# Success Factors for 5G and the 4th IR in Emerging Economies

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# Main Themes

- The current 5G Standard 5GPP Release 15
- Opportunities for 5G technology RD&I
  - Creation of smart Industries & Services…..4IR
  - Extending the reach of Broadband Internet
- 5G Success Factors for Future Africa
- Initiatives for Digital Inclusion & Sustainability in the Era of 5G & 4IR
- Conclusions

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# The CSIR : Council for Scientific & Industrial Research

- SCIR is a Multi-disciplinary Science & Technology Research & Innovation Organization funded mainly by Government.
- **The CSIR's Executive Authority is the Minister of the Department of Science and Technology**

**In numbers:**

71yrs
1945 - 2016

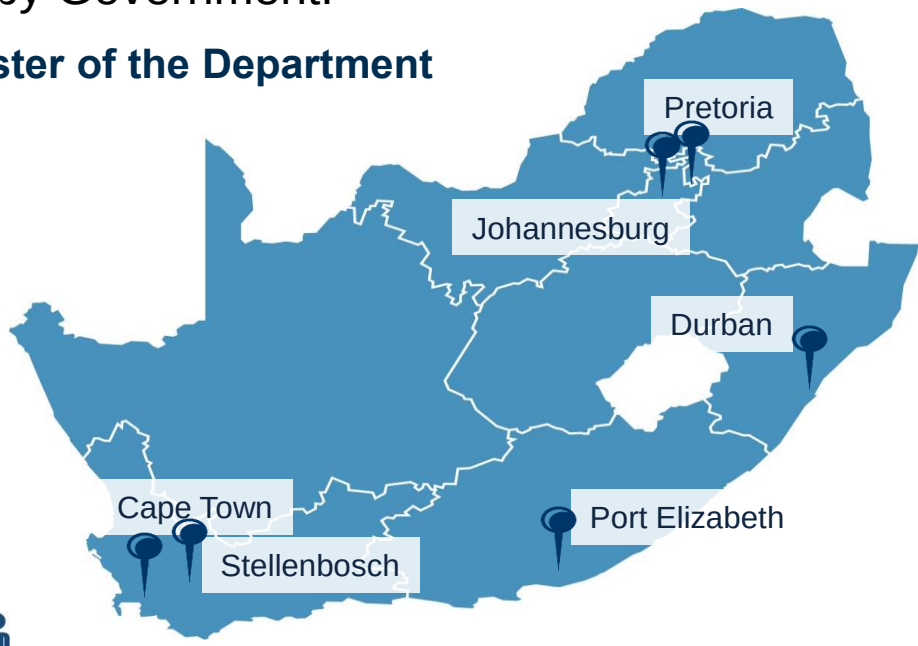
2411
total staff

355
doctoral qualifications

500+
Publication equivalents

R2.15 bn
total operating income

1691
total in SET base

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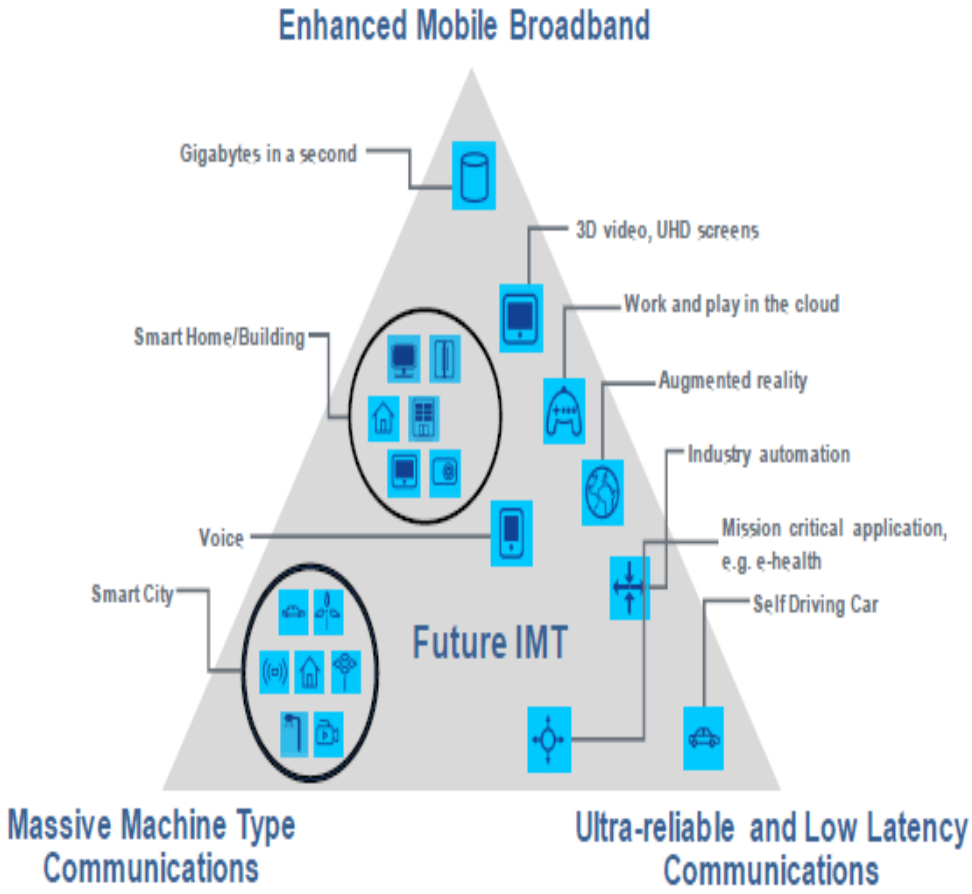
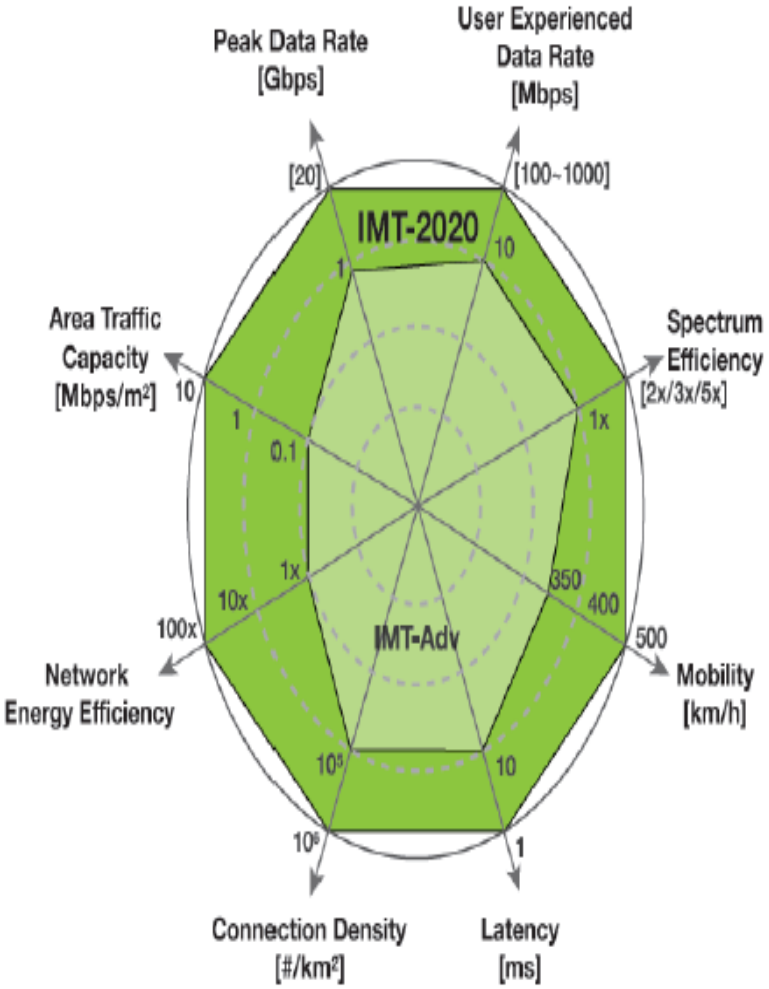
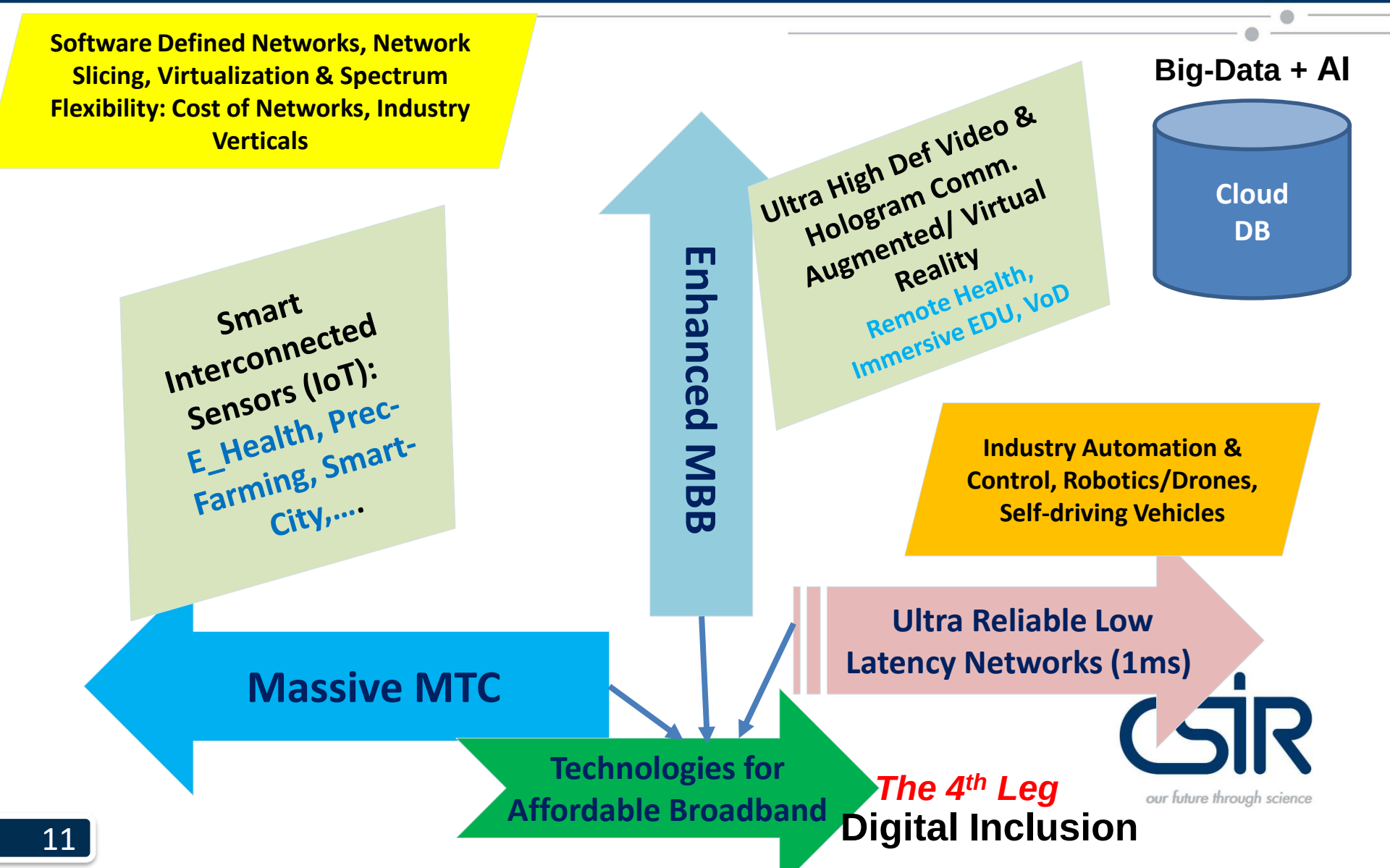
# IMT Advanced & IMT 2020
# Source: ITU-R WP 5D



# ITU/5GPP 5G Wireless ICT Standard : NSA 2018



# Synergetic Opportunities:
## 5G RD&I for Affordable Broadband : The 4th Leg

- **MTC:** 5G Research on Energy Efficiency (IoT) & Green Networking ⇔ Rural Connectivity- 5G NR is 75 % EE than LTE-R…
- **EMBB:** Research on Spectrum Sharing & Spectrum Toolboxes ⇔ Enabling 5G 20/10 DL/UL Gbps Networks…. Unlicensed rural broadband networks.
- **URLLC:** Self Optimized Networks (SoN), Lower Network Management OpEX.
- 5G Research on New RAN,…Long-Range Cells: EU-Brazil-SA 5GRange Project !
- Network Softwarization….. SDN/NFV- Network-Slicing….. Low Cost of infrastructure.
- Edge-Computing & Cloud RAN

