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NGA Vision for 6G

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3GPP Stage 1 Workshop on IMT2030 Use Cases

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NGA Vision for 6G

SA1 IMT-2030 Use Cases Workshop

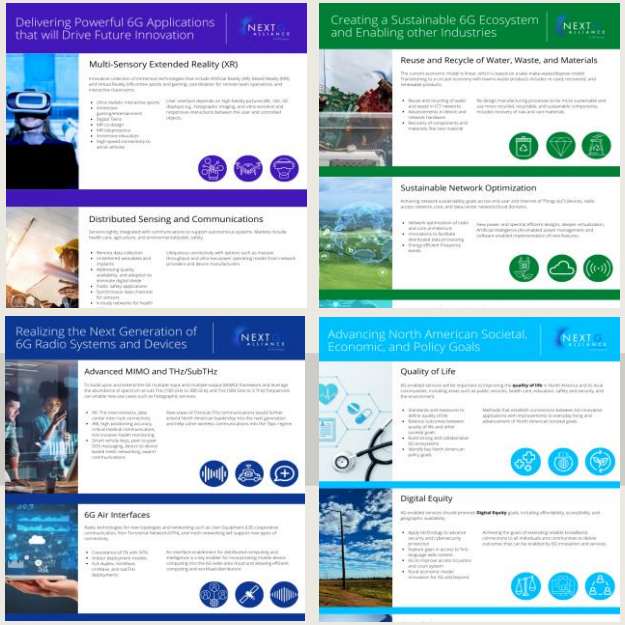
Presentation by Next G Alliance

Presentation Outline

- Next G Alliance (NGA) Overview
- NGA's 6G Vision: Goals and Drivers
- 6G: Perspective on Societal and Economic Needs
- Sustainable 6G
- 6G Use Cases
- Roadmap for Deployment of 6G
- Key Considerations for 6G in 3GPP

NGA’s Journey to 6G

Develop North American 6G vision and key foundational documents



https://www.nextgalliance.org/research-priorities/

Align on a collective set of 6G Research Priorities

Create 6G Public/Private Partnerships for Next Frontier of Innovation and Investment

Next G Alliance 6G Vision

North American 6G Roadmap defines the path for connecting every stage of the lifecycle and progressing to an end-of-decade 6G vision

6G Leadership Priorities incorporate innovative applications, societal needs, economic goals, government actions, and technology developments

Audacious Goals create the framework for advancing North American priorities and positioning a robust 6G marketplace

Perspective on Societal and Economic Needs

Key Outcomes and Priorities

Quality of Life

- Access to Food & Housing
- Smart Health & Wellness
- Immersive Education
- Intelligent Transportation
- Public Safety

Digital Equity

- Cost effective and affordable access to 6G connectivity
- Simple to deploy, operate and maintain 6G networks
- FWA, NTN as enablers

Privacy and Trust

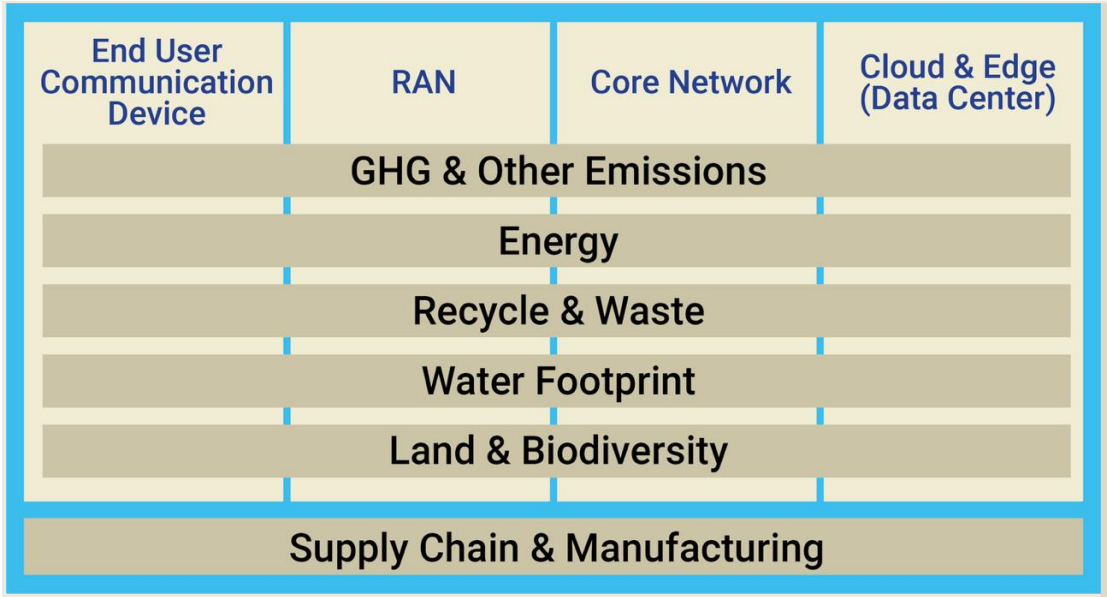
- Privacy technologies for real-time applications
- Secure network protocols for distributed AI systems
- Privacy and security for JCAS systems

