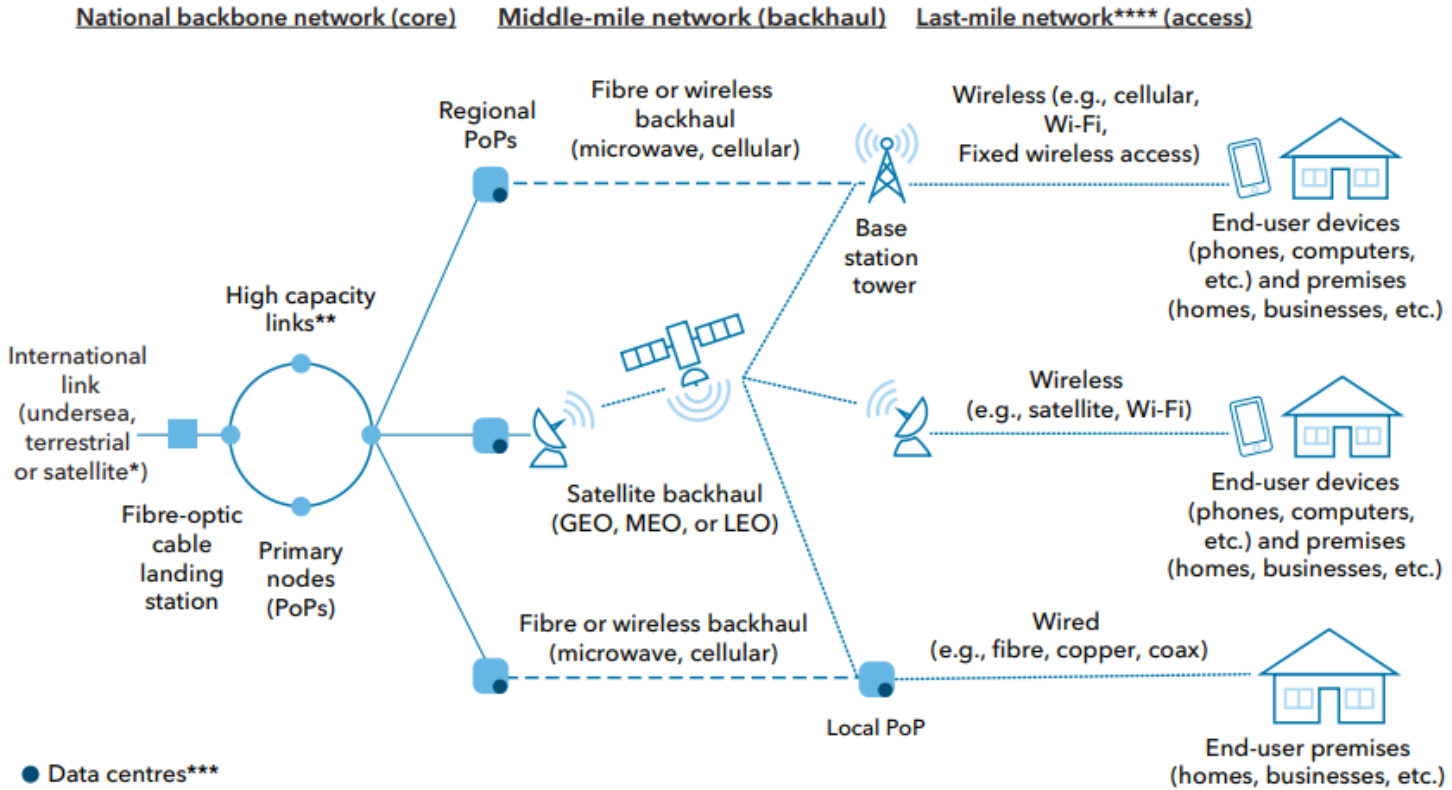
Universal Connectivity by 2030

Mobile and fixed network architecture for rural and remote areas



Notes: Not exhaustive, for illustrative purposes and some segments are interchangeable further, particularly in the last-mile;
*In few country cases, satellite continues to be the main, or only, source of international connectivity;
** These are predominantly fibre-optic links (terrestrial and undersea) but in few country cases, national backbone networks utilize wireless microwave and satellite;

*** Data centres can be placed in various parts of the network, depending on the need to aggregate data (such as in core networks, or place data as close to end users as possible (such as in middle mile and last-mile networks);
**** The technologies listed for the last mile are not exhaustive.