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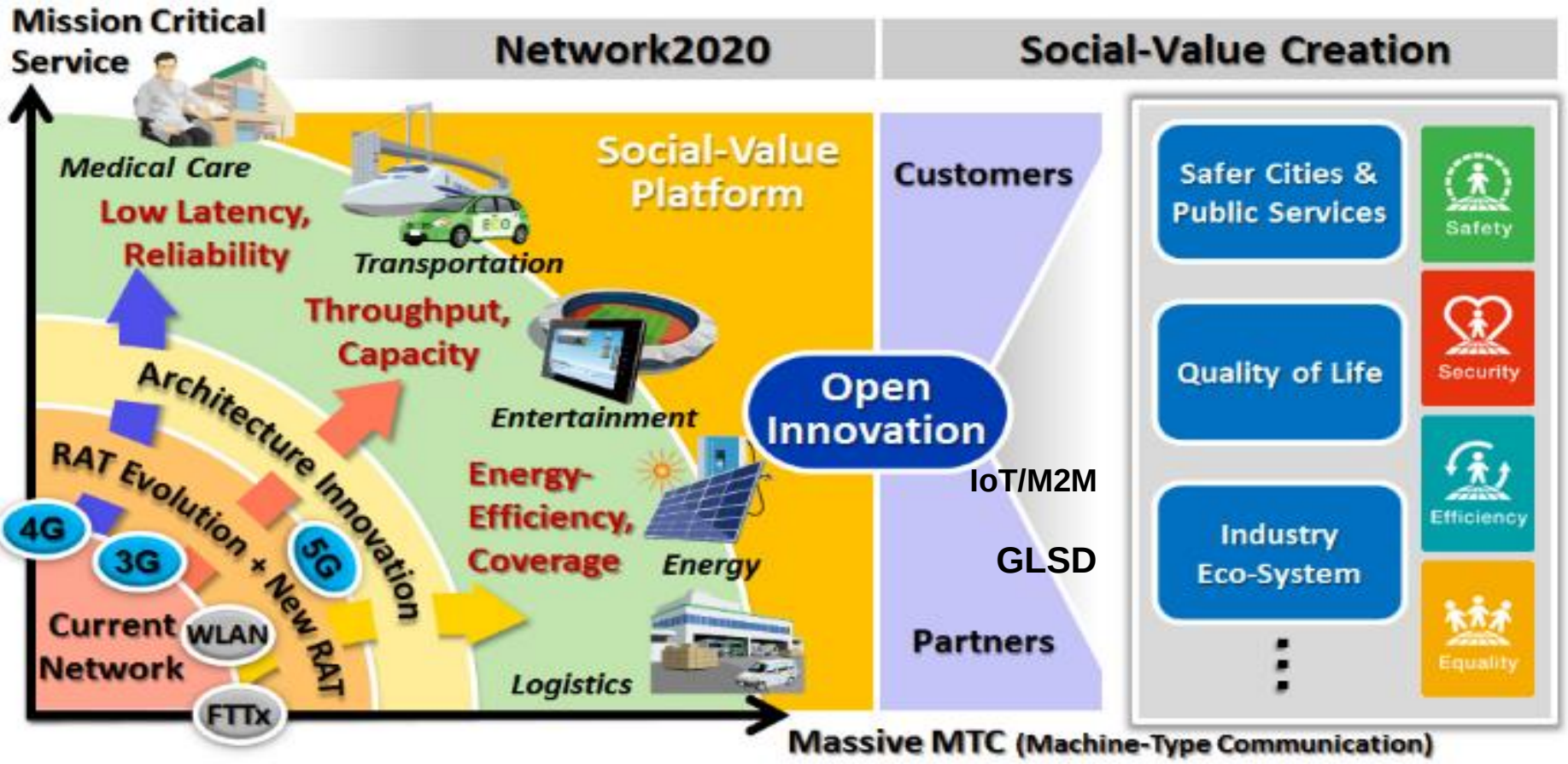
# Success Factor 2: 5G enables smart industries

- 5G is an important enabler to the 4th Industrial Revolution (4IR)
- Identify Relevant Use Cases for emerging economies
  - CSIR & Ericsson White Paper…. AfricaCom-2018.



# Success Factor: Enabling Smart Industry & 5G Use Cases for Emerging Economies

- ***Smart Agriculture & IoT Systems (SAIS)***
- ***Smart EDU- VR/AR_LBS***
- ***Smart Health Systems (SHS)***
- ***Robotic Mining Safety and Security (RMSS)***
- **Integrated and Intelligent Transportation Solutions (I2TS)**
- **Smart Micro Grids & Energy Utilities**

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# 5G Success Factor2: Affordable Broadband for the next Billion : SA-Connect

- 20 Mbps , 90% of the Population by 2020.
- 100 Mbps, 75 % of the population, 2030.
- Cost of Broadband per month should be ~ 2.5 % of average income !
- Regulatory & Policy Intervention:
  - Capacity Building
  - ICASA/DTPS/DoC & African Regulators