Economic Growth

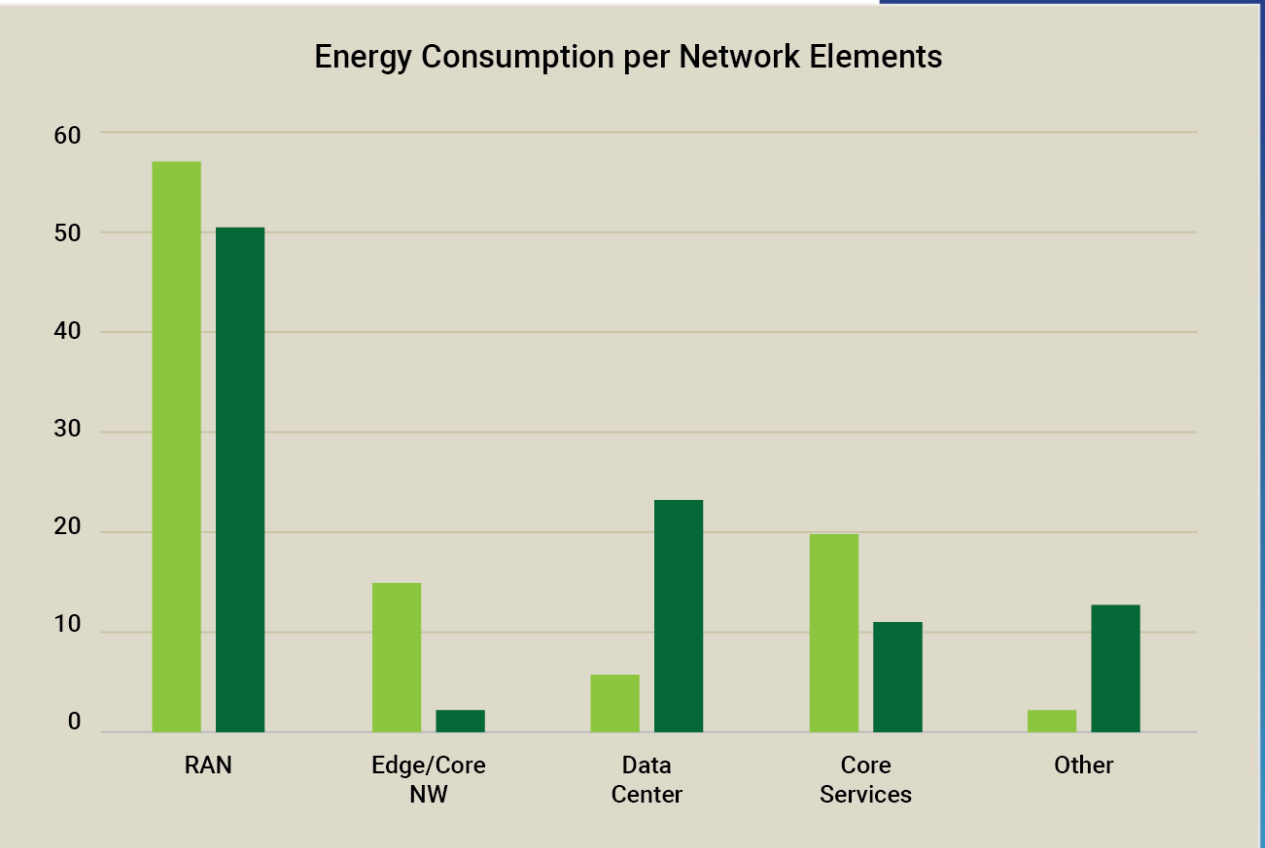
- Smart Agriculture
- Immersive Employee Training
- Industrial Automation
- Automated Asset Tracking and Management

Sustainability

Transitioning to Sustainability Native 6G



Sustainability Native 6G requires optimization across the value chain



Trends in energy consumption of the mobile network

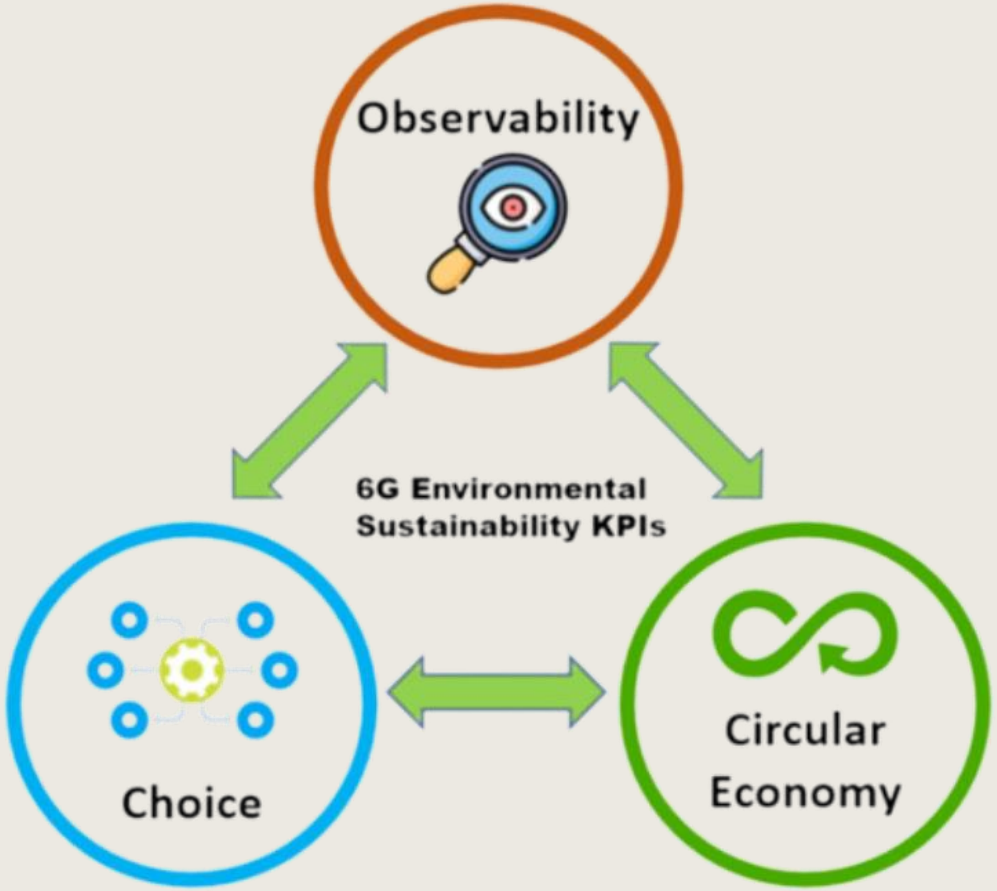
Sources: Next G Alliance Report: Sustainable 6G Connectivity — A Powerful Means of Doing Good and J. Wu, Y. Zhang, M. Zukerman and E. K. -N. Yung, "Energy-Efficient Base-Stations Sleep-Mode Techniques in Green Cellular Networks: A Survey," in IEEE Communications Surveys & Tutorials, vol. 17, no. 2, pp. 803-826, Secondquarter 2015, doi: 10.1109/COMST.2015.2403395.

