3GPP TSG SA1#106
May 27 – 21, 2024
Jeju, Korea

S1-241050
Agenda Item 8

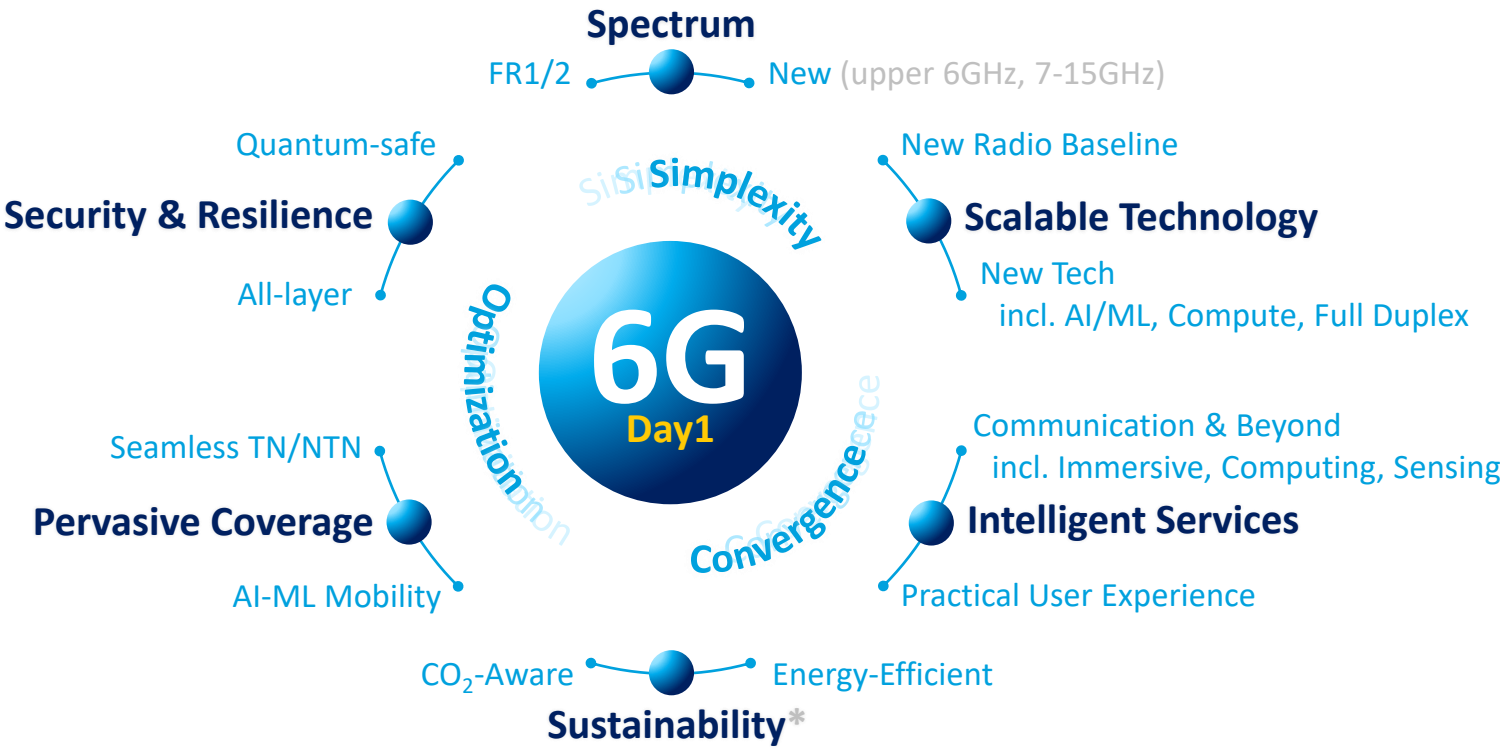
Considerations for SA1 Rel-20 Part 2 study

6G

MediaTek Inc.