**International Definitions vary in Bandwidth & Cost of Broadband: (ITU,ETSI,ATU,TIA,FCC, Ofcom,…..)**

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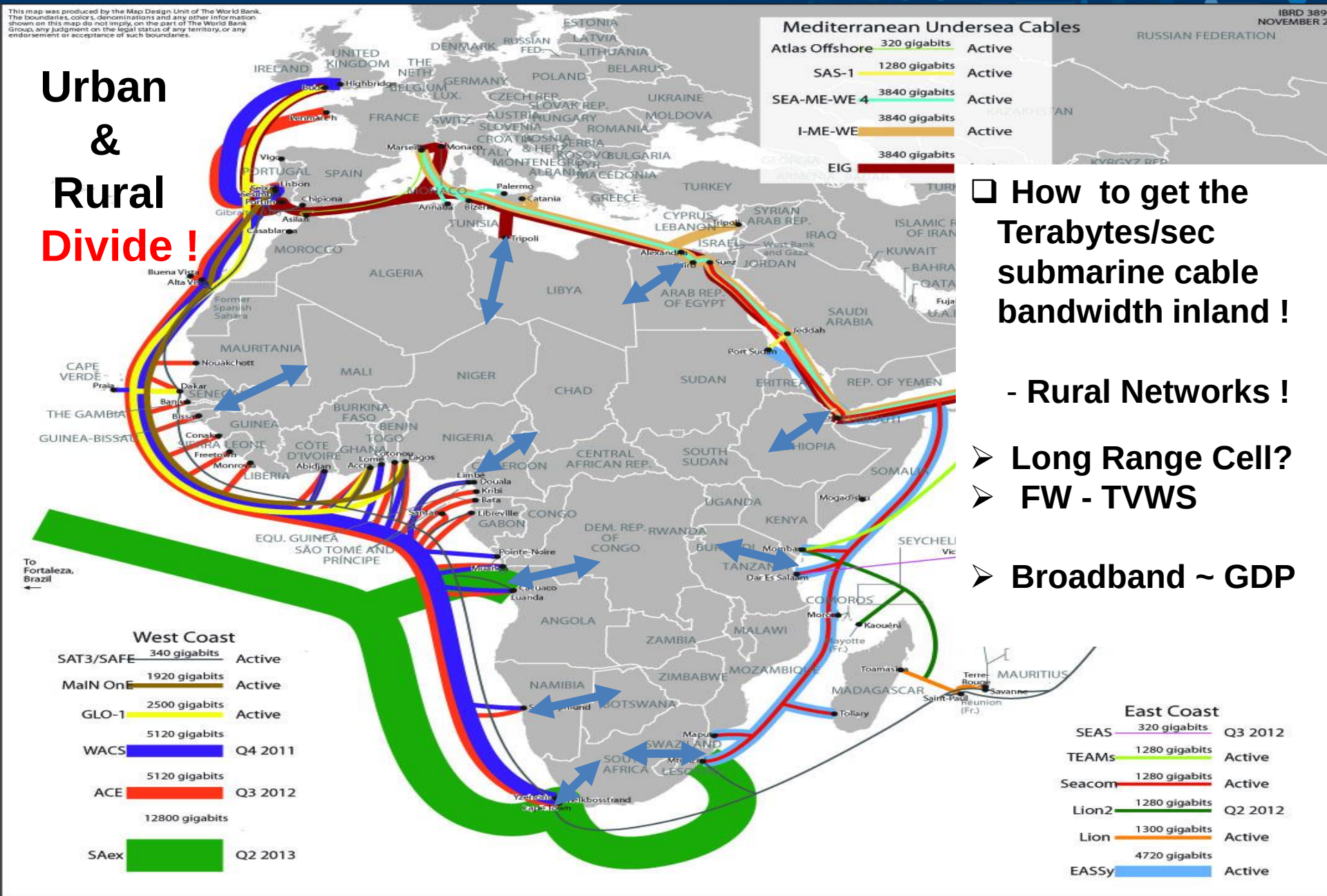
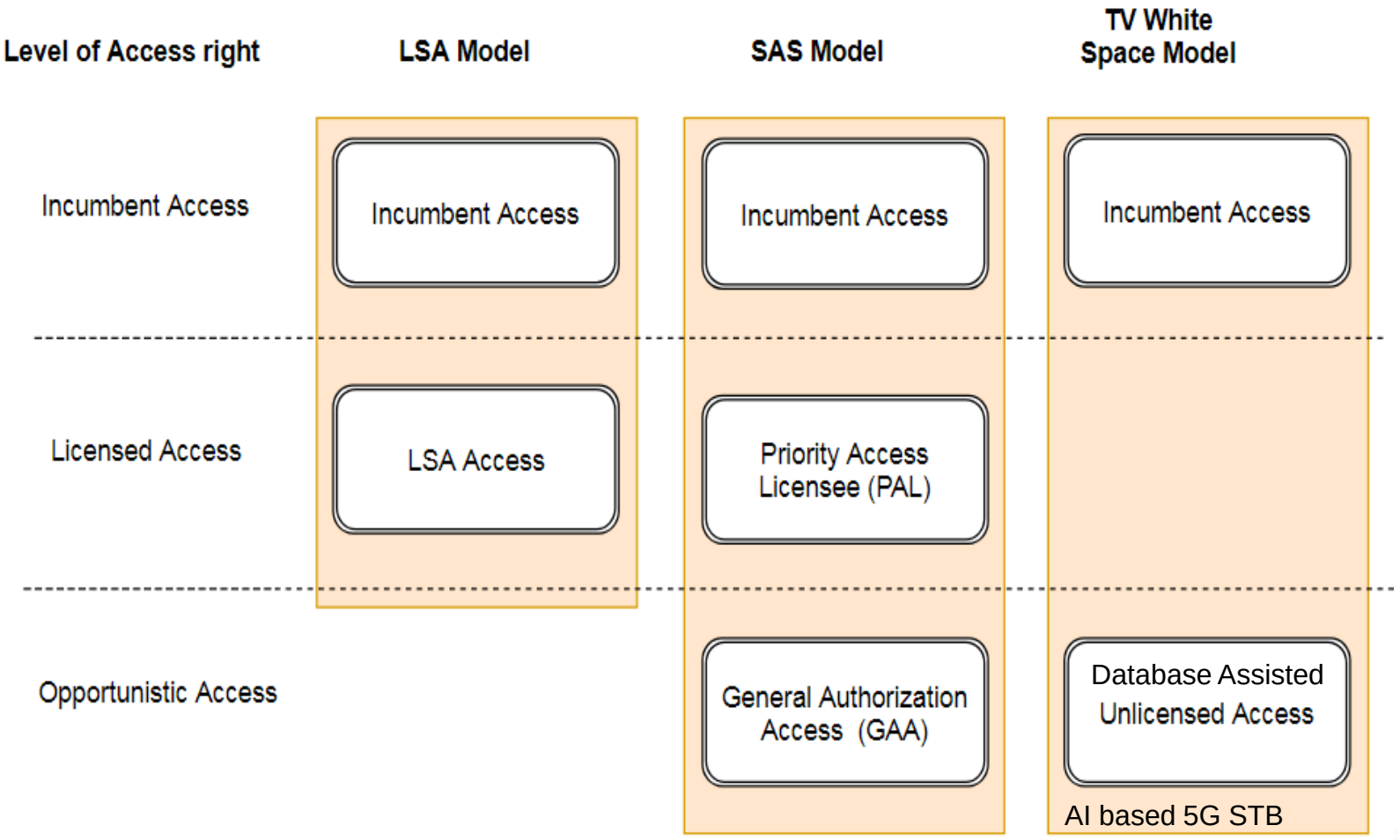
# Addressing 75+ % BB Unconnected in Africa