Paradigms for Sustainability Native 6G

- **Observability:** Allows to track and report environmental indicators and enables choice by informing high levels of steerability and versatile actions

- **Choice:** Empowers the entire value chain, from standards and product developers to operators and users, to exercise preferences that impact sustainability

- **Circular Economy:** Ensures near-zero waste through high degrees of reuse and recycling of renewable or recovered components, raw and rare materials, and products



Source Next G Alliance Report: Evolution of Sustainability Indicators for Next-Generation Radio Network Technologies

Applications that affect all aspects of life and society

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Everyday Living

Service robots for home assistance

Indoor/outdoor delivery services

Intelligent travel assistance

Experience

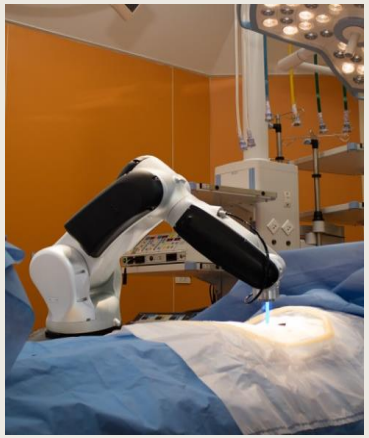
Real-time interactive gaming

MR entertainment

MR-powered classrooms

XR-enriched transportation

Critical Roles



Digital twins

Robotics for hazardous conditions

Remote healthcare, testing & monitoring

Manufacturing & agriculture

Societal Goals

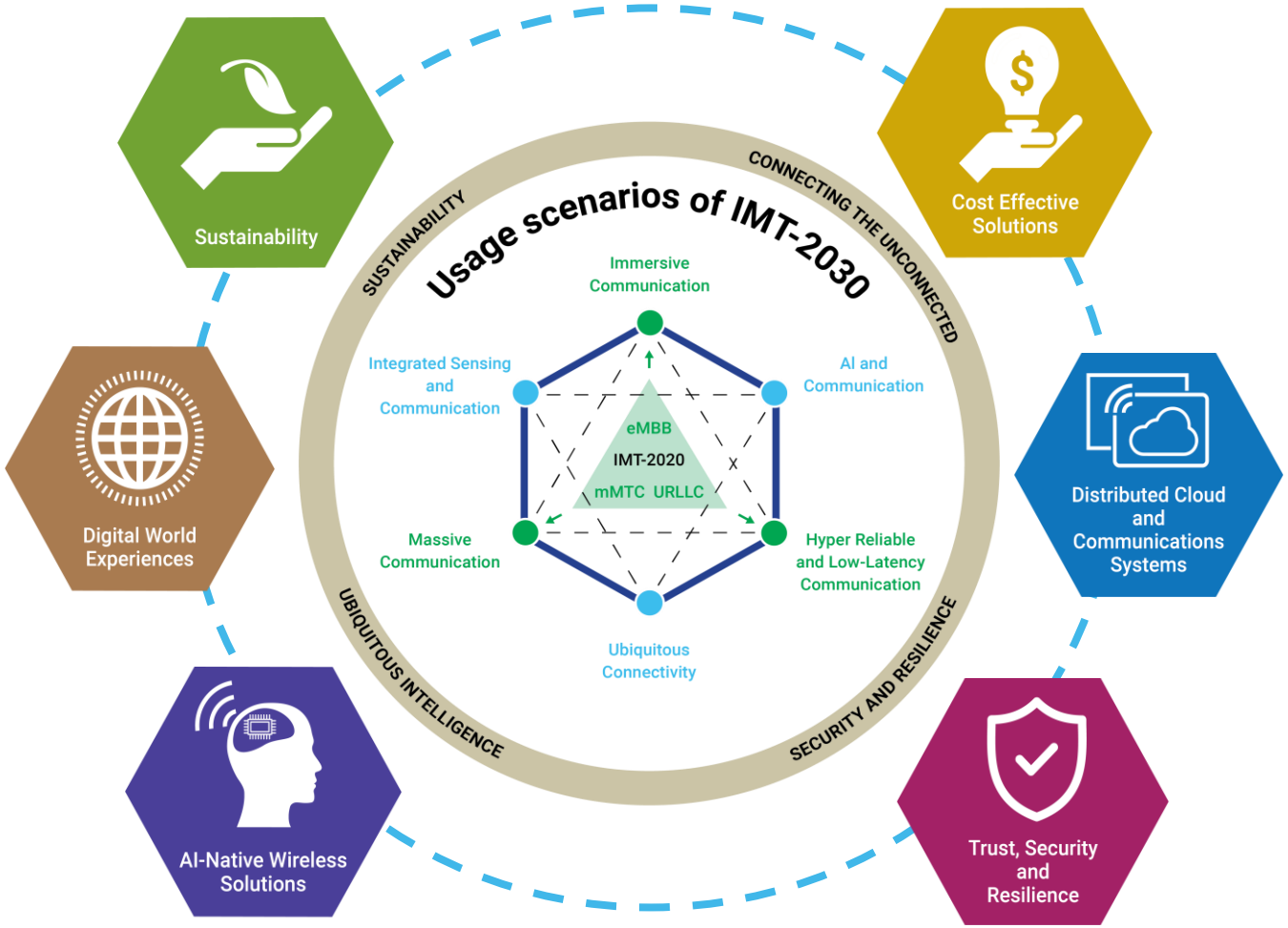
Digital equity

Cultural and civic participation

Public safety

Sustainable society

Mapping of NGA Audacious Goals to usage scenarios and overarching aspects of IMT-2030



NGA Use Cases

