

Applications at the edge

- Hannu Flinck
- 25-07-2016

Since end of 2014 close to 70 companies have joined the ETSI Industry Specification Group for Mobile Edge Computing (MEC)

Standardization

Co-founded by Nokia in October 2014, the ETSI Industry Specification Group for Mobile Edge Computing grow from an initial 6 to over 50 members in less than a year.

Wide ecosystem support

The group is composed of leading telecom operators, network infrastructure vendors, IT/middleware vendors, independent software vendors, and OTTs.

Use case proliferation

Members of the group (as well as other companies) continuously deliver new use cases that exploit the benefits of edge computing.

MEC members Allot ASTRI AT&T Ceragon Cisco ETRI Eurecom Fujitsu HP Huawei IBM Intel ISMB InterDigital ITRI Juniper NEC Nokia NTT Docomo	Orange PeerApp PT Quortus Red Hat Saguna Samsung Sony Spidercloud Telecom Italia Telefonica Telekom Austria Vasona Viavi Vodafone Xilinx YAANA ZTE	MEC p Accelle ACS AMD Adva Akama Altera Artesy Athone Brocac Caviun China Core A Druid EdgeC EE IDT Inform Gallery KDDI

MEC participants

Accelleran

Akamai

Altera

Artesyn Athonet

Brocade

Cavium

China Mobile Core Analysis

EdgeCom FF

Informa

Gallery KDDI

Laver123 Nextworks Ouortus SCII D SK Telecom Univ. de Madrid

MEC applications could be deployed at hotspots, city-wide, or across the entire network

Zone applications

E.g. special services in stadiums, exhibitions, malls, enterprise campuses

Deployed in combination with Small Cell and Macro BTS (RRH, DAS)

City-wide applications

E.g. IoT applications deployed as part of Smart City initiatives, or services for city residents and visitors

Deployed at metro aggregation sites and baseband hotels

Network-wide applications

Network-wide applications

E.g. essential network functions, and ubiquitous services that require a consistent experience / performance

Deployment in combination with Radio Cloud, or specific deployment patterns (e.g. Car2X along roads)

NOKIA Bell Labs

3

Which applications at the mobile edge?

Real time	Interactive	Private	loT	Data and compute heavy
Lowest application latency end-to-end, for a real time user experience or critical communications	Maximum transaction rate between device and cloud for an interactive user experience	Local communications for robust performance, privacy, and security	Real time insights from data exploited at the point of capture, minimum cloud ingress bandwidth	Local compute and storage for most demanding workloads to go mobile











NOKIA Bell Labs

Mobile Edge Computing: how it works (LTE view)



5 © 2016 Nokia



Mobile Edge Computing reference architecture from ETSI



NOKIA Bell Labs

MEC applications

Subscribers

Better and more mobile broadband, and exciting new services

Enterprises and corporates **Extends traditional footprint**

You Tube

Throughput guidance (video optimization)

User and network analytics

LTE coverage extender



Local breakout to enterprise network Private LTE (local EPC, HSS, IMS)

Footfall analysis Mission critical group communications

Object tracking Local content

Internet-of-Things and Verticals

New frontiers for network-based service innovation



Edge video analytics Edge audio analytics IoT gateway*



Edge video orchestration Augmented reality



Video surveillance



Deployable LTE system (network-in-a-box) Mission critical group communications



User engagement Indoor navigation





Car-to-car and car-toroadside communications CopCar2.0*





Edge video orchestration

Create exciting live views for stadium visitors



Use case

- > Live camera signals are locally ingested and played out to visitors in real time
- > Visitors can select between different cameras, which are presented in HD and SD quality levels
- Distribution over unicast and broadcast (based on local eMBMS gateway)

Benefits

- > Exciting service for event visitors, providing an immersive real time experience: <<1s from camera to device, including encoding, play-out, decoding
- > Video traffic does not put any strain on venue backhaul
- eMBMS (multimedia broadcast multicast service) can be deployed as a local SW function, without impact to the core network

China Mobile and Nokia deliver extreme mobile broadband and real time video Deployed at F1 Shanghai, powered by small cells and Mobile Edge Computing



Mobile Edge Computing to deliver live video to spectators inside the venue with <<1s of end-to-end latency, versus 30s and more when watching over the Internet

Real time experience



Close to 100 LTE small cells deployed, 228GB of LTE data delivered during the peak hour, 1.27TB delivered during the entire event