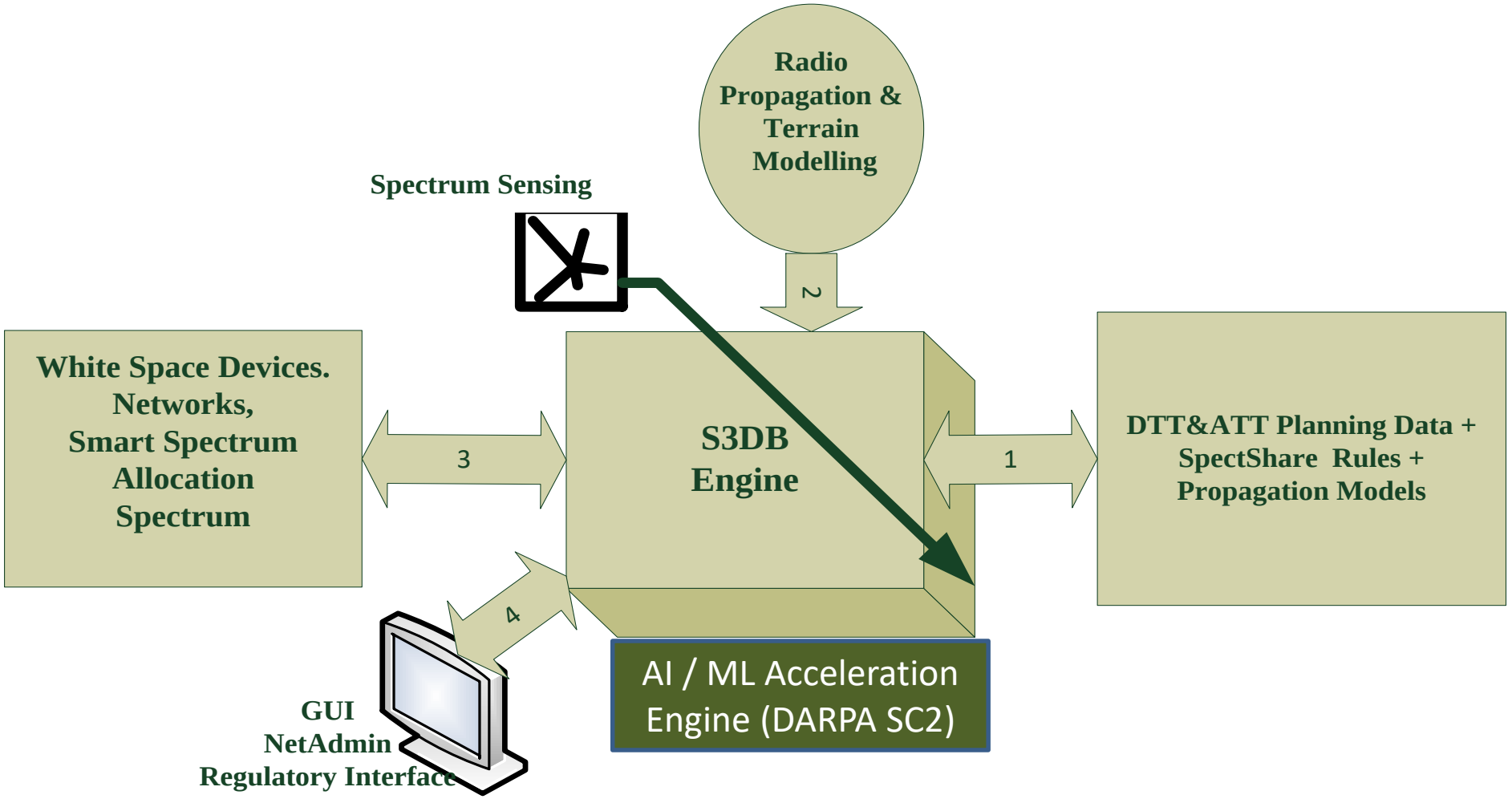



- How to get the Terabytes/sec submarine cable bandwidth inland !
  - Rural Networks !
- Long Range Cell?
- FW - TVWS
- Broadband ~ GDP

# Proposed Spectrum Sharing Mechanisms in 5G



# Spectrum Sharing & Co-existence Tool : For a Heterogeneous 5G Radio Networks

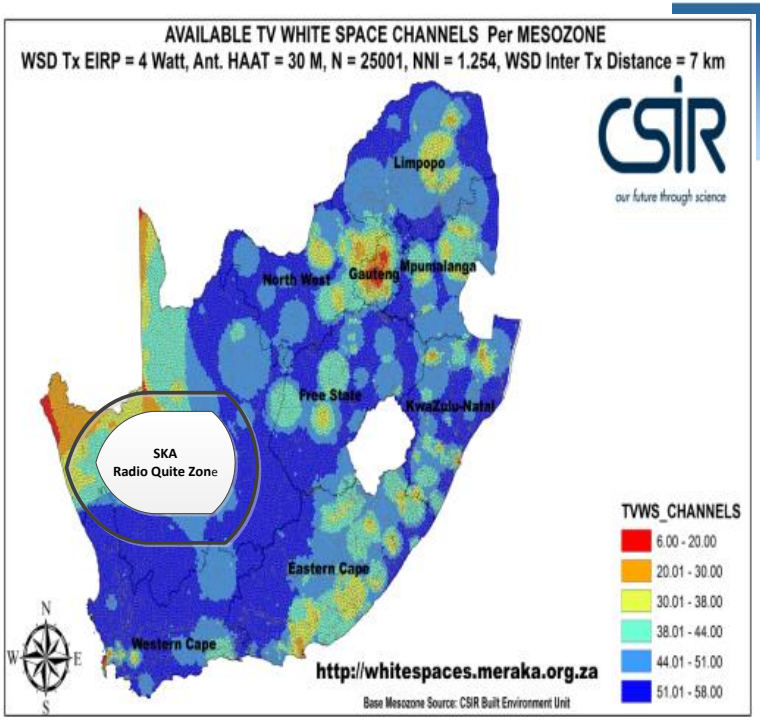


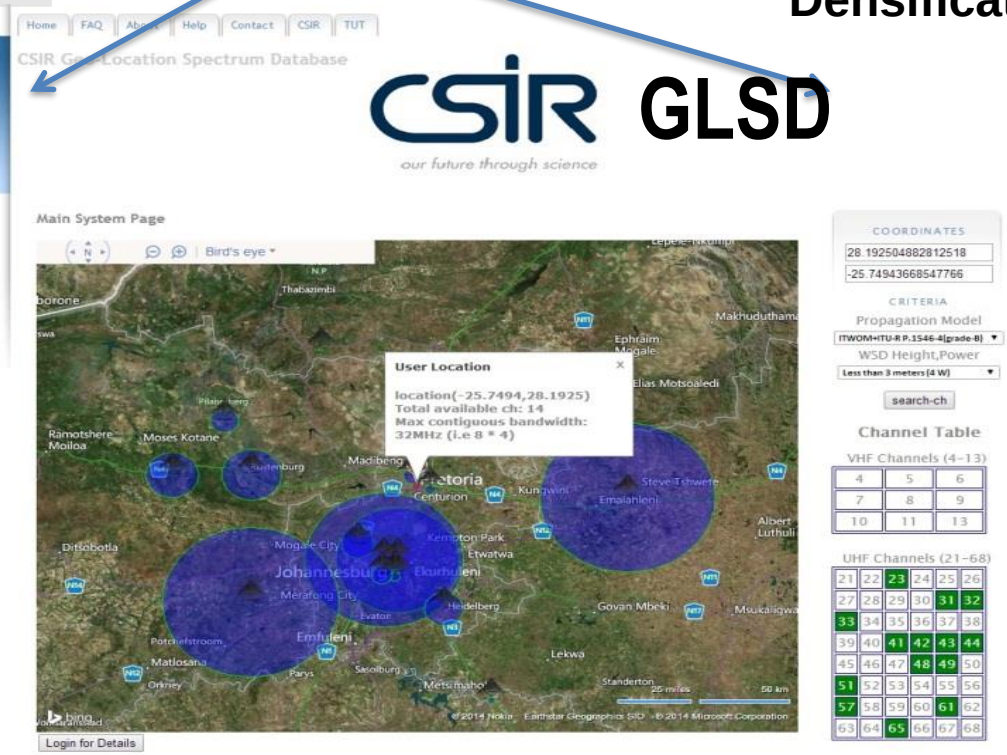
# Spectrum Sharing & Co-existence Tool : Improving 5G Network Capacity & Affordable BB

