Overview of Piccolo project "In-network compute for 5G services"

COINRG Meeting

November 2020

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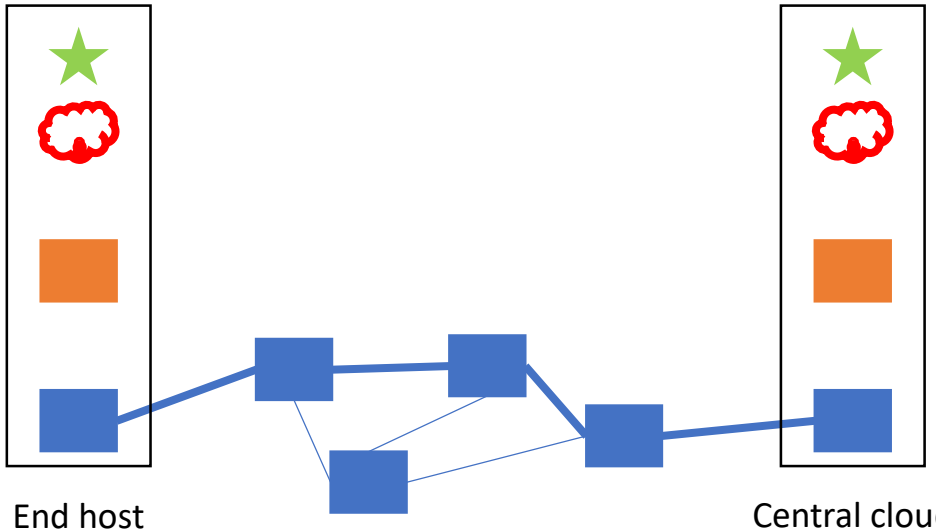
Piccolo project – key facts

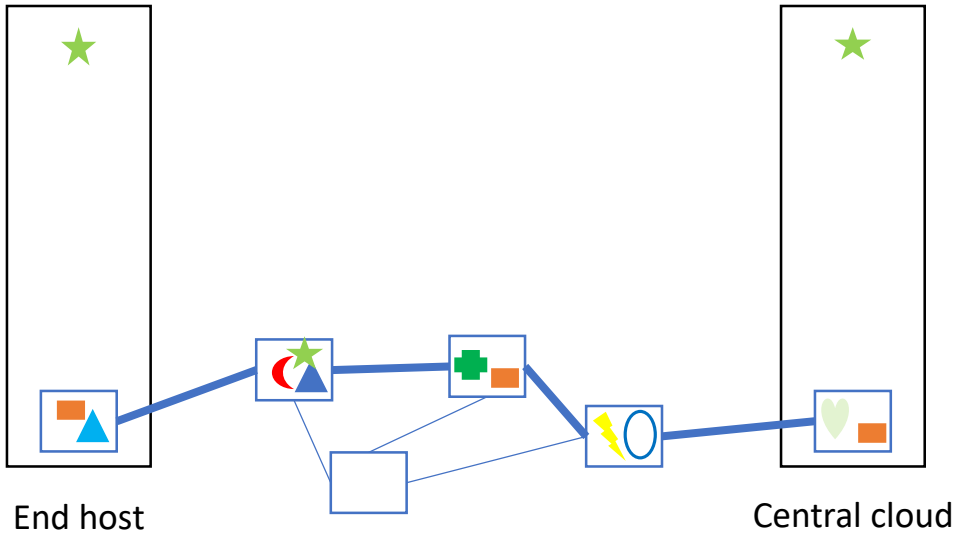
- “In-network compute for 5G services”
- Collaborative project under the Celtic framework
- Mix of large companies, SME and academic partners
- Longer-term research – in-network compute
- Plus earlier steps in Use cases & PoCs
- Jointly funded by Partners and Innovate-UK (UK) & BMWi (Germany)
- 2 years from October 2020
- https://www.piccolo-project.org/
- We’re keen to collaborate through fora such as COINRG

Partner	Key people
Arm	Chris Adeniyi-Jones
Bosch	Dennis Grewe
BT (co-lead)	Philip Eardley
Uni Emden/Leer (co-lead)	Dirk Kutscher
Fluentic Networks	Yiannis Psaras
InnoRoute	Andreas Foglar
Sensing Feeling	Jag Minhas
Stritzinger	Peer Stritzinger
TU Munich	Joerg Ott

Piccolo – In-network compute for 5G services



Today: Compute "out of the network"



Piccolo vision: Compute "in the network"