6G Day-1

Rel-21 – Commercial ~2030 – Consumer-focused



* Sustainability also considering bridging the digital divide

Motivation

Meaningful Global 6G from Day 1

- **Mission:** To enable superior user experience in immersive and sticky applications over pervasive coverage with sustainable low energy consumption and constrained cost, following three defining attributes:
  - Sustainable improvement under **Simplexity** principle
  - Native system **Optimization** led by practical user experiences
  - Native x-domain **Convergence** for efficiency & performance

- **Key motivations**
  - New use cases, applications, Device Types
  - Access to and optimal usage of Spectrum
  - Practical Technology Innovation
  - Energy Efficiency and Sustainability

Lessons learnt from 5G are important

- 5G was driven by IMT2020 eMBB, mMTC and URLLC
  - eMBB The consumer market, driven by eMBB, has brought success to 5G along the same vein as 4G
  - mMTC An early decision to not design a new 5G LPWA has secured 3GPP LPWA CIoT success into 5G era
  - URLLC Subject to different market dynamics than the consumer market, the IIoT market uptake is slow
- 5G has attracted major interest in the 3GPP ecosystem
  - 3GPP satellite, leveraging existing 3GPP technologies, brings true global coverage with a single device (esp. together with terrestrial deployments)
  - "New-to-3GPP" Verticals: misc. suites of 3GPP specs are available, pending wide market adoption
- Economies of scale are essential for success
  - Tech adoption in the consumer market can pave the way to success in other markets

- A simple migration story is required
  - Competing 3GPP 5G standards, stemming from misc. Arch options, led to complexity, confusion and a fragmented 5G market
  - 5G non-standalone (=EPC) is widely deployed.

    5G standalone (=5GC) is slowly growing
- Day-1 sustainability is essential

- **6G to build on a backwards-compatible evolution of 5GC**
- **3GPP: need for coordination between SA1 and RANp wrt KPI setting and requirements**

Continued evolution driven by

SA1

New Use Cases/Applications, Device Types

- **Key new Use case/Application** trends, high throughput and guaranteed (low) latency, higher capacity:
  - **Immersive** user experience
  - **Generative AI** as a key disruptor
- **Cross-domain convergence** driving new use cases and improved UXP incl.
  - Computing and communication
  - Sensing and communication
  - Terrestrial and Non-terrestrial
- **Consumer market** to drive ”initial” 6G adoption, as in previous generations
- Corresponding **Device types** to address the above
  - w/o unnecessary device market fragmentation

New & Existing Spectrum for 6G

- **Upper-6GHz and “FR3”** to complement existing **FR1/FR2**
  - meeting anticipated capacity demand from new use cases/applications
- **Effective Re-farming from legacy** to 6G and **Aggregation of new and existing spectrum** to maximize UXP
- **New licensing scenarios or regimes** (incl. “complementary” usage of TN spectrum for NTN)

Practical Technology Innovation

- **Improved baseline Radio design** (based on current state-of-the-art) with no backwards compatibility constraints
  - Applying “Simplexity” and “Optimization” principles
  - Latest deployment trends, KPIs
- **AI/ML as a native component** for operational effectiveness
- **Pervasiveness of computing power** across devices and communication infrastructure

  Collaborative compute for AI/ML tasks, Ambient Intelligence

  Virtualization and cloudification to enable the above
- Future-proofed for **Security, Resilience and Trust**

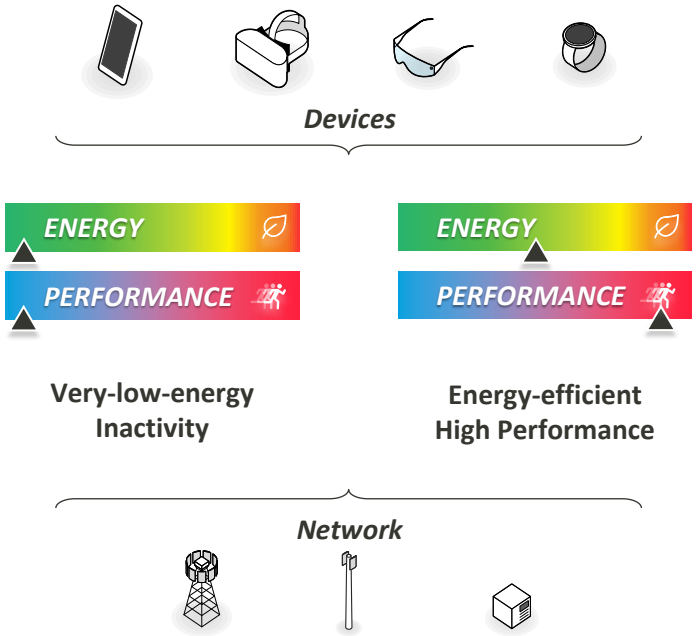
Essential focus on **Energy efficiency** and **Sustainability**