## Smart Spectrum Sharing

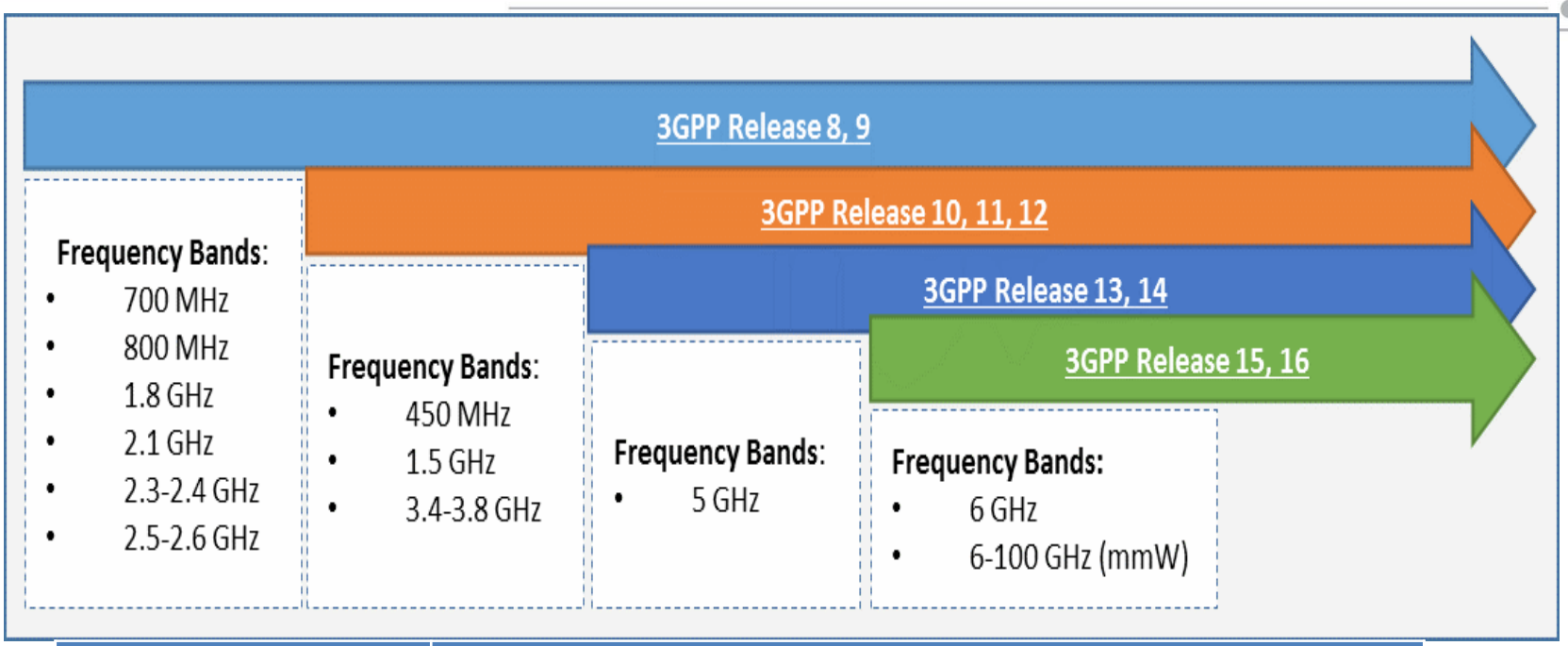
Network Capacity = Spectral Efficiency X Amount of Spectrum X Number of Base Stations

