User-Centric Approach to Always-Best-Connected Networks

Jari Kellokoski
jari.k.kellokoski@jyu.fi
Content

- Research problem
- Background
- Always Best Connected
- Implementation and Measurements
- Conclusions
Research Problem

- Creation of software architecture that can enable always most suitable connection to IP network (in a heterogeneous network environment)

- Always Best Connected (ABC) IP Network: what is the best/most suitable
  - In term of cost, throughput, latency, current consumption and large number of other criteria?

- User-Centric
  - User should be in control ()?
  - User preferences should be taken into account: for example use of selected network in home, work; some applications must use fixed access point

- Co-operation with existing/coming standards
  - The proposed solution must work in co-operation with 3GPP and IETF standards such as: Evolved Packet Core, Proxy Mobile IPv6
Background

- End user devices (mobile phones, tablets) are equipped with more than one radio access (e.g. cellular, WiFi, Bluetooth).
- Number of hotspot style networks (specially WiFi) has increased
  - Traditional hotspots such as in airports, hotels, coffee shops
  - And they are also available in large number in home and in companies
- The Evolved Packet Core (EPC) was introduced in 3GPP Release 8 in 2008 along side with LTE. Key improvements from architecture point of view was all IP model and a simplified structure in every way
- Most significantly (regarding to ABC) it allows connectivity from non-3GPP access types, such as WiMAX, cdma2000 and WiFi
- Utilizes IETF protocols such as Proxy Mobile IPv6 for seamless handovers between different radio access networks (vertical handovers)
Access Gateways: different depending on radio access e.g. LTE, trusted non-3GPP and untrusted non-3GPP
Access Network Discover and Selection Function (ANDSF) will help UE to find suitable access
Pros: UE don’t need to turn on multiple radios in order to discover networks
Cons: User is not in control, dictated by the operator
Implementation and Measurements

Implementation

- Two clients: one Android one Qt based
- Applications can
  - Scan available networks
  - Can switch between networks
  - Prioritize networks
  - Show user applications
  - Show which of the user applications use network
- Networks are prioritized:
  1. Known protected WiFi
  2. Cellular access if expected throughput => HSDPA
  3. Open networks
  4. Other networks
Implementation and Measurements
Test Setup

Open IMS services
Internet services

PDN GW

ANGW
ePDG

WLAN
WLAN
WLAN Hotspot

Moving UE
Implementation and Measurements

Results

- Test done without any optimization and without Mobile IP
- Android based (Samsung Galaxy S2):
  - WiFi to WiFi – average connection switch time ~ 850 ms
  - WiFi to HSDPA – average connection switch time ~ 2500 ms
- Qt based (Nokia N900)
  - WiFi to WiFi – average connection switch time ~ 1550 ms
  - WiFi to HSDPA – average connection switch time ~ 3500 ms
- Service continuity was dependent on application implementation as the IP address was changed during the network
Conclusions and Future Work

- ABC application was created to actively find most suitable networks.
- Yet the solution is 3GPP EPC compatible as it can intrepid the ANDSF information from the operator.
- Basic prioritization of network was done by the ABC application.
  - Simply known fast networks first, open and unknown networks at last.
- Network switch performance was implementation dependent and by default way too slow for real-time communication.
- In future:
  - EPC should be simulated for seamless vertical handover (with Proxy Mobile IP and IPSec tunnels).
  - Network selection algorithm and mechanism improvements.
  - Performance measurements with simulated EPC.