ACACIA – Context-aware Edge Computing for Continuous Interactive Applications over Mobile Networks

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Overview

Motivation
• Continuous Interactive (CI) mobile apps emerging, e.g., AR, VR, and face recognition
• Many use cases
  – Retail, stadiums, tourism, museums etc
• Characteristics of CI apps
  – Highly responsive
  – Compute intensive

Current Solutions
Computation offloading to cloud servers
• No consideration for mobile network complexities
• Mobile Edge Computing (MEC) over mobile network
  – Need to modify current mobile network infrastructure and establish new specifications
• Context discovery & user’s localization
  – Significantly help optimize CI application

Solutions proposed and studied in standalone manner

Open Question: How should the three entities (user, network, and application) be jointly orchestrated and combined in a service abstraction to deliver low latencies and enable CI application in mobile network?

ACACIA
• Service abstraction framework
• Adapts a holistic end-to-end approach to enabling low latency CI services over existing mobile networks
• Leverage client context information through LTE-direct to optimize both network and application processing

ACACIA Design
(i) User context discovery
- LTE-direct : Pub-sub mechanism
- Publish “service” availability
- Subscribe to “interests”
(ii) Context-aware traffic redirection
- Request a connectivity between a CI app and closest CI server (on demand)
(iii) ACACIA Mobile Edge Network
- Use LTE/EPC QoS bearer framework with SDN and NFV GW-Us (standards-compliant MEC)
(iv) Context-aware application optimization
- ACACIA device manager provides location information to the CI server

ACACIA Use Case

ACACIA Architecture

ACACIA Demo Scenario

RTT Reduction
MEC
LTE RTT (~70 ms)

Isolation of CI Traffic
Conventional EPC
EPC with MEC
ACACIA

Control Overhead
LTE Radio Promotion Event
(Release and re-establish)
- One event requires 15 control msgs
(SCTP (7), GTPv2 (4), OF(4))

Per day
Average
Worst
Data (MB)
2.58
20

App Optimization
Matching time

LTE Connection to Internet
1. Open a CI app (User context)
2. Bind the CI app to ACACIA Device Manager
3. Send user context to MRS from ACACIA Device Manager
4. Create policy rules for the user’s CI app
5. Setup dedicated bearer in network for the user’s CI App through GW-Cs, MME, eNodeb and LTE modem in mobile device
6. Setup flow rules in local S&PGW-U for the dedicated bearer
7. Running the CI app with a CI server