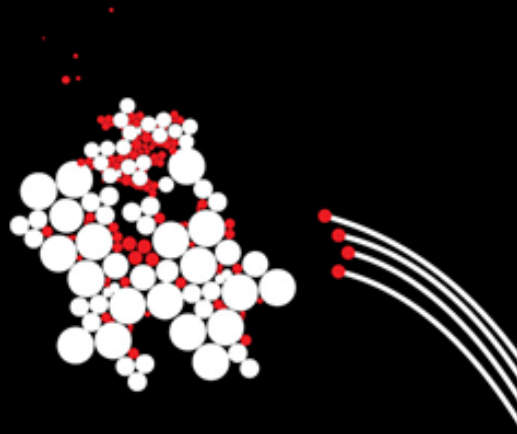
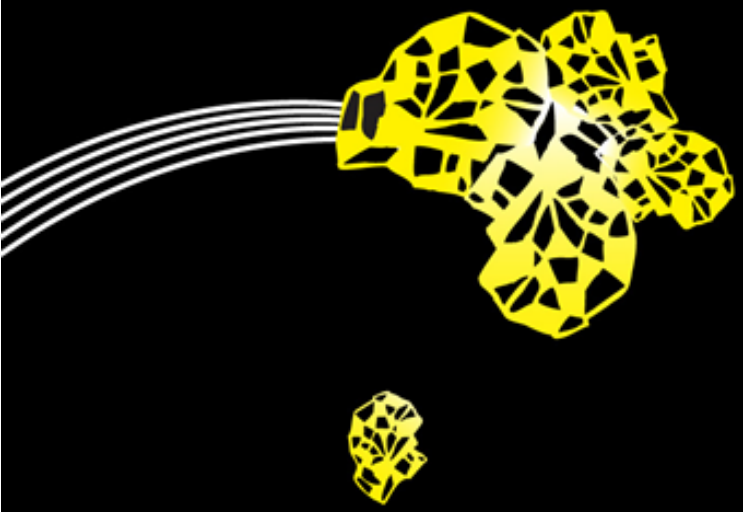
UNIVERSITY OF TWENTE.

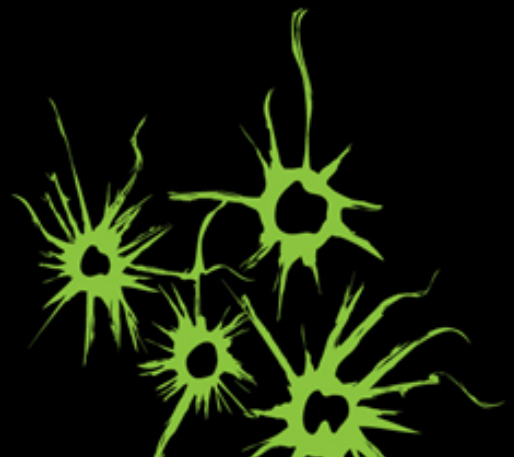
Department of Computer Science and the Electrical Engineering, The Netherlands



Software Defined Networking to Improve Mobility Management Performance

Morteza Karimzadeh, Anna Sperotto, and Aiko Pras
m.karimzadeh@utwente.nl





AIMS 2014, Czech Republic, Brno

Agenda

- **Introduction**
- ***The current mobility management approach***
  - *Inherent characteristics !*
  - *Problem!*
  - *Approach!*
  - *Advantages!*
  - *Examples of activities*
- ***How OpenFlow-based SDN architecture could be used to support IP mobility ?***
  - *Why!*
  - *How!*
- ***Which OpenFlow-based SDN approach!***
- **Evaluation and Validation**

INTRODUCTION

- Telco. Networks (*e.g, 3G and 4G*) and Mobile Networks (*e.g, WiMAX and WiFi*) become the major access method to the Internet.
- Network operators rapidly turn their services into full IP-based *(both voice and data).*
- Number of mobile subscribers interested in IP applications such as Video Conferencing, Voice over IP (VoIP), Game net, download /upload of large size files (*particularly in cloud computing environment*) are rapidly growing.