SA1

Sustainability

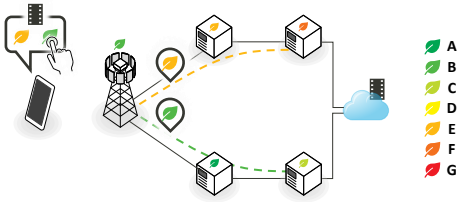
Native Energy Efficiency

Native Green credentials and Scalable design for all apps, scenarios, devices and network



Carbon-aware System

Carbon-awareness enabling reduced carbon footprint



- End-to-end CO_2 emissions tracking (carbon-intensity)
- Carbon-aware resource management
- User-driven carbon-aware service delivery

Sustainability KVI(s)

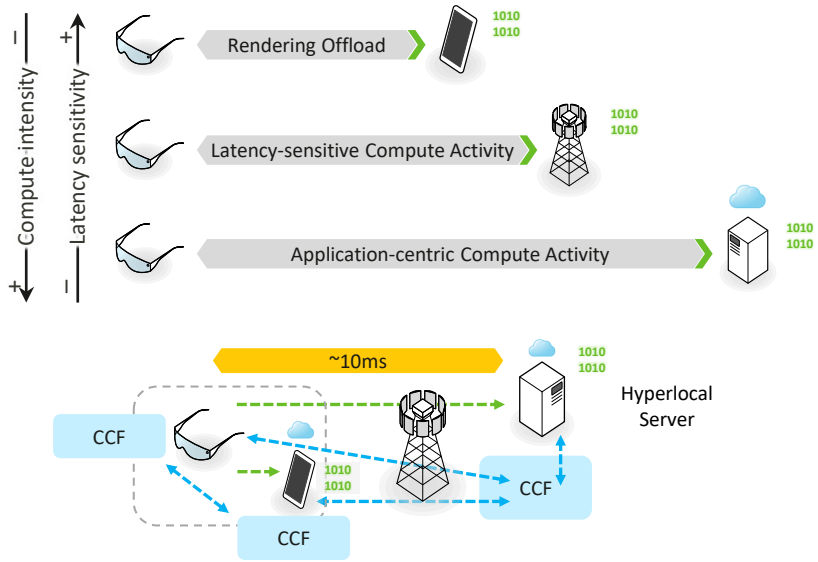
Key Value Indicator(s)

- Transparency and Validation
- Need for tangible, **measurable** metric when in-operation

Ambient Intelligence

Integrated Computing and Communication

Compute tasks offload to Device, Access Network for demanding application requirements