NGA Use Case White Papers, Applications and Services

Representative Use Cases

Vertical Industries and Consumer Needs White Paper

Working Groups

Roadmap | Applications | Technology | Spectrum | Green G | Societal and Economic Needs

NGA Use Case Categories, Applications and Services

Multi-sensory Extended Reality

Distributed Sensing & Communications

Network Enabled Robotics & Communications

Personalized User Experience

These reports are available from the NGA 6G Library

North American Representative Use Cases

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Multi-Sensory XR

Fixed Wireless Access

ITS/Connected Vehicles

Smart Factory

Low Power Wide Area (LPWA)

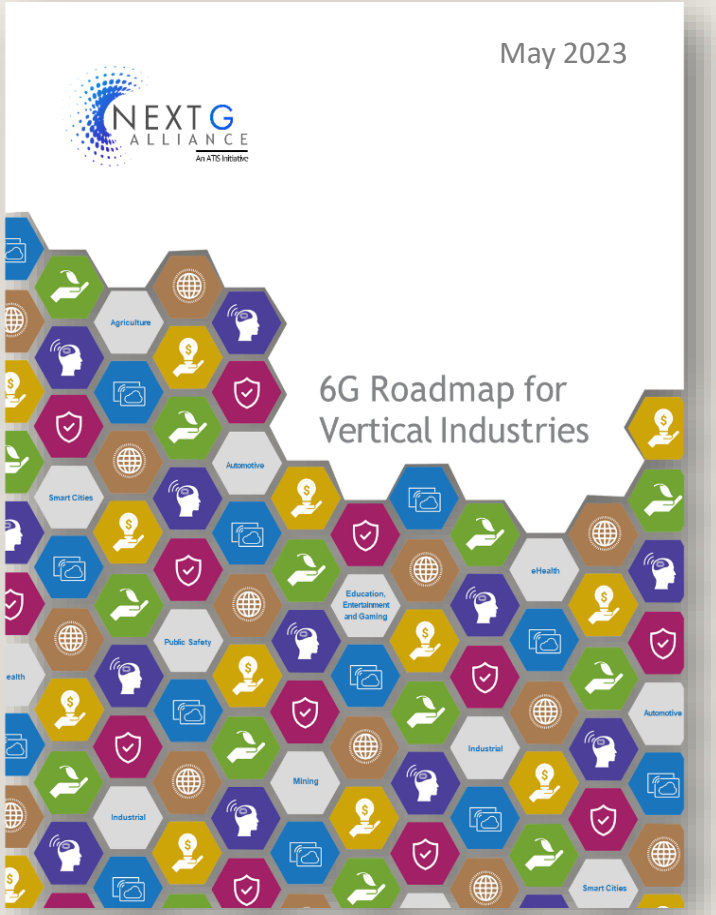
Personalized User Experiences

Robots

Digital Twins

Short Range Massive Sensors (Ambient IoT)

6G Roadmap for Vertical Industries



Agriculture

Automotive

Education, Gaming and Entertainment

eHealth

Industrial

Mining

Public Safety

Smart Cities

- ✓ Change how we live and work
- ✓ Translate North American needs to technology outcomes
- ✓ Target shared investments in 6G PoCs and testbeds
- ✓ Connect North American 6G needs to marketplace

Sector Landscape for Vertical Industry

Automotive: North America is the **world's second largest** automobile market, with **16.6 million** vehicles sold in 2021.

Agriculture: $1.055 trillion (5%) – Contribution to U.S. GDP (2021). **6.8%** – Contribution to Canada's GDP (2021).