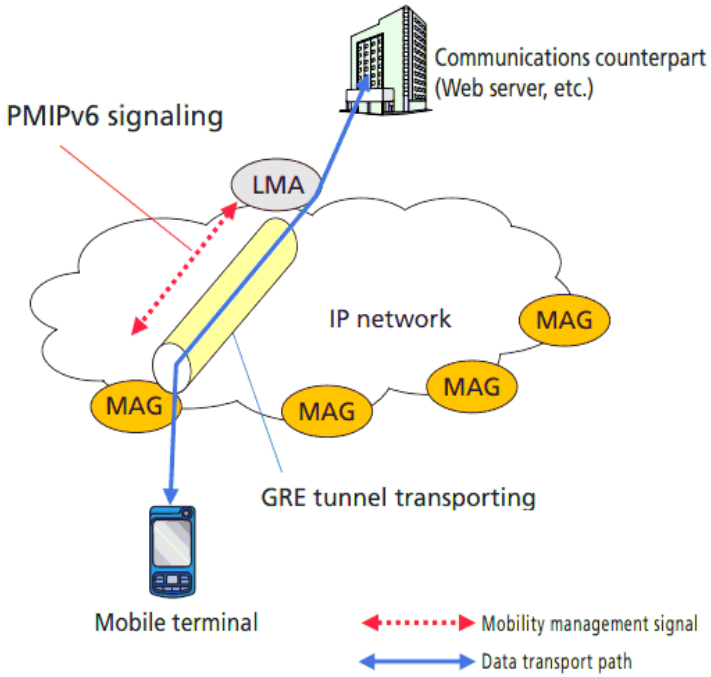
INTRODUCTION

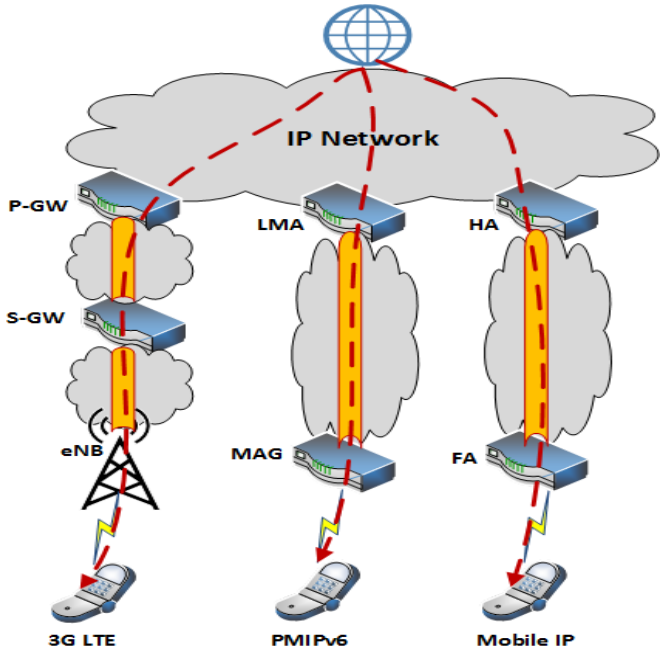
- Supporting *IP mobility to keep ongoing-sessions continuity* becomes a necessity for future internet's users changing their mobility anchor points in inter (intra) operator (technology).

- IP Mobility management refers to the mechanisms maintaining active session continuity to users across personal, local, and wide area networks without interruption.

The current mobility management approach!

- Most of the current IP mobility solutions standardized by both IETF(*MIP, PMIPv6*) and 3GPP rely on a centralized mobility anchor entity which is in charge of:
  - *Control plane (signaling)*
  - *User plane (data forwarding)*