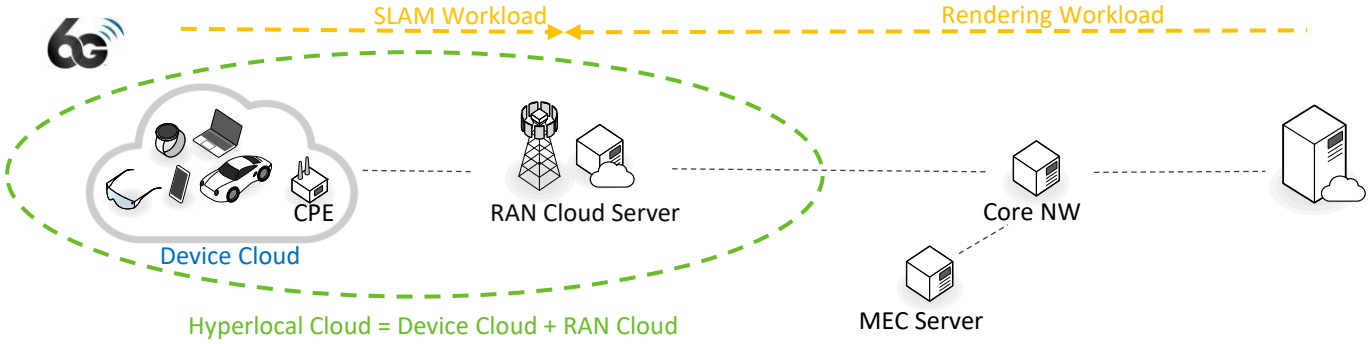
CCF: Compute Control Functionality — Compute offload — Control signaling

Lead Example Use Cases

- XR Compute Workload offloading
- Collaborative Perception for improved car safety
- AI Agent

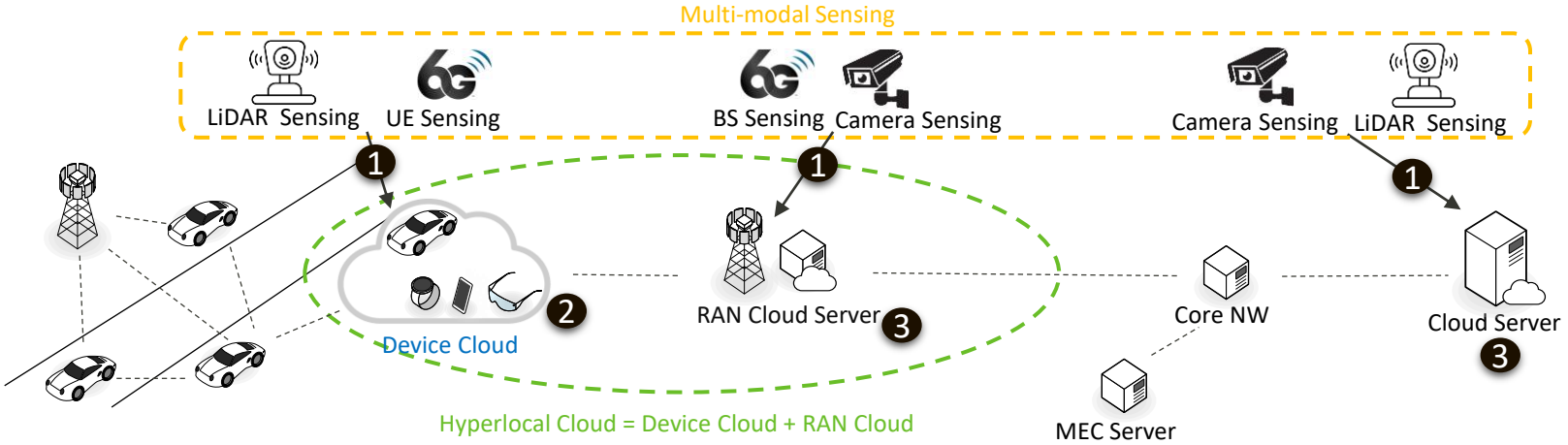
XR Compute Workload Offloading

- **Mobile augmented reality applications require compute workloads e.g.**
  - Simultaneous Localization and Mapping (SLAM) for precise environmental mapping and user positioning
  - Real-time rendering for integrating virtual elements (e.g., avatars, objects) and environment
- **Device limitations (e.g. capabilities, battery) may require compute offload**
- **Good user experience requires**
  - [Computing] Low-latency – excessive delay disrupts the user experience
    Computing resource must be close to end-user (physical distance and # of hops) to minimize absolute latency/jitter
  - Seamless service continuity with minimal interruption
- **3GPP System to provide compute capabilities, incl.**
  - Interaction between computing/communication management functions for efficient dynamic offloading
    E.g., QoS-like regime to manage latency/performance/capacity of compute tasks
  - SLAM/Rendering workloads could be processed by **local device cloud** or RAN Cloud server
  - Greater control over processed data **in-device** both for data governance and privacy