Today's problem	Emerging first step	Piccolo future
Inefficient & slow to shift data to function	Edge: shift function to nearer data	Holistic resource mgt
Linear computing: Single-ended functions (Lambdas)	Specialised compute (GPU)	Distributed computing: Chains, meshes and parallel micro-functions (Pi functions)
"Circuit-like" resilience & scaling	Load balancer at front end	"Packet-like" resilience & scaling
Network provides packet transfer	Operator edge initiatives: MEC, OPG	Network provides transparent in-network computing: permissionless innovation

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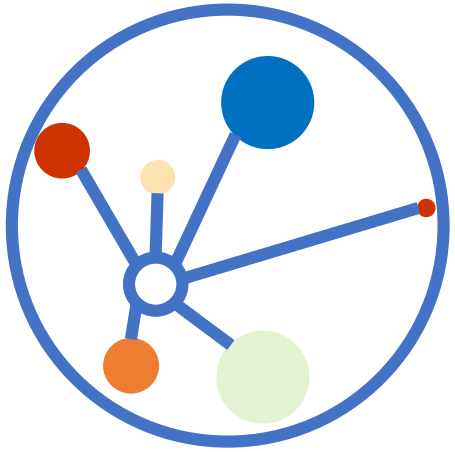
Piccolo – In-network compute for 5G services

Vision processing:
Multi-sensor processing

Future car:
Connected auto driving &
predictive diagnostics

Smart streetlight:
Automated placement of
functions & scaling



Network:
Platform as a Service &
Scalable network mgt

Common themes /problems:

- Reverse CDN problem
- Low latency
- User privacy
- Data ownership
- 3rd party apps

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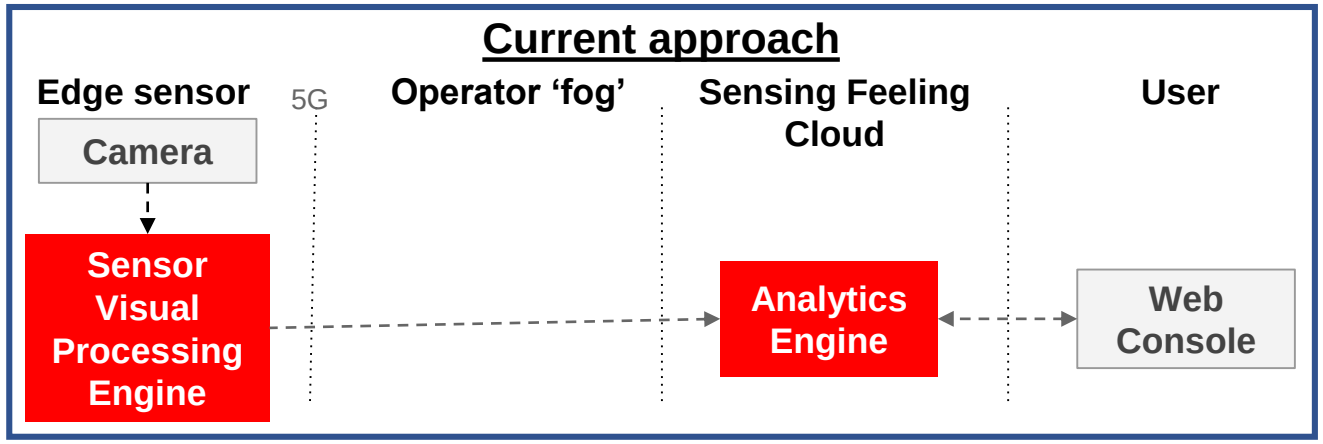
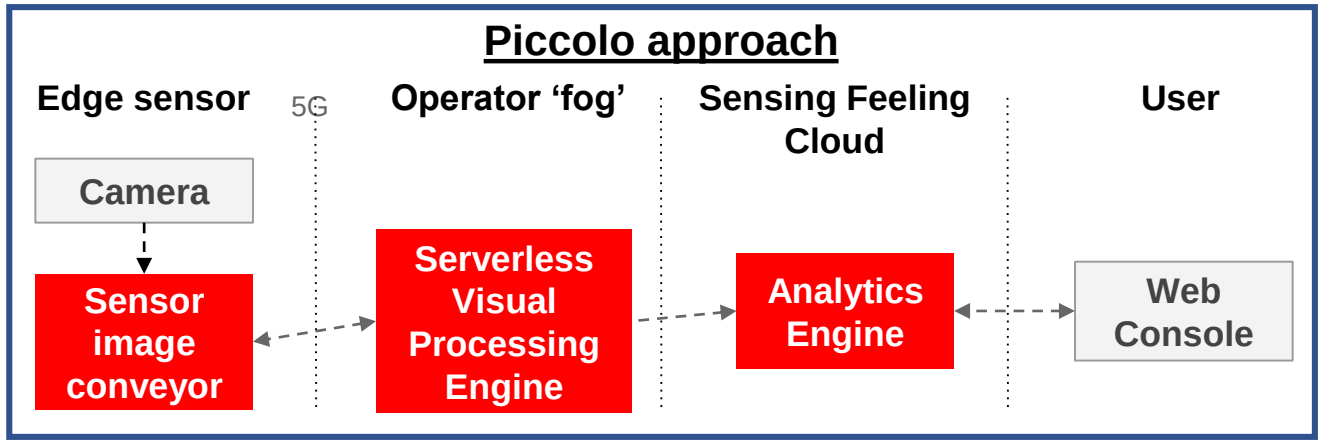
Vision processing use case – Human behaviour sensing