Extreme capacity



Combination of LTE small cells and Mobile Edge Computing deployed at one of the busiest network locations, during one of the most prestigious events

Latest technology

High level network architecture



Throughput guidance for an optimal video experience Developed and tested with Google, proposed for standardization to IETF





Use case

- Computes real time throughput guidance for individual user connections
- Guidance is sent within upstream user packets, no extra signaling is required
- Largely eliminates the inefficiencies in mobile delivery today, which are caused by sources being unable to gauge network capacity

Benefits

- > Best video experience as a differentiator
- > Network resources freed up along the entire delivery chain, including the air interface
- > Simple and completely non-intrusive optimization, also for encrypted content
- > Cooperate technique to replace obsolete Gi LAN optimizers (e.g. Citrix decided to shut down Bytemobile)

High-level solution Throughput guidance



- > The LA Analytics Agent calculates real time throughput guidance based on user plane and control plane analytics.
- > TG is provided for each individual bearer.
- TG is exposed through enriching upstream TCP options, that is, within the user plane, to avoid additional out-of-band signaling.
- Therewith, TG works for both encrypted and unencrypted content. Throughout the year of 2015 Google have encrypted most of their content, which makes most traditional optimizers in the Gi LAN useless.
- TG is exposed to configurable domains only and signed by the application, in order to maintain authenticity and integrity of the information.
- Operators deploying TG need to ensure that upstream TCP options are not dropped by firewalls etc.

NOKIA Bell Labs

A field trial with Google has exceeded the expectations from the previous lab results

- Video resolution is consistently higher, and the number of resolution changes is reduced
- > Huge improvement in mean throughput shortens download time and thus releases network resources earlier, and saves battery life
- Significant improvements in TCP round trip time and retransmissions



TG Measured Throughput

nput — Exponential Averaged Throughput

——Cell Capacity



Connected car: Digital A9 Motorway Test Bed Nokia, Deutsche Telekom, Continental and Fraunhofer ESK

- Combined expertise from an automotive supplier, an operator and a network vendor
- Many cars are already equipped with a large number of cameras and sensors providing valuable information and improving safety
- But they can only look a certain distance ahead – they cannot "see through" a truck or sense a traffic jam
- Vehicles assisted by MEC can receive information from other vehicles, which is something an in-car sensor cannot provide, e.g. can receive warnings in less than 20 ms.



Source: 360.HERE.com

See more: https://www.youtube.com/watch?v=rbPH3OGO2F4&feature=youtu.be





Copyright and confidentiality

The contents of this document are proprietary and confidential property of Nokia. This document is provided subject to confidentiality obligations of the applicable agreement(s).

This document is intended for use of Nokia's customers and collaborators only for the purpose for which this document is submitted by Nokia. No part of this document may be reproduced or made available to the public or to any third party in any form or means without the prior written permission of Nokia. This document is to be used by properly trained professional personnel. Any use of the contents in this document is limited strictly to the use(s) specifically created in the applicable agreement(s) under which the document is submitted. The user of this document may voluntarily provide suggestions, comments or other feedback to Nokia in respect of the contents of this document ("Feedback"). Such Feedback may be used in Nokia products and related specifications or other documentation. Accordingly, if the user of this document gives Nokia Feedback on the contents of this document, Nokia may freely use, disclose, reproduce, license, distribute and otherwise commercialize the feedback in any Nokia product, technology, service, specification or other documentation.

Nokia operates a policy of ongoing development. Nokia reserves the right to make changes and improvements to any of the products and/or services described in this document or withdraw this document at any time without prior notice.

The contents of this document are provided "as is". Except as required by applicable law, no warranties of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose, are made in relation to the accuracy, reliability or contents of this document. NOKIA SHALL NOT BE RESPONSIBLE IN ANY EVENT FOR ERRORS IN THIS DOCUMENT or for any loss of data or income or any special, incidental, consequential, indirect or direct damages howsoever caused, that might arise from the use of this document or any contents of this document.

This document and the product(s) it describes are protected by copyright according to the applicable laws.

Nokia is a registered trademark of Nokia Corporation. Other product and company names mentioned herein may be trademarks or trade names of their respective owners.



Revision history and metadata

Please delete this slide if document is uncontrolled

Document ID: DXXXXXXXX Document Location: Organization:									
Version	Description of charges	Date	Author	Owner	Status	Reviewed by	Reviewed date	Approver	Approval date
		DD-MM-YYYY					DD-MM-YYYY		DD-MM-YYYY