Education, gaming, and entertainment: Educational apps market is expected to grow to **$38 billion** by 2028. Mobile gaming market is estimated to reach **$80 billion** by 2030.

eHealth: 18.8% – Contribution to U.S. GDP (2020). **12.2%** – Contribution to Canada's GDP (2020).[1]

Industry and IoT: Projection of **1 million** IoT devices per square kilometer and more than **10 million** base stations.[4]

Mining: Canada ranks among the **top five countries** in the global production of minerals and metals.[2]

Smart Cities: 56% of today's global population is concentrated in cities, and this number is expected to grow to **70%** by 2050. North America is the most urbanized continent, with over **80%** of its population concentrated in dense urban locations with populations exceeding **100,000**.[3]

Public Safety: Public safety involves protecting the general public to help community members feel secure when facing imminent threats from natural calamities to man-made incidents. This includes the work of providing remedies and assistance to help the public recover from disaster situations.

[1] Stastista Research Department, July 27, 2022, [2] Mining Association of Canada, [3] World Bank, [4] McKinsey Global Institute; Harbor Research

Use Cases: Multi-Sensory Extended Reality (XR)

Lightweight XR glasses, brain-computer interfaces, and lightweight haptics wearables than can be deployed in a network at a scale comparable to today's smartphone

North American Market Needs

- Education/Training – Enabling global reach of Education System
- Healthcare – Increasing efficiency and reach to remote population
- Entertainment & Sports – Moving from viewing to immersion

Key 6G Potential User Experiences	Key 6G Capabilities
• **Sensory fusion for enhanced sensations** • Multi-sensory Feedback • Un-occlusion and Environmental Awareness • **Hyper-realistic Virtual Environments** • Spatial Collaboration and Telepresence • Adaptive Content and Personalization • **Holographic Teleportation**	• AI/ML • Wide Area Cloud / Edge Computing • Precise positioning • Very High Data Rate

NGA Report: https://www.nextgalliance.org/white_papers/multi-sensory-extended-reality-xr-in-6g/

Use Cases: Digital Twin

Virtual representation of physical world for Manufacturing, Urban Planning, Transportation, Healthcare, Aerospace, Automotive Design, Supply Chain, Smart Agriculture, Defense and Security

North American Market Needs

- Network Planning and Management
- Manufacturing and Industrial Applications
- Healthcare and Life Sciences
- Aerospace and Defense
- Transportation, Logistics, Smart Cities and Infrastructure Management

Key 6G Potential User Experiences	Key 6G Capabilities
• **Holographic visualization** • Personalized and Context-Aware Experiences • Digital Co-design • **Predictive and Prescriptive Insights**	• AI/ML • Wide Area Cloud / Edge Computing • Sensor Fusion • Multi-Modal Data Integration • Very High Data Rate • Enhanced Privacy and Security

NGA Report: https://www.nextgalliance.org/white_papers/multi-sensory-extended-reality-xr-in-6g/

Use Cases: Robots; Smart Factories

Delivery Robots, Service Robots (SOBOTS) and Collaborative Robots (Cobots) in smart factories

North American Market Needs

- Industry/Agriculture/Mining – Cobots connected in an IIoT scenario
- Healthcare – SOBOTS personal care aids

Key 6G Potential User Experiences	Key 6G Capabilities
• **Enhanced safety measures in manufacturing (uncaged robotic operations, Cobots)** • Enhanced Autonomous Guided Vehicle / Collision Avoidance for Smart Factories • Wide area Crop monitoring for Smart Agriculture (aerial robots / UAVs and autonomous robots) • **Robotic assistance for enhanced healthcare experience (SOBOTs)**	• AI/ML • Precise Positioning • Hyper Reliable Low Latency • Integrated Sensing and Communications • Wide Area Cloud / Edge Computing • Service continuity • Enhanced Privacy/Security

NGA Report: https://nextgalliance.org/white_papers/network-enabled-robotic-autonomous-systems/

Use Cases: ITS/Connected Vehicles

Autonomous Guided Vehicles (AGVs), Traffic management systems, electronic toll collection, vehicle-to-vehicle (V2V) communication, and advanced driver assistance systems (ADAS).

North American Market Needs

- Communication with infrastructure, external services, within and between vehicles using both TN and NTN
- Urban mobility, logistics, and the broader transportation infrastructure

Key 6G Potential User Experiences	Key 6G Capabilities
• Enhanced Vehicle-to-Everything (V2X) Communication • Autonomous Driving and Vehicle Automation • Immersive Entertainment and Passenger Experience • Intra-Vehicle communication • **Predictive Analytics and Traffic Management**	• NTN and TN integration for seamless connectivity and coverage • Sensor Fusion • Integrated Sensing & Communication • Enhanced Privacy and Security