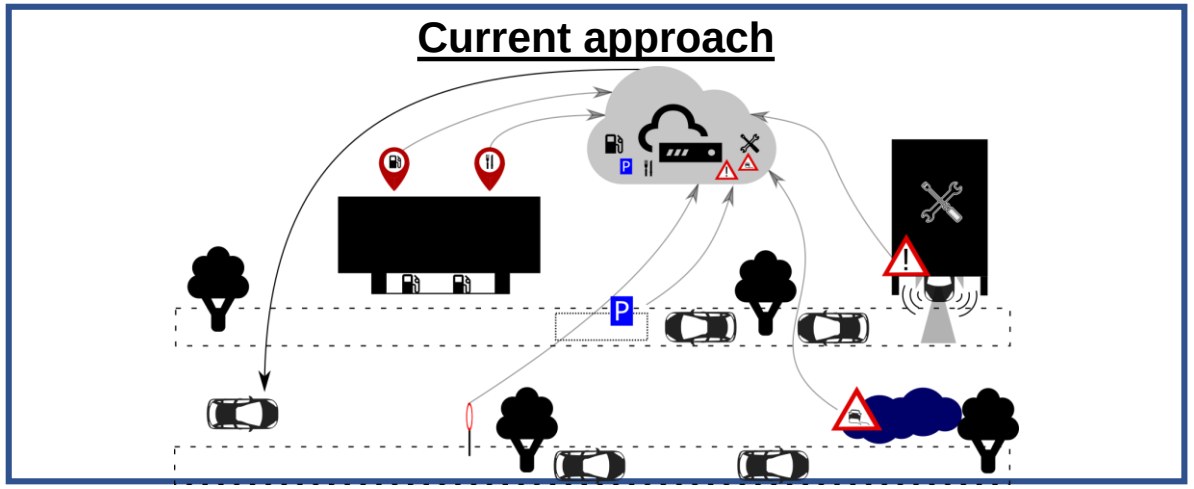
- Applications
  - Insight into people in real world spaces (train stations, shops, conferences…)
  - Safety & risk management
- Current Technical approach
  - Computer vision & machine learning
  - Focus on privacy & ethics – no video stored, no tracking of individuals etc
  - People, vehicles – occupancy counts, motion flow, attention to objects, emotional response
- Piccolo benefits
  - Low or ‘zero’ cost edge sensor - Address ‘long tail’ market
  - Attention focussing between multiple cameras
  - Adaptive and scalable