Densification



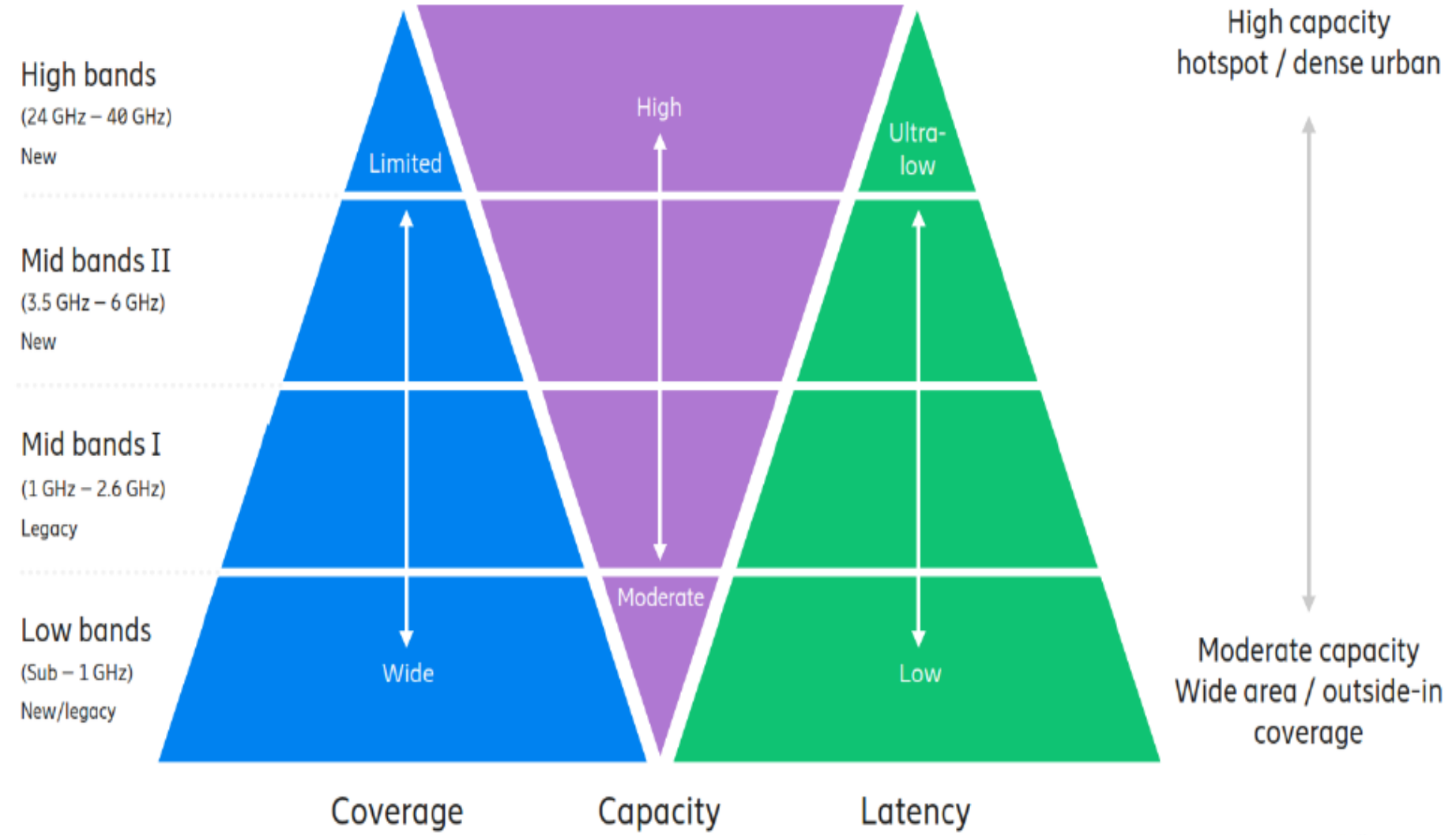



# ITU / IMT 2020 Frequency Allocations



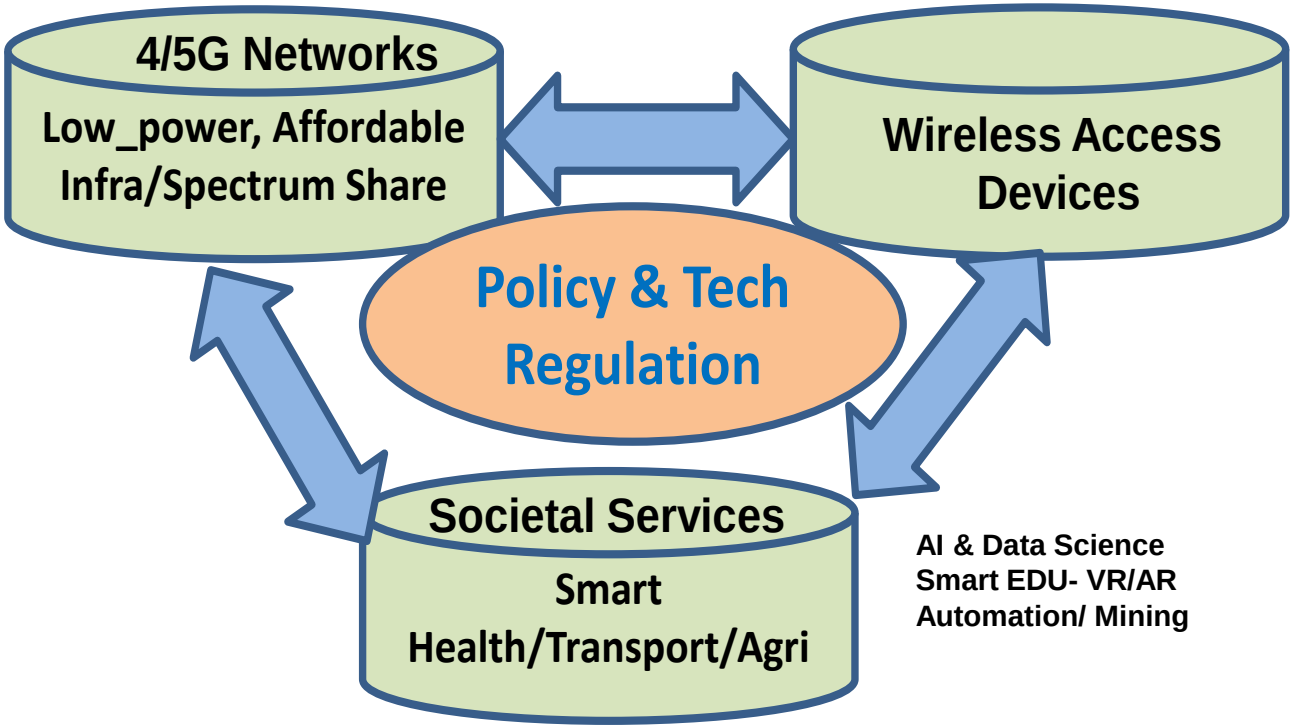

| Band Range | Spectrum and application Types | | |
|---|---|---|---|
| | Typical Spectrum Types | 5G App1 | 5G App2 |
| 54kHz -1GHz | Widespread Coverage Range, 700,800,900 MHz | Rural/Unlicensed | Urban, WA-LAN (IoT) |
| 1GHz -6GHz | Mixed Range and Capacity, 1800 MHz, 3.3 -3.8 GHz | Urban/Rural/Unlicensed | IoT/ITS/V2V/V2X |
| > 6GHz | Gigabits Wireless Broadband (6-28GHz) | UWB, Wireless Fiber | Wireless VOD |

# ITU / IMT 2020 Frequency Bands w.r.to Coverage, Capacity & Latency Dimensions



# The 5G & Affordable Broadband Ecosystem

Long Range Cells
Heterogeneous
SDN/NFV
AI in 5G (SON)




Smartphones,
Laptops
Tablets
Wearables

AI & Data Science
Smart EDU- VR/AR
Automation/ Mining

***Improved QoS & QoE will require a constant improvement and optimization in all eco-system components: Networks, Devices, Services & Enabling Policy***

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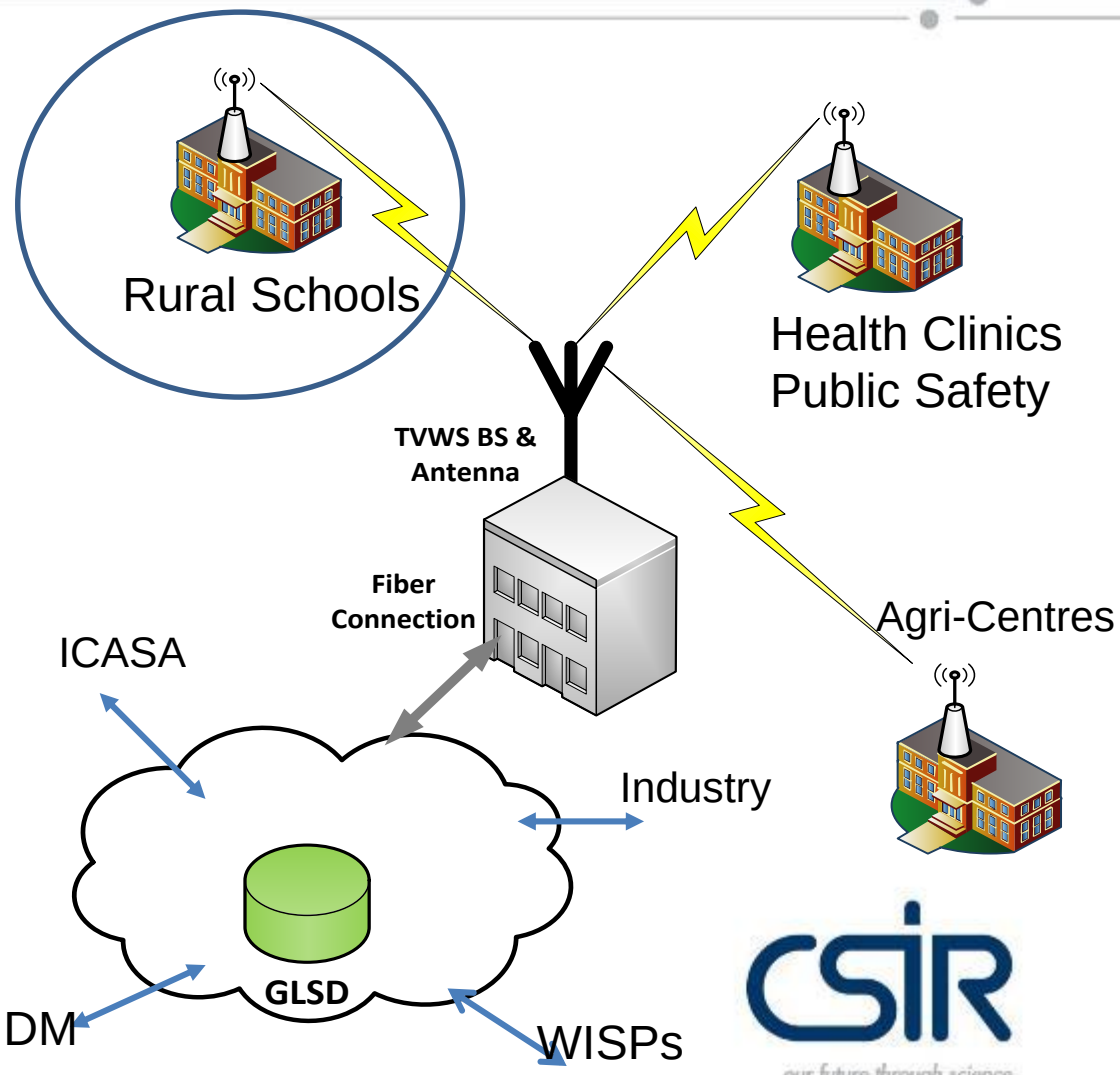
# Connecting the Next Billion Using Spectrum Sharing Broadband Networks (TVWS)

- **Fixed Wireless TVWS**
  ***Network Test-bed***
  - **Current Network connects 10+6 Schools (~ 68k Students).**
  - **New Use cases :**
    - **Health Clinics.**
    - **Agri-centres.**
    - **Public Safety.**
    - **Smart Communities.**
    - **BB Public Safety Networks**
- **TVWS network for M2M & IoT**
- **5G Fixed wireless Access and co-existence with TVWS**

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**Empowering Rural Communities with Digital Inclusion**

# AI & Machine Learning for Smart 5G Networks (WWRF42-AIW)

- Wireless networks generate massive data suitable for multi-criteria optimization ~ AI & ML techniques.
- AI-SON: cost of network management in remote area and green energy networks.
- Improving the reliability and security of networks.
- Develop accurate algorithms to dynamically allocate spectrum, reduce interference and provide QoS guarantees in a heterogeneous radio environment.
- CSIR Participation in DARPA-SC2 and IEEE DySPAN for the development of intelligent spectrum management systems.