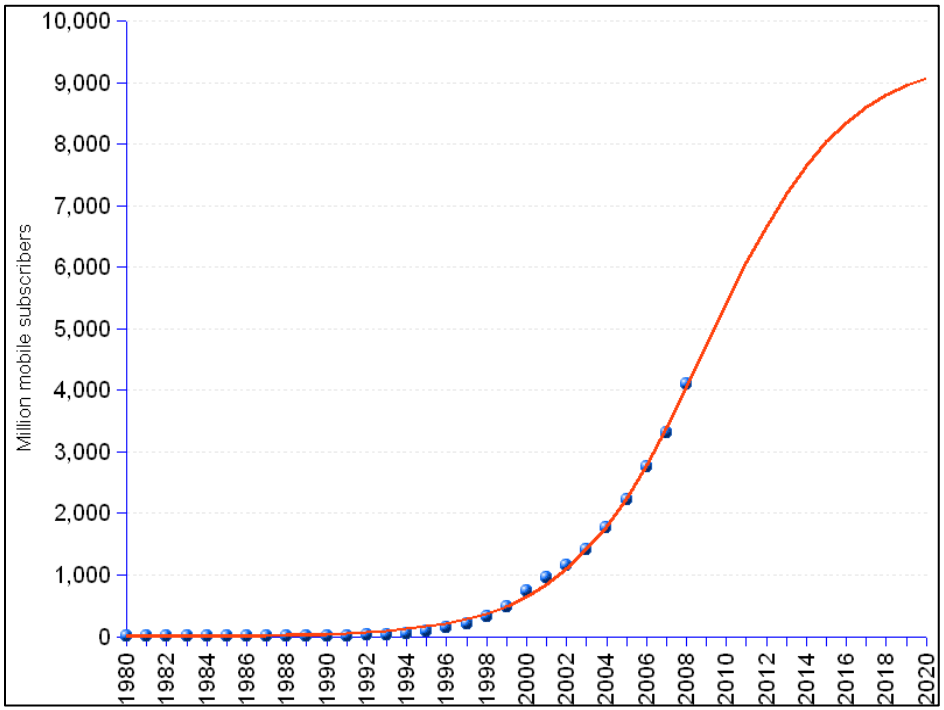




Inherent characteristics of in centralized management!

- Tunneling for each node *(even fixed one)*
- Data processing overhead during node movement *(encapsulations/de-capsulation during tunneling updates)*
- Suboptimal routing *(when MN and CN are close to each other but far from the anchor point)*
- Scalability issue *(signaling overhead)*
- Reliability issues *(a potential single point of Failure, costly maintenance!)*

Problem!

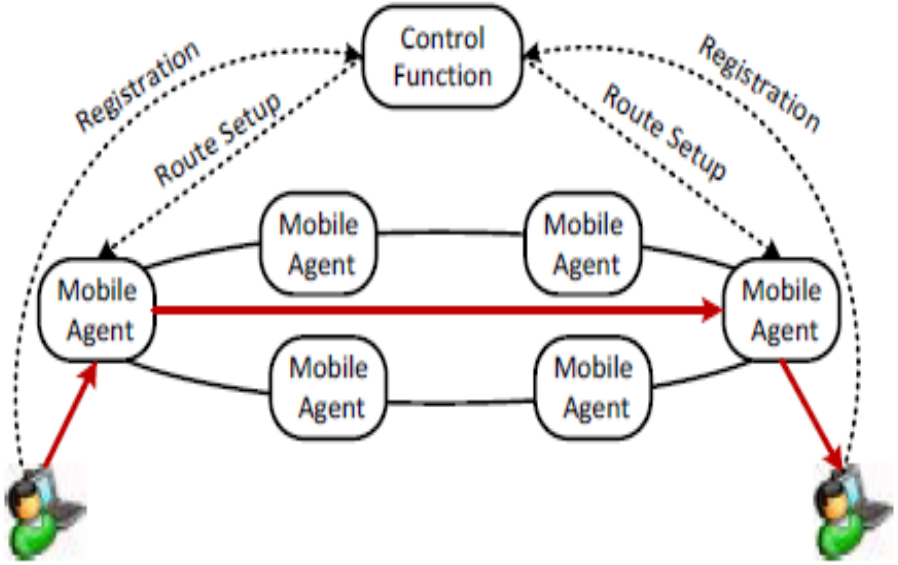


Number of mobile subscribers (ITU International Telecommunications Union, 2012)

- Current centrally managed IP mobility is insufficient in terms of scalability and resource utilization to efficiently deal with demands raised by ever-growing number of mobile users of new generation of applications seeking for IP mobility!

- **How to cope it?**

Approach!