Use Cases: Personalized User Experience

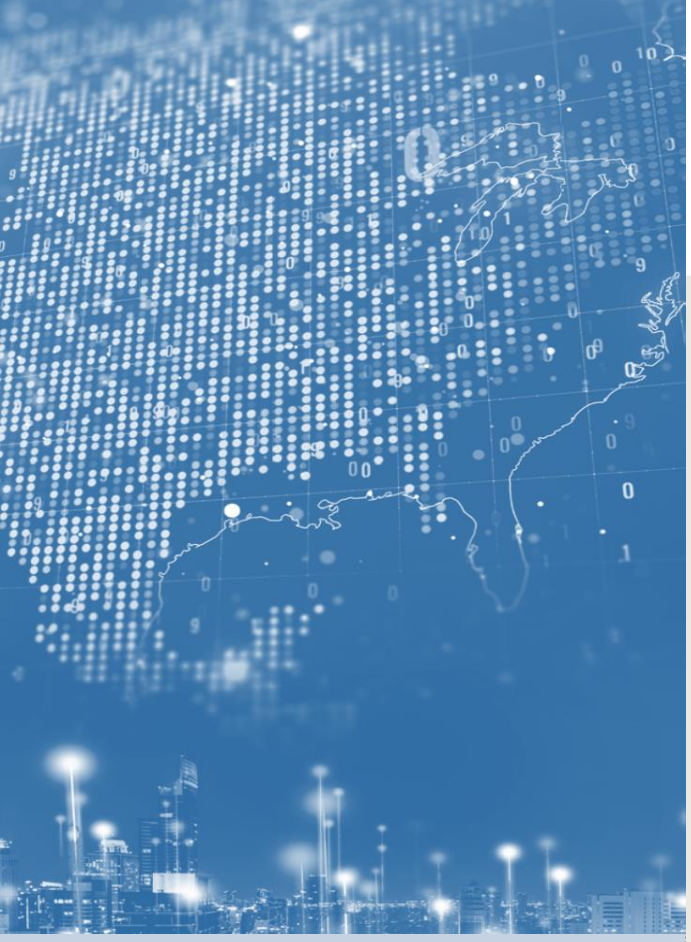
Seamlessly integrating multiple services with the user's environment so they can enjoy the best of the digital world experiences powered by new technologies

North American Market Needs

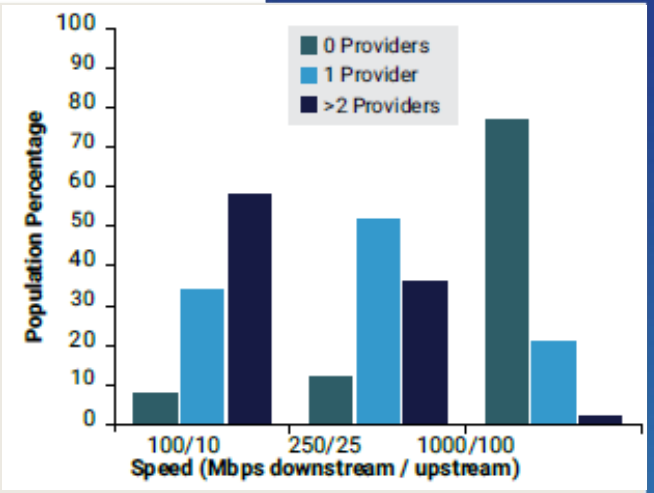
- Healthcare – Quality of life for ageing population
- Travel & Shopping – Simplifying everyday tasks
- Education – Customized curricula to advance learning

Key 6G Potential User Experiences	Key 6G Capabilities
• Situational Awareness • Predictive Personalization • Interactive and Tailored Experiences • XR	• Data collection and advanced sensors • Spatial anchors for mapping digital content • Contextual data interpretation and anticipatory personalization with enhanced prediction • Wide Area Cloud / Edge Computing • Devices with enhanced AR/VR User Interface • Privacy-preserving techniques

Use Cases: Fixed Wireless Access



High Speed Broadband Service across Urban, Suburban and Rural Areas delivered via Fixed Wireless Access



North American Market Needs

- Increase consumer choice of broadband provider
- Rural and remote areas are underserved for high-speed broadband
- Cost efficiency to better support business case

Key 6G Potential User Experiences	Key 6G Capabilities
• UL Data rate and coverage enhancements to increase Digital Equity in areas without Broadband access. • Enhanced data rates and coverage to enable advanced Broadband services such as Gaming, immersive applications and Digital Twin applications in Dense Urban and Rural geographic areas. • Consistent user experience across urban and rural areas.	• Very High Data Rates and Coverage with enablers including Enhanced MIMO • Spectrum sharing and new spectrum in cmWave • Improved CPE performance