Source : ITU [5]

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Affordability of rural broadband infrastructure

Wireless access technologies

Broadband Wireless Access (BWA)

- Mobile cellular 3G/4GLTE/5G networks
- Wireless LAN, Wi-Fi, WiMAx
- Fixed wireless access (FWA)
- Satellite access technologies
- Backhaul connectivity using microwave and millimetre wave radio technologies

Are often more cost-effective and enable a faster deployment of broadband infrastructure in rural and remote communities

Fibre access technologies

Optical fibre access networks (FTTx)

- Superior technology to connect homes, business premises and mobile cell sites
- Highest capacity over long ranges
- Easy to upgrade by simply upgrading electronics at the ends
- Low power consumption

However, setup costs for planning, optical cable installation and the longer deployment time often makes FTTx less affordable, especially in remote areas with no existing infrastructure

Both technologies are complementary and are often deployed in a hybrid access infrastructure

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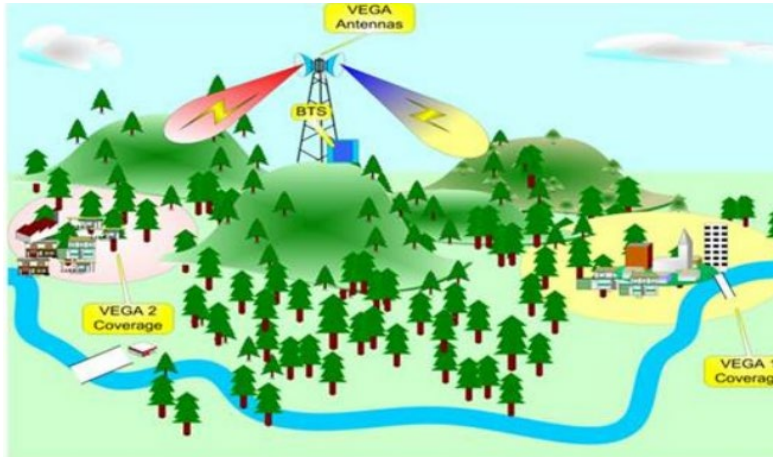
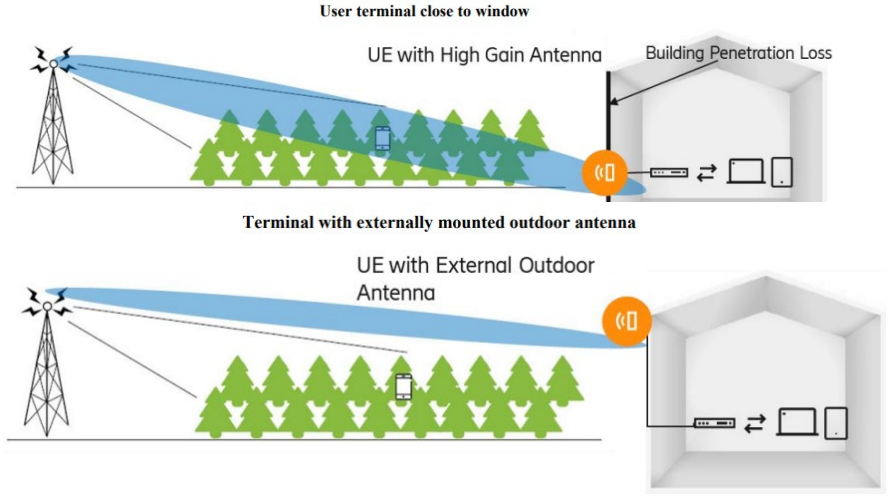
Wireless access technologies

Fixed Wireless Access (FWA)

Report ITU-R M.2518-0 (11/2022) Terrestrial International Mobile Telecommunications for remote sparsely populated areas providing high data rate coverage

Describes IMT solutions that support remote sparsely populated areas providing high data rate coverage





Very High Gain Antennas (VEGA) can cover a 15 to 35 km range, depending on deployment parameters like frequency, antenna height, ground surface and vegetation

Source : ITU [6]