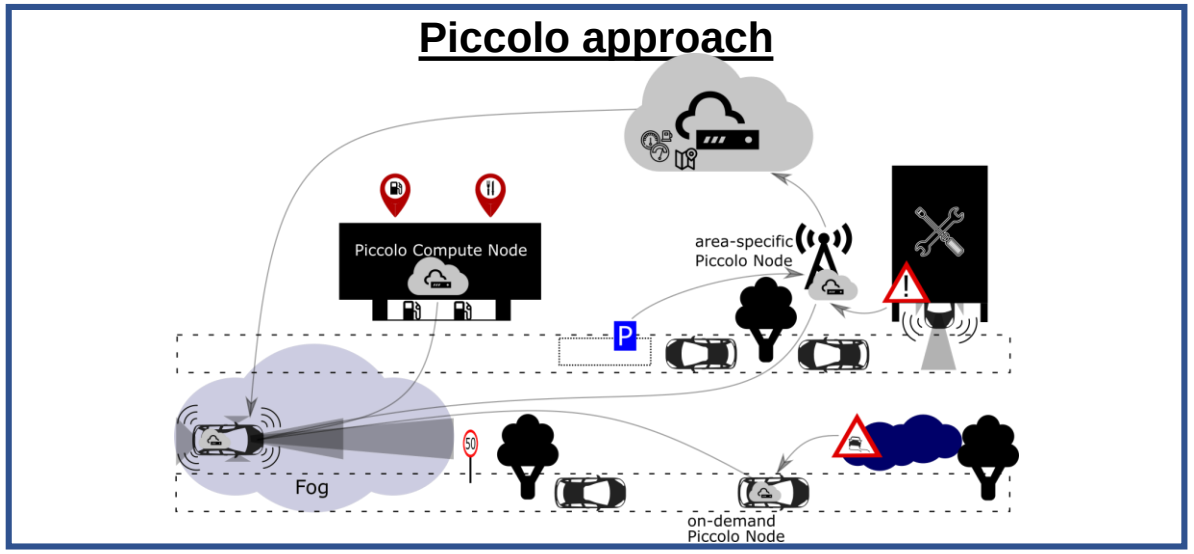




Automotive use case – Infrastructure assisted driving

- Application: ‘Enriched Local Dynamic Maps’
  - Enhance today´s ‘Electronic Horizon’ for upcoming automated driving
- ‘Current’ Technical approach
  - ‘Electronic Horizon’ is a cloud-based virtual sensor projecting a view of the road ahead
  - Driver assistance (such as predictive cruise control - comfort-driven scenarios)
  - ‘Enriched Local Dynamic Maps’ needs asymmetric comms, reliability & low latency
- Piccolo approach
  - Localised collation, analysis & distribution – more efficient and faster
  - Reduce computation in the vehicle
  - Multi-tenancy of OEMs
  - Adaptive and scalable (automatic deployment of functions based on application requirements)





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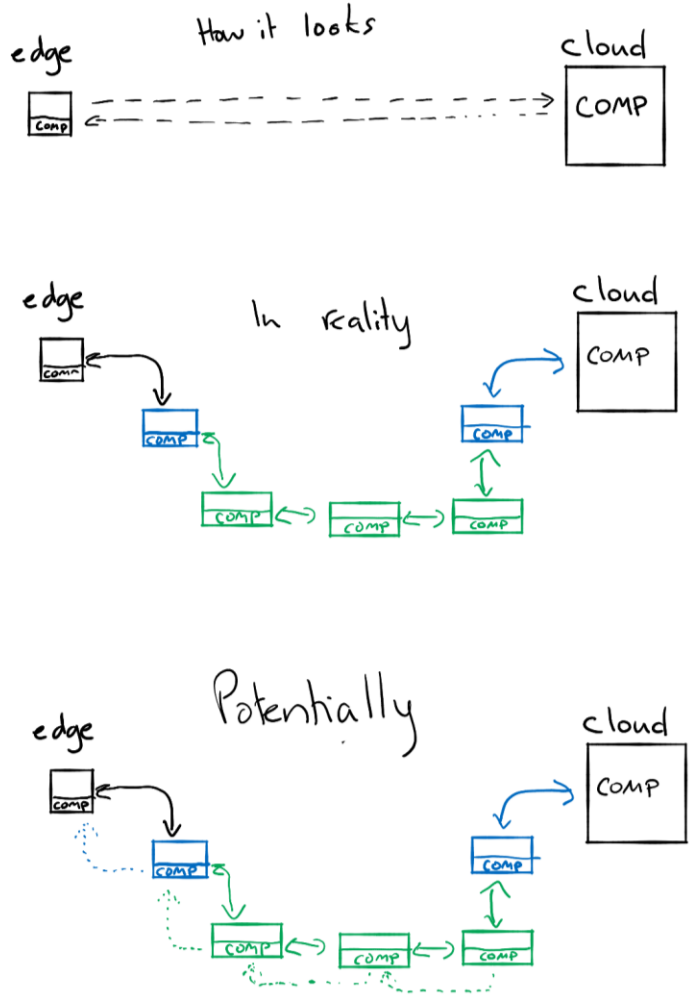
In-network compute – Potential initial research directions

- Application view - Integration of computation and networking, so network offers compute as ‘first class primitive’
- Infrastructure view - Make compute capabilities or primitives in the layer(s) below visible /usable (traditionally: only see compute in your own layer)
- Automated distribution within the network – according to application requirements, policy constraints, resources & not just at design time
- Call function by name rather than address
- “Stateless” functions – beyond their short life, state stored and pulled in by functions as needed



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Questions?

Acknowledgements:

This project receives funding from the German Federal Ministry for Economic Affairs and Energy (BMWi) within the "Development of Digital Technologies" framework programme and is managed by the "Digital Technologies and Applications" project agency of the German Aerospace Center (DLR) in Bonn, Germany.

This project also receives funding awarded by UK Research and Innovation through the Industrial Strategy Challenge Fund.

The project is also funded by each Partner.

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