CELTIC-NEXT
Next Generation Communications

Project Information

PICCOLO

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Partners:

ARM Limited, UK

BT, UK

Fluentic Networks, UK

InnoRoute GmbH, Germany

Peer Stritzinger GmbH, Germany

Robert Bosch GmbH, Germany

Sensing Feeling Ltd, UK

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Project Websites

www.celticnext.eu/project-piccolo

https://www.piccolo-project.org/

Piccolo: In-network compute for 5G services

The Piccolo research project develops new solutions for in-network computing that remove known and emerging deficiencies of edge/fog computing. Starting from a set of innovative industry-relevant use cases, we are creating a distributed computing platform that can leverage different kinds of underlying infrastructure and can cater to various business needs whilst providing an open platform for future applications.

Main focus

Our motivation is that the centralised cloud computing model in use today has difficulty handling new and emerging applications. Ever-more powerful user and IoT devices are producing enormous amounts of data – too much to send into the cloud for centralised processing, and further the round trip time is too large for the stringent latency requirements of some applications. Also, there are increasing concerns about leaving data privacy at the mercy of big cloud operators.

Therefore our main focus is to enable a shift from centralised to in-network compute, so as to alleviate these concerns, whilst thereby opening up new horizons for application development and creating new infrastructure markets.

Approach

Our approach has three main strands.

Firstly, we study the use cases for in-network computing and associated requirements – in particular, in the context of

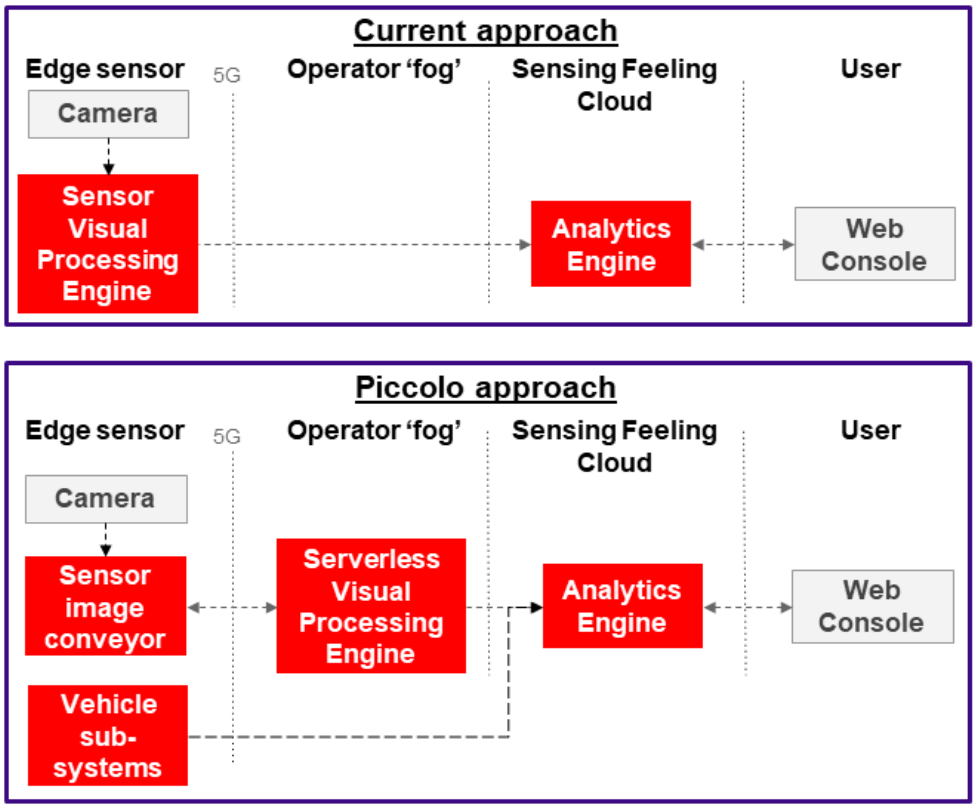

Diagram: Example of Piccolo approach, as being instantiated in one of our Proof of Concept demonstrators

several experimental proof-of-concept applications that reflect our Partners' commercial interests in the fields of vision processing, assisted driving, smart factories and the automation of network management.

One prototype provides a real time risk measurement for a vehicle. Today's vehicles come equipped with a myriad of sensors. By combining these in-vehicle metrics such as speed and acceleration with scene telemetry obtained from processing camera images (concerning driver fatigue, nearby pedestrians for example), we derive a measure of the current safety risk. This information can be displayed directly to the driver, or potentially even to a fleet manager thousands of miles away.

We are developing other proof-of-concept demos that use Piccolo's distributed computing to help with the control of a smart factory, and with the automation of network management.

A second strand of work concerns the design of the individual Piccolo nodes in a network. We want an open, low latency, efficient, secure, in-network platform that supports Functions-as-a-Service (FaaS). It needs to allow a wide variety of types of hardware and execution environment, as nodes could vary from road-side units, 5G base stations and IoT devices.

Our final strand considers how to design a distributed computing system built from the individual Piccolo nodes. The resulting solution needs to be flexible, optimising the placement and execution of application functions across the nodes and the usage of networking and computing resources.

Main results

The main goal of the project is to bring the Piccolo distributed computing concepts closer to real usage. The main expected results are:

- Design for the individual Piccolo nodes, which provides a trustable, secure and efficient platform for running fine-granular compute functions with adequate isolation and performance.
- Design of the distributed computing system built from the individual Piccolo nodes. It can incorporate different types of nodes (such as automotive platforms, edge nodes, and cloud backends).
- Control algorithms that can flexibly place application functions across the nodes, so as to meet the application's requirements whilst optimising the usage of networking and compute resources.
- Evaluation results for the different aspects of the system, including application development (usability, productivity), resource efficiency, resilience, scalability, and performance.
- Proof-of-concept use case prototypes from automotive edge computing and data offloading for vision processing, amongst others.

Impact

The Piccolo project's impact is through:

- Concepts and research insights, which help bring to fruition distributed computing at the edge of the network
- Prototypes to help evaluate and advance our concepts
- Contributions to standards and potentially open source projects
- Products arising directly from or inspired by Piccolo.

We aim to provide the cornerstones of a new approach to networked application design and development that can enable:

- The creation of a new ecosystem of networked applications for different vertical sectors;
- New key technologies for integrating computing and networking that promote a cloud-platform independent model of distributed computing which can strengthen the position of European vendors and network operators in the global competition;
- A boost for the Piccolo infrastructure vendors and operators (ARM, BOSCH, BT, FLUENTIC) as early developers and adaptors;
- A boost for the Piccolo application providers (BOSCH, SENSING FEELING, INNOROUTE, STRITZINGER) who can make first use of the Piccolo advances in their use cases.

About CELTIC-NEXT

CELTIC-NEXT is the EUREKA Cluster for next-generation communications enabling the digital society. CELTIC-NEXT stimulates and orchestrates international collaborative projects in the Information and Communications Technology (ICT) domain.

The CELTIC-NEXT programme includes a wide scope of ICT topics based on new high-performance communications networks supporting data-rich applications and advanced services, both in the ICT sector and across all vertical sectors.

CELTIC-NEXT is an industry-driven initiative, involving all the major ICT industry players as well as many SMEs, service providers, and research institutions. The CELTIC-NEXT activities are open to all organisations that share the CELTIC-NEXT vision of an inclusive digital society and are willing to collaborate to their own benefit, aligned with their national priorities, to advance the development and uptake of advanced ICT solutions.

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