DESIRE6G

Meeting extreme KPIs through Deep Programmability in 6G AI-Native Systems.

OVERVIEW

One of the primary goals of 6G should be simplicity, as the organic outcome of using cutting-edge technologies such as the ability to programme the user plane, cloud-native features like automatic scaling and failover, seamless acceleration of network functions (NFs) or application workloads, and artificial intelligence-driven network automation. To this end, the DESIRE6G project proposes a novel architecture that utilises and expands upon these promising technologies with the aim of supporting diverse use cases, while focusing on addressing the challenges of ultra-low latency, mission critical control loops.

CONCEPT/ ARCHITECTURE

The figure above illustrates the DESIRE6G (D6G) system organised into four layers. The system is deployed on distinct D6G sites across the edge-to-cloud continuum. Each site can contain hardware accelerators and traditional compute resources, running the (virtualised) NFs necessary for the execution of the deployed network services, and application functions (AFs). Sites vary based on requirements and location, e.g., sites supporting RAN operation are equipped with COTS hardware including accelerators, FPGAs/ ASIC boards, RF antennas etc. One of the novelties of our architecture is the D6G UE that may run a stripped-down version of the D6G stack, enabling E2E monitoring and service control. The D6G layers are outlined in the following:

- **Intent-based Orchestration Layer**: The Service Management and Orchestration (SMO) platform is responsible for orchestration, lifecycle management and automation of E2E network services (NSs), in line with current specifications (i.e., O-RAN, ETSI MANO). Towards that end, the DESIRE6G SMO focuses on activities such as ML-powered intent-based service management, orchestration of AI/ML workflows, network service federation employing Distributed Ledger Technology (DLT) and data management and exposure services pertaining to the SMO/non-RT RIC. Its northbound API enables the full operation of system and the NSs.
- **Optimisation and Control Layer**: DESIRE6G implements distributed network intelligence employing a Multi-Agent-System (MAS) closer to the physical infrastructure, responsible for service-specific optimisations, receiving monitoring information and fine-tuning the network and compute resources accordingly. It employs and dynamically configures the D6G pervasive telemetry system to receive service specific performance indicators, e.g., end-to-end latency for latency-critical services. The MAS is secured with binary hardening of the agents and a lightweight application based DLT for dynamic multi-agent association.
- **Programmable data plane (PDP) layer**: The E2E PDP employs highly disaggregated NFs and AFs to carry out the logic of each selected service. By hiding the complexities of the underlying execution environments and hardware entities from the logical view of the service, this layer offers a cloud-native-like data plane design with transparent scaling / failovers and hardware acceleration. The infrastructure management layer (IML) is at the heart of the PDP layer, responsible for bridging the logical view and the physical world: it supports virtualisation while seamlessly accessing and controlling hardware accelerators and functionalities like service routing, flow-aware load balancing and heavy hitter handling.

Deep Programmability and Secure Distributed Intelligence for Real-Time E2E 6G Networks

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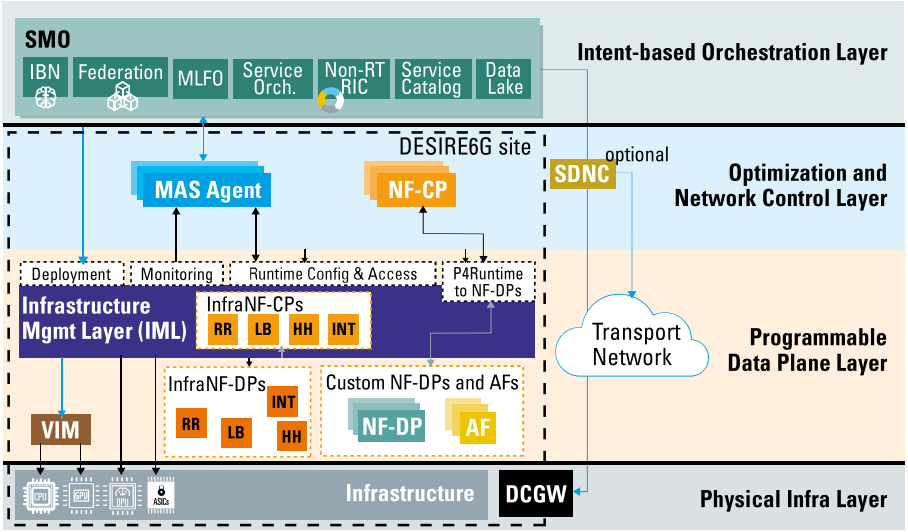
Verticals concerned:
Augmented Reality, Digital Twins

Project Consortium Members:
Ericsson, NEC Labs Europe, NVIDIA, Telefonica, University of Amsterdam, University Carlos III of Madrid, Eötvös Loránd University, University of Oulu, Technical University of Catalunya, Sant'Anna School of Advanced Studies, National Inter-University Consortium for Telecommunications, Nubis PC, Tages Solidshield, Accelleran

DESIRE6G (D6G) system



USE CASES/ SCENARIOS

The proposed innovations will be will be validated and evaluated utilising the 5TONIC laboratory (https://www.5tonic.org) in Spain and the ARNO testbed (http://arnotestbed.santannapisa.it) in Italy. DESIRE6G focuses on two representative 6G use cases, featuring Augmented Reality (AR) and Digital Twin (DT) industrial applications. The first use case involves an AR surveillance and inspection application offering a (perceived) zero latency immersive experience to the end-user. The application aims to exploit a camera-equipped drone to perform inspection of the area of interest, collect images and send them to an edge computing node to perform data analysis and object detection. The operator via the headset will be able to control the drone's operations, e.g., select the cameras' direction and/or focus on specific objects. Using the D6G software stack, it will showcase AI-powered and hardware-accelerated communication to enhance AR, reaching new level of interaction between the user and the connected system. Moreover, AI-augmented object detection will grant the user a versatile way to quickly scan wide areas, gaining valuable information about the surroundings. The second use case involves an operational Robot DT, where robots continuously transmit sensor data upstream (e.g., lidar, camera, odometry, joint states) to update their virtual models, while simultaneously they receive real-time navigation instructions in the downstream. We will showcase that the system can support the required ultra-low latency of the control loops and their respective reliability requirements, through the proposed innovations at the control and data plane (in-network acceleration and optimisation etc.). Both use cases can benefit from the D6G E2E service orchestration and MAS layers to enable granular service life-cycle management with optimised resource and energy consumption.

FIRST RESULTS

Current and envisaged use cases, extending beyond 2030, require a more flexible and dynamic network architecture. 6G systems are expected to further broaden the range of vertical sectors supported, with reduced complexity while pushing performance limits even further. DESIRE6G addresses these objectives by proposing an AI-powered intent-based cloud native 6G system architecture supported by a performant, measurable, predictable, and customisable data plane. With the initial architecture and interface specifications at hand, along with the software releases of novel functionalities/components, DESIRE6G will technically validate the proposed innovations via PoCs as well as assess the sustainability of the DESIRE6G system through techno-economic studies.