Use Cases: LPWA and Short- Range Massive Sensors

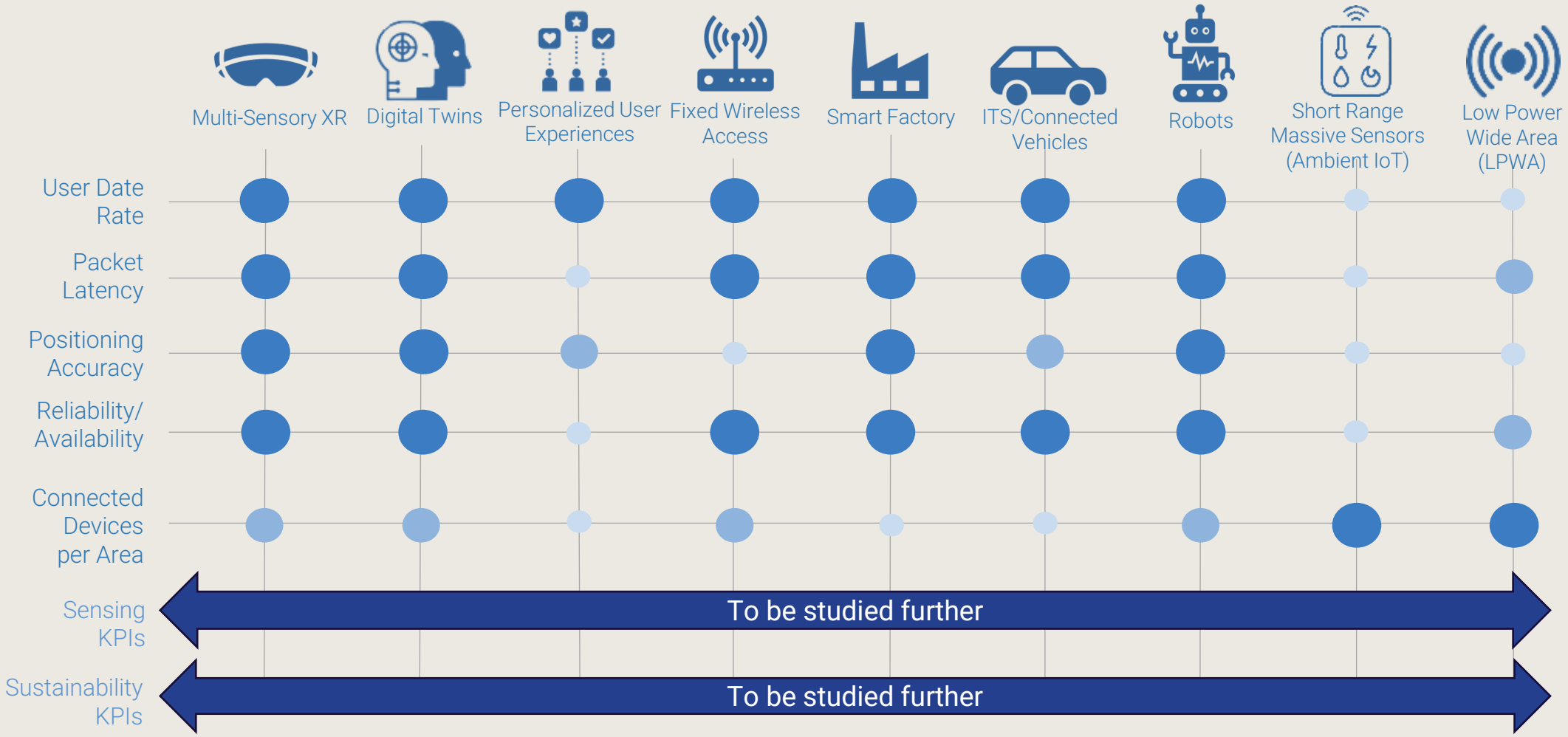
Establish value-driven sensor and data collection opportunities through ubiquitous connectivity facilitated by emerging network services

North American Market Needs

- Public Safety – Fire protection, occupancy sensing
- Sustainability – Sensing enabled Cost and Energy Savings
- Automotive – Increase safety
- Agriculture – Precision and automated farming
- eHealth – High network reliability and security

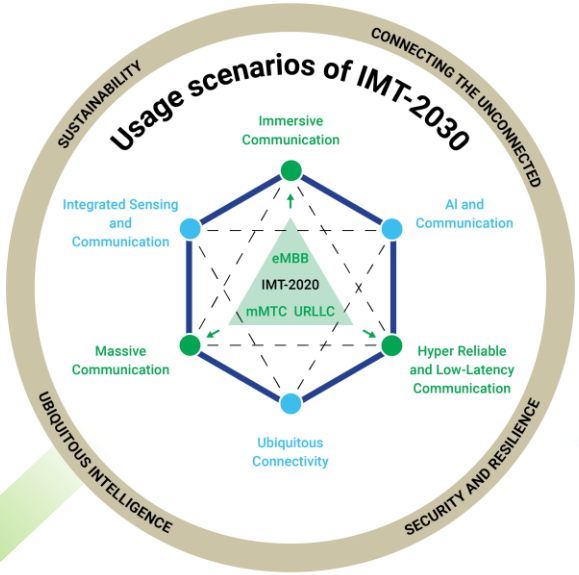
Key 6G Potential User Experiences	Key 6G Capabilities
LPWA-related Use Case	• 5G supports LPWA-related use cases only with LTE technologies. There is considerable potential for 6G to further enhance LPWA operation. • 6G LPWA technologies should be addressed in the first phase to avoid maintaining legacy LTE systems by NAM operators
Short Range Massive Sensors	• 6G KPIs are still under study given that 5G NR RAN normative work has not begun