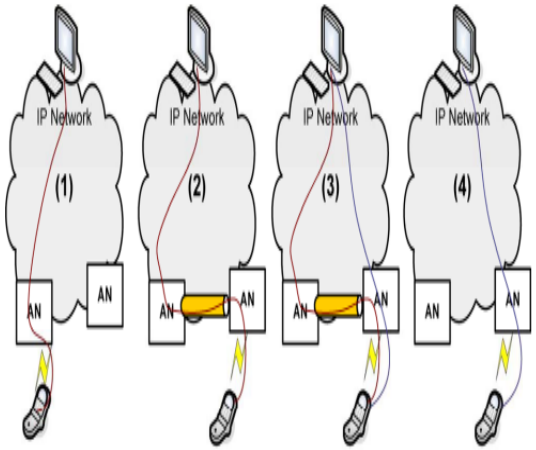


- Implement a flatter system to distribute the control and/or data plane (*fully/partially distributed*) among the mobility anchors located at the edge of the network.

Advantages!

(+) Temporary tunnels only during handovers.

(+) Tunnels' endpoints being located at access nodes' level, the rest of the network is not impacted.



(+) Signaling overhead and encapsulation processing will be diminished in a large factor *(compared to centralized schemes)*

(+) Optional forwarding reduces congestion in transport network (*packet loss and delays!*).

(+) More scalable in case of increasing number of MN.

(-) Deployment issue!

(-) Administering issue!

Examples of activities

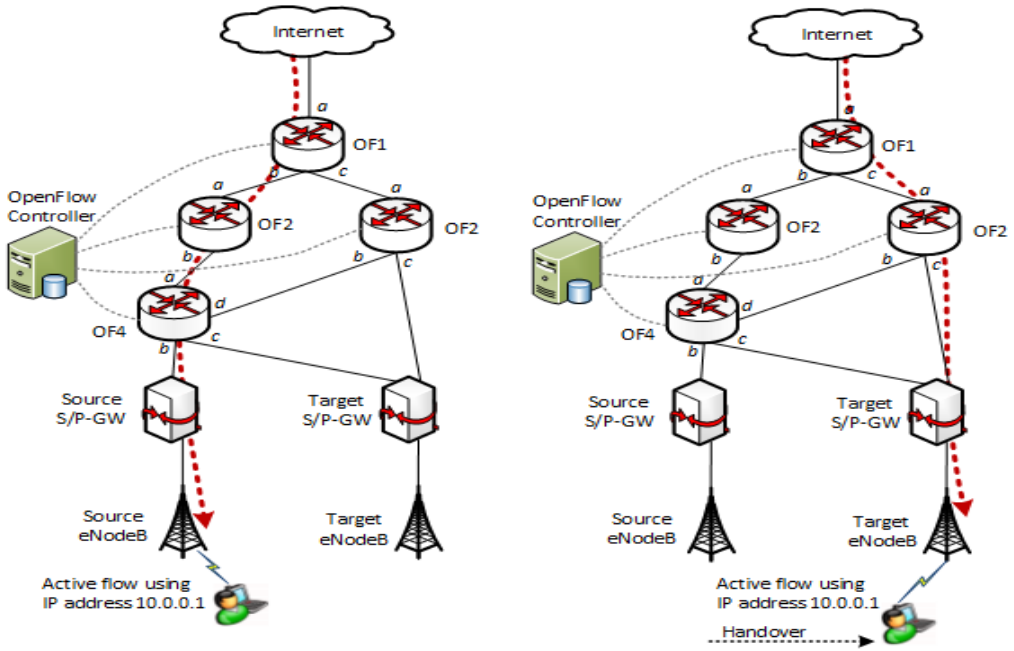
- IETF based technologies
  - Double NAT (D-NAT) *(performing address translation in Ingress NAT router and Egress NAT router)*
  - Distributed Mobility Anchoring (DMA) *(Uses dynamic anchoring in the access routers, Relies on a centralized database storing ongoing mobility sessions)*
  - Inter-domain DMM *(focuses on inter-domain roaming scenario* even if it is at the cost of sub-optimal routing *, using a centralized* mobility anchor *to guarantee session continuity)*
- 3GPP based solutions
  - Local IP Access (LIPA) / Selected IP Traffic Offload (SIPTO) *(LIPA provides connection for UEs via eNB in the same IP network. SIPTO supports IP Traffic for UEs connected via a eNB to Internet)*

How OpenFlow-based SDN architecture could be used to support mobility ? (Why!)

- SDN decouples forwarding functