Press release

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Halfway through DESIRE6G: a look at our achievements

DESIRE6G, a SNS JU and Horizon Europe project aimed at revolutionizing next-generation wireless communication systems, has reached the halfway point of its 3 year timeline. We take this opportunity to highlight our main achievements.

WP2: Requirements and Architecture Design

In WP2 we have successfully defined five use cases along with their Key Performance Indicators (KPIs) and Key Value Indicators (KVIs). These use cases were selected after a comprehensive review of various industry initiatives such as NGMN, Next G Alliance, the Hexa-X EU project, and academic research. Based on the system requirements derived from these use cases and the technological innovations targeted by our project, we have developed the end-to-end architecture of DESIRE6G, which extends from the RAN to the Core interconnected by the transport network. This architecture integrates programmability, acceleration capabilities, and autonomous networking through Multi-Agent Systems (MAS), with deployment managed by a comprehensive Service and Management Orchestrator (SMO). Additionally, we have designed a robust methodology for defining the project datasets, which will play a crucial role in our ongoing and future research activities.

WP3: Intelligent and secure management, orchestration, and control

In WP 3 we have made significant strides in building the Service Management and Orchestration (SMO) framework for DESIRE6G. The focus has been on three main areas:

1. **Day 0 Operations:** Orchestration and management of service and application descriptions, including optimal function split (IBN) and service placement optimization (Network Optimization

Engine). We have also developed mechanisms to ensure efficient, low-latency communication between SMO components.

2. Day 1/2 Operations: Development of the Multi-Agent System (MAS) to optimize deployed services based on runtime parameters, ensuring security and attestation of functions using distributed ledger mechanisms.

3. AI-Based Algorithms: Deployment of AI algorithms within the SMO (MLFO) and MAS for network service control, enhancing automation and efficiency.

WP4: Unified Programmable Data Plane Layer

WP 4 has made a significant step towards defining a programmable Radio Access Network (RAN), transport, and core forwarding plane. This allows for flexible, customized packet processing operations, protocol support, and multi-tenancy, enabling the use of service-specific software stacks and hardware acceleration. The architecture developed addresses the main workflows for network service deployment and runtime operation/optimization, supported by pervasive service and infrastructure monitoring.

Some of our key WP4 results are:

- Infrastructure Management Layer (IML): Designed IML as a local NFVO and VIM for managing computational, softwarized network functions, and hardware-accelerated data plane resources. Added multi-tenancy support for P4 programmable data planes and developed an access control proxy for control plane entity isolation.
- Programmable Traffic Management: Implemented solutions for performance isolation and dynamic reconfiguration in the data plane for slices and users, and planned addition of a QoS API for dynamic QoS reconfiguration based on monitoring KPIs.
- Infrastructure Network Functions: Designed main network functions for end-to-end deployment across multiple DESIRE6G sites.
- Hardware Acceleration: Identified 11 network functions suitable for hardware acceleration; began development of 4 HW-accelerated network functions.
- Load Optimization Methods: Designed IPR-protected methods for hybrid CPU-based and hardware-accelerated data plane function instances, enabling seamless scaling.
- SOL Framework Integration: Started integrating SOL framework with vAccel for efficient neural AI-enabled application deployment in DESIRE6G, improving processing speed and efficiency.

- Service Monitoring Innovations: Adopted P4-based in-band telemetry (INT) for passive flow monitoring across network service segments, and integrated INT solutions to reduce traffic overhead and improve efficiency, interfacing with the MAS system for dynamic re-optimization.

WP5: Integration, Validation and Demonstration

In WP5 we have begun building the distributed testbed environment for the project. This involves defining the D6G main integrated testbeds, D6G federated testbeds, and both short-term and long-term demonstrations. During the first period, while awaiting a stable architectural framework (WP2) and software/hardware releases from technical work packages 3 and 4, we adopted a bottom-up approach to identify and implement mature Proof-of-Concepts (PoCs). These PoCs aim to support and accelerate the integration and final demonstration phases. We have conceived several preliminary PoCs, particularly focusing on the innovative Multi-Agent System. Moreover, we released a first version of open datasets and commenced the integration phase of released components to produce preliminary versions of demonstrations related to the main use cases, such as augmented reality and digital twins.

Some WP5 key results are:

- D6G Testbed Infrastructure: Identified and built distributed testbed infrastructure, including two main integration testbeds (ARNO and 5TONIC) and several federated testbeds for component testing and pre-validation.
- Open Source Data Sets: Released and described the first release of open source data sets for AI training and inference, available from open source repositories and aligned with planned demonstrations and AI developers' needs.
- Component Integration: Started integrating components from the first software releases of the intelligent and secure management, orchestration, and control platform, (Milestone 3.2) and the unified programmable data plane layer (Milestone 4.2), developed an integration methodology to ensure compatibility and interaction within the D6G architecture.
- Demonstrations: Four demonstrations, 2 of which already presented at flagship events:
    - Demo 1: AR with Perceived Zero Latency. To be presented at ICTON 2024 in July 2024.
    - Demo 2: Real Time Digital Twin
    - Demo 3: Deployment of Secure Machine Learning Pipelines for Near-Real-Time Control of 6G Network Services. Presented at OFC2024 in March 2024.

- Demo 4: Distributed Multi-Agent System fed with Telemetry Data for Near-Real-Time Service Operation. Presented at OFC2024.

WP 6: Exploitation and Innovation

The consortium has been very active in communication and dissemination efforts to maximize project awareness and to ensure that project findings are effectively communicated to stakeholders, disseminated through various channels, aligned with standardization efforts, and strategically exploited for maximum impact and value creation. Specifically, DESIRE6G has delivered:

- 25 scientific publications (7 in journals and 18 in international conferences/workshops);
- 30 dissemination talks/ presentation in conferences, workshops, events;
- 3 organized (or co-organized) events (e.g., workshops);
- 2 demonstrations at flagship events;
- 8 standard contributions (3 adopted/agreed/accepted);
- 5 open source contributions (4 accepted);
- 5 patent filed applications.

DESIRE6G is currently organizing, together with PREDICT-6G and DETERMINISTIC6G, the **2nd 6G-PDN workshop** for 18 November 2024, focused on 6G Programmable Deterministic Networking with AI. The workshop is co-located with MobiCom'24, and will take place in Washington DC, USA. The call for papers is now open, with deadline on July 19th. Consider submitting here.

Overall, the work carried out in DESIRE6G has significant policy relevance, particularly in relation to legislation and standards. Therefore, we are consistently streamlining our findings into the SNS working groups to ensure that our research shapes the essential frameworks and regulations governing emerging 6G technologies.

Follow our developments via our website and social media channels:

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Project Coordinator
Dr. Chrysa Papagianni
Institute for Informatics
University of Amsterdam

Technical Coordinator
Gergely Pongracz
Research Area Networks
Ericsson Hungary

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