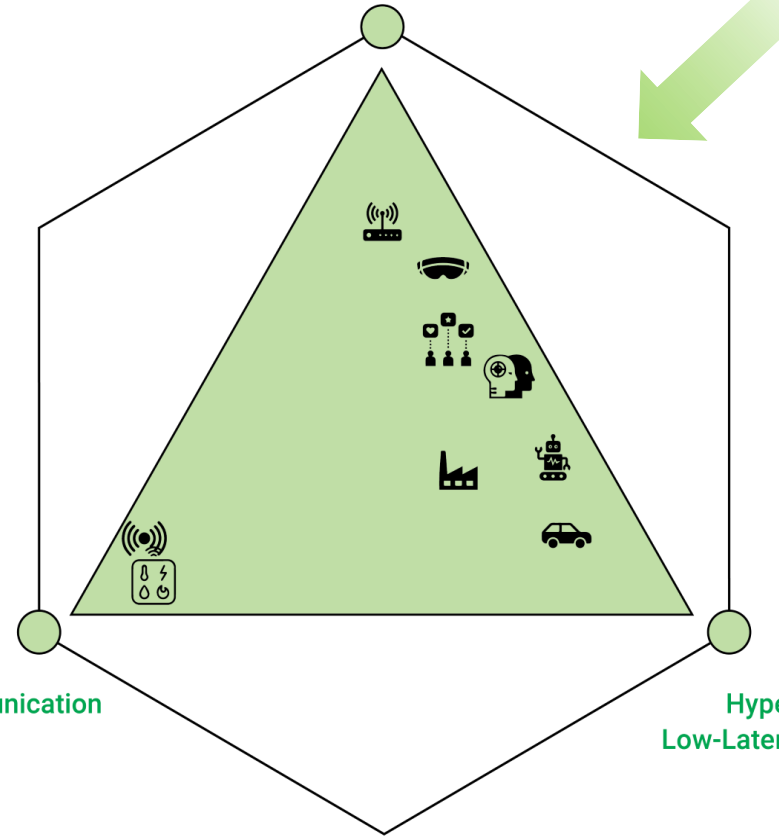
5G to 6G KPI Enhancements



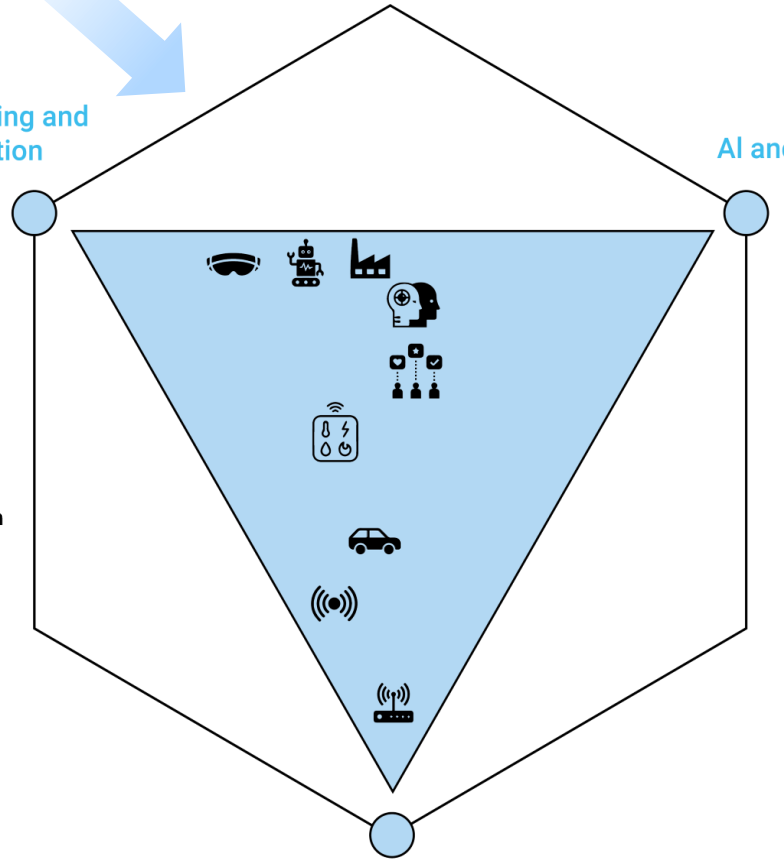
Enhancement Required Relative to Realized 5G:

Mapping NGA Use Cases to IMT-2030 Usage Scenarios





- Multi-Sensory XR
- Digital Twins
- Fixed Wireless Access
- Personalized User Experiences
- Robots
- ITS/Connected Vehicles
- Smart Factory & Industrial Automation
- Low Power Wide Area
- Short Range Massive Sensors



Technologies and Use Cases

Selected Subset of Technologies	Technology & Market Readiness	Multi-Sensory XR	Digital Twins	Fixed Wireless Access	Personalized User Experiences	Robots, Robotic applications	ITS/Connected Vehicles	Smart factory, Industry automation	LPWA	Ambient IoT/ Massive Sensors
Advanced MIMO	High									
Spectrum Sharing	High									
Upper mid-band enhancement	Medium									
NTN	Medium									
Positioning	Medium									
JCAS	Medium									
Distributed computing or cloud	Medium									
AI/ML	Medium									

Essential

Beneficial

Not needed

Relevant NGA Research Priorities

- New Radio Components & Antennas
- Trust, Security, Resilience
- Artificial Intelligence AI/ML
- Spectrum Sharing & Enhanced Spectrum Access
- Radio Access Technologies
- Joint Communication & Sensing
- Cloud Native Networks and Distributed Cloud

Key Considerations for 3GPP

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- Recommended Use Case Priorities, Technologies and Research Actions are aligned to NGA Vision and North American Needs
- Importance of observability, choice, and circular economy for implementing key sustainability indicators in order to achieve Net Zero emissions
- Importance of cost and operational efficiency to address economic sustainability and overcome the digital divide
- Identified and studied eight Verticals for 6G North American Needs
- Identified key technology components corresponding to the use cases
- The success of 6G will require collaboration across governments, industries, and academia

NGA 6G Library

Identified prioritized use cases and corresponding North American Market needs and KPIs in alignment with IMT-2030 usage scenarios

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Building the foundation for North American leadership in 6G and beyond