Collaborative Perception for Improved Car Safety

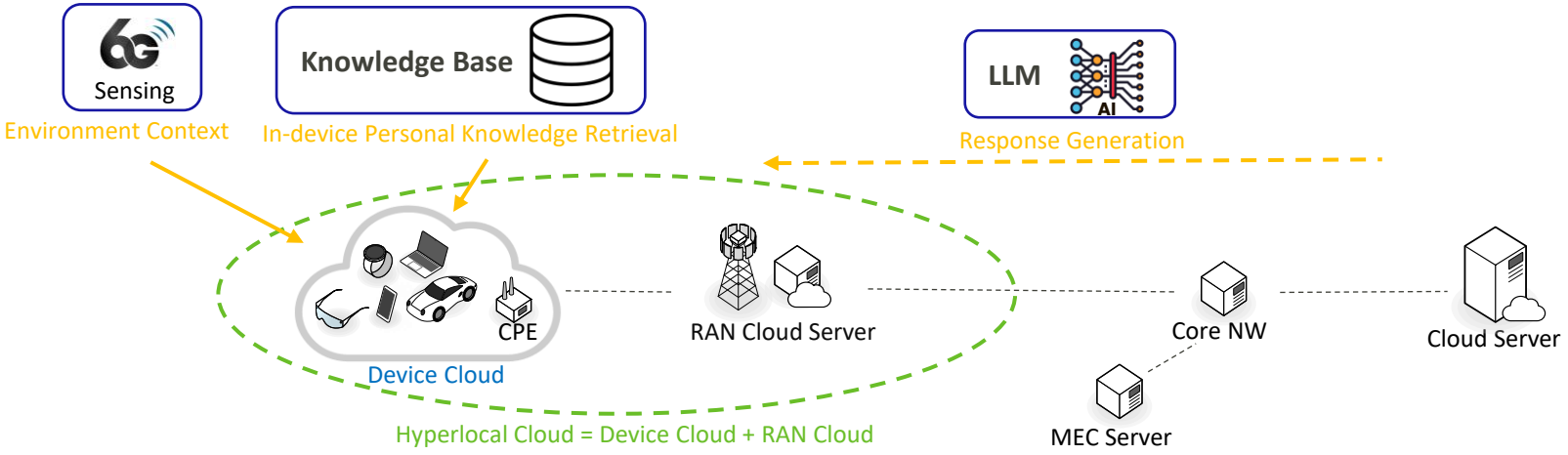
- **Collaborative multi-modal Sensing by-ADAS, by-3GPP-Network and by-Road-Safety-Infra**
  - Will generate real-time massive volume of data 1
  - Will require computing capability support and information exchange in a decentralized and real-time manner
- **Decentralized workload** is essential for efficient, private, and low-latency data processing considering the strengths of different sensor types
  - **Data governance and privacy in-device:** greater control over processed data, vs forwarding raw data 2
  - **Reduce transport network burden:** Early pre-processing of raw data close to collection points to reduce the data volume sent to next processing node
  - **Multi-node cascaded processing**: On-path combination/fusion data processing progressively produces useful results 3
- **3GPP System to provide compute capabilities**
  - Enhance interaction between computing/communication management functions for efficient and real-time processing
  - Energy reduction by processing data at the optimal node(s)



ADAS: Advanced Drive-Assistance System

AI Agent

- **AI agent using retrieval-augmented generation (RAG) technology require two phases**, e.g.,
  - Retrieve relevant knowledge for a user query from a database based on user's personal knowledge/surrounding environment
  - Generate a response through pre-trained AI model (e.g., LLM) given the retrieved data
- **Necessity for real-time AI response** is paramount (as excessive delay disrupt the user experience)
  - LLM service must be close to user to minimize absolute latency
- **3GPP system to provide compute capabilities**
  - Provide response via LLM model close to user, e.g., processed by RAN cloud server
  - Provide mechanism for device to discover LLM model(s) nearby with RAG support



Thank you!