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# Initiatives for 5G Extension & Emerging Economy Context

**The 4th Leg of 5G**
**IEEE/ICASA-5G-WG**

**Extending 5G RD&I to address the Emerging Economy Context & SDGs.**
**-Spectrum Sharing**
**-Green Networks**
**-SoN/SDN/EdgC**

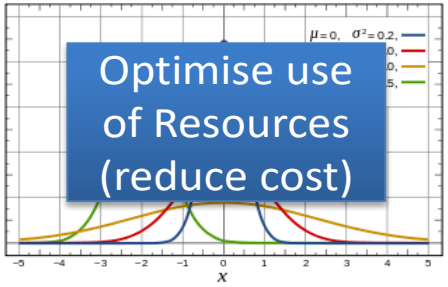
**Frugal 5G**
**India/IEEE-SA**

-Low Cost Backhaul
-Dynamic Spectrum
- Low Power Networks
- ….

**5GRange**
**EU+Brazil+CSIR**

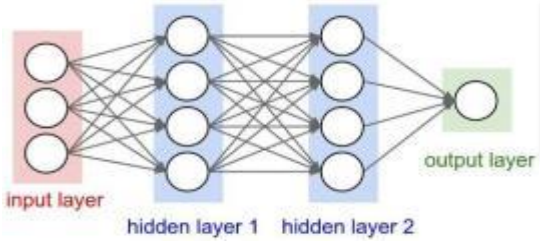
5G Technology Extension for Affordable Remote Area Internet Access.
-Cognitive RAN
-DSA

# 5G+AI & 4th IR for Efficient Resource Use



Optimise use of Resources (reduce cost)

Predict Demand (effective planning)


Customise your offerings (efficient delivery)

European Commission

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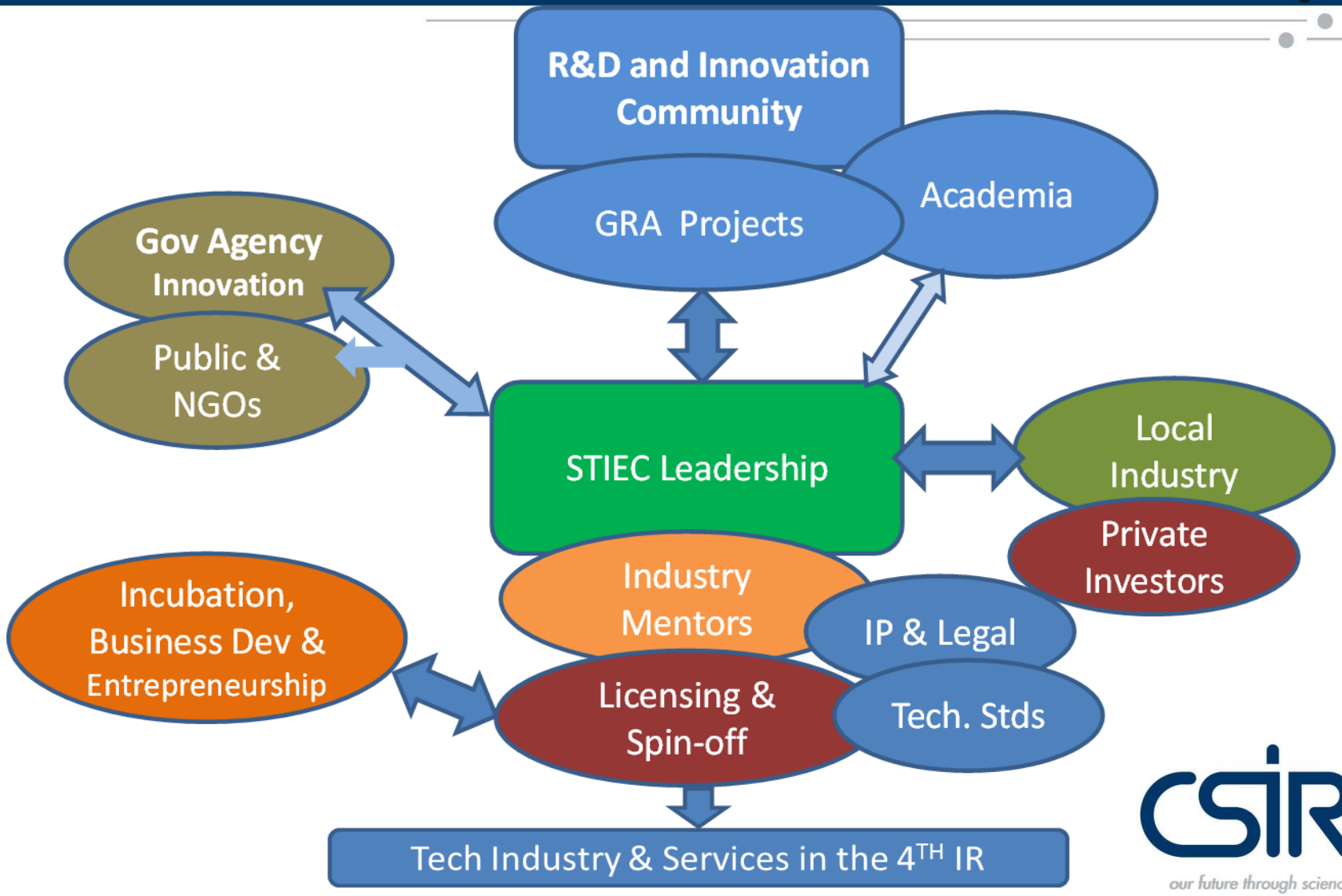
Integrated Planning !

# New Technology Innovation & Economic Beneficiation from 5G & 4th IR

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# Concluding Remarks for the 5G & 4IR Era

- 5G Migration & 4th IR are inevitable… PPPs
- RD&I in Networked Sensors : IoT4Smart Cities & Communities … Privacy Concerns.
- National Data Integrity and Protection Rules
- Cyber security : End to End !
  - Sensed Info/Data Integrity, Signal Processing, Network Reliability
- Requirement of Multi-disciplinary Skills in the 4th IR era.
  - Educational Institutions Curriculum for 5G & 4th IR!
- RD & Innovation for Technology Beneficiation
  - Sustainable Development issues: UN-SDGs
  - Addressing Inequality & Digital Inclusion
- Need for enabling Regulation & Policy

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# *In the Space Ship Earth there are No Passengers we are all Crews !*

Thank You !

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