Compute-First Networking Use Cases

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What is CFN?

- Collaboration between Huawei, BT, and Cambridge University

- Looking at the intersection of use cases, node and network technology for compute-first networking, i.e., in-network computing
  - Investigate driving **use cases** for CFN, leading to **requirements** for node and network technologies
  - Develop key networking and node **technologies**
  - Provide **demonstration** of key benefits in selected use case

Taxonomy for Use Case Work

- **Description**: Brief description of use case
- **Services**: What services are used here?
- **Drivers**: What drives the need for solutions?
- **(Expected) Economic Value**: Include references to market reports
- **Time to Demand**: When are solutions to this use case required that rely upon novel CFN features?
  - Express in Short (<2 years), Mid (<5 years), Long (<10 years)
- **Stakeholders**: Who drives adoption? User organization? Service provider? Operator? Regulatory body?

Distributed Data Storage

- **Description**: There is a need for vendor and service provider independent data ecosystems and marketplaces, open to all at reasonable cost and with low entry barriers.
- **Services**: DCS/DLTs with
  - Discovery (matching constraints such as HW capabilities, security, PoW pattern)
  - transactions (multipoint sending of constraint-based requests to selected group of miners) and
  - PoW/PoS (computation over pattern)
- **Drivers:**
  - Data sovereignty and locality, combined with growing opposition to centralized and foreign owned data platforms
  - Growing value in data gathering and sharing
  - Regulation, such as GDPR

Transportation/V2X

- **Description**: Vehicle-to-everything (V2X) is communication between a vehicle and any entity that may affect, or may be affected by, the vehicle, with D2D, D2C, and D2N modes.
- **Services**: A/V communication, computational calls, sensor gathering and fusion, e.g., for
  - Positioning through distributed AI
  - Localized object recognition for L5 driving
  - Localized dynamic high precision maps
  - Predictive accident avoidance
  - Predictive vehicle flow management
  - Virtual black block
  - …

  - Provide reaction capacity to (virtualized services with fast re-routing)
  - Reduce needed capacity (filter, pre-processing)
  - Data privacy and access control (link to DDS use case)
  - Always connected to best service (compute-aware traffic steering)

- **Drivers:**
  - L5 driving requirements in various worldwide regions

Digital Twin

- **Description**: "*A Digital Twin is a virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity*" [DT Consortium], consisting of data, computational and representational models, and service interfaces
- **Services**: A/V communication, computational calls, sensor gathering and fusion, e.g., for
  - Data retrieval, fusion and storage (e.g., using DLT solutions)
  - Distributed AI computations for models, using gRPC or RDMA invocation models
  - Communication patterns may be 1:1, 1:n, M:N with short-lived groups, including for A/V communication, often needing to optimize communication as well as computation pipeline (e.g., live feed A/V with feature extraction in central unit)
- **Drivers:**
  - Driven by several vertical industries, such as manufacturing, automotive, supply chains & logistics, aerospace, defense, utilities, smart grids, healthcare, smart cities
  - Emergence of a number of industry initiatives, such as DT Consortium, IDTA, GAIA-X

Requirements Derived from Use Cases

- Focused on the notion of ‘computational processes’ being identified in the network system, not their communicating network endpoint, leading to requirements for
  - **Identification** (linking to processes, obfuscation of purpose)
  - **Announcement** of computation (within and across domains, delegated announcements, pre-announcement)
  - **Interconnection** across limited domains [RFC8799]
  - Allowing to **bind** to available computational instances **under dynamic constraints**
  - **Collective communication** patterns (request-specific)
  - IPv6 support
- Note: some of those requirements already captured in existing COIN use case draft

Next Steps

- For COIN
  - Consider integration of use cases & requirements into existing COIN use case draft

- For CFN project
  - Pick a use case of choice
  - Work towards system architecture and demonstrator