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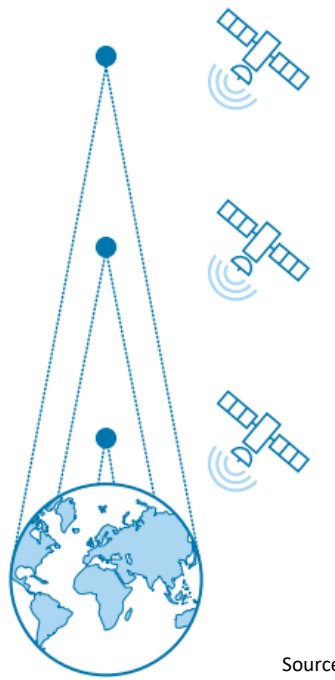
Wireless access technologies

Satellite access technologies

GEO, MEO and LEO satellite characteristics

Satellite category	Altitude	Orbital period	Latency (round-trip)	Number of satellites to span globe	Cost per satellite	Effective lifetime of satellite
GEO	35 786 km	24 hours	approx. 477 ms	3*	approx. USD 100 to 400 million	15 to 20 years
MEO	2 000 to 35 786 km**	127 minutes to 24 hours	approx. 27 to 477 ms	5 to 30 (depending on altitude)	approx. USD 80 to 100 million	10 to 15 years
LEO	160 to 2 000 km	88 minutes to 127 minutes	approx. 2 to 27 ms	Hundreds or thousands (depending on altitude)	approx. USD 500 000 to 45 million	5 to 10 years

Comparison of GEO, MEO and LEO satellite characteristics, including coverage areas



GEO satellites at altitudes of 35 786 km
Full orbital period of 24 hours
Latency (round-trip) of approx. 477 ms

MEO satellites at altitudes of 2 000 km to 35 786 km
Full orbital period of 127 minutes to 24 hours
Latency (round-trip) of approx. 27 ms to 477 ms

LEO satellites at altitudes of 160 km to 2 000 km
Full orbital period of 88 to 127 minutes
Latency (round-trip) of approx. 2 ms to 27 ms

Source : ITU [5]

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Our Products & Trainings

- Spectrum Management
  - Spectrum Management Training Progamme (SMTP)
    - Modules
      - **OM1:** Legal Basis and Regulatory Framework of Spectrum Management
      - **OM2:** Spectrum Engineering Fundamentals
      - **OM3:** Wireless Telecommunications Technologies
      - **EM1-1**: Spectrum Monitoring
      - **EM1-2**: Enforcement and Type Approval of Equipment
      - **EM1-3**: SM for Satellite Systems
      - **EM1-4**: SM for HF Systems, Science, Maritime and Amateur Services
      - **EM1-5**: SM for Aeronautical and Radio Determination Services and Military Systems
      - **EM1-6**: Computer-aided Spectrum Management
      - **OM4:** Economic and Market Tools of Spectrum Management
      - **OM5:** Strategic Planning and Policies for Wireless Innovation
      - **EM2-1:** (Legal Specialization): Advanced Spectrum Authorization Regimes
      - **EM2-2:** (Legal Specialization): Socio-Economic Impact of Spectrum Regulation; Competition and Consumer Protection
      - **EM2-3:** (Technical Specialization): Terrestrial TV Broadcasting Planning and Digital Transition
      - **EM2-4:** (Technical Specialization): Opportunistic Spectrum Access and Cognitive Radio
      - **EM2-5**: (Technical Specialization): Electro Magnetic Fields and Health
  - Introduction to Spectrum Management - Self-Paced Training

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Our Products & Trainings

- Network Design
  - ICT Infrastructure Business Planning Toolkit
  - Broadband Mapping
    - ITU academy course: Introduction to broadband mapping
    - Deep dives with ITU Membership in different countries on Connectivity Analysis
    - Open Fibre Standards
  - Last Mile Connectivity solutions
- Conformance and Interoperability
  - Type Approval procedures, Testing Domains, Regional Technical Collaboration
  - Virtual and On-the-job training in collaboration with partner Testing Laboratories (e.g. CERT/Tunis, NCA/Ghana, CPqD/Brazil)
    - Example: Conformity and interoperability on test reports analysis and regulatory aspect of electromagnetic compatibility testing (EMC)

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Our Products & Trainings

- Future networks
  - Mobile networks IMT-2020, 5G.
  - Resilient and Green Digital public Infrastructure.
  - Satellite Communication.
  - Transition to IPv6.
  - Optical Fibres Deployments.
  - Internet of Things.
  - Emerging Technologies.
  - Artificial Intelligence applied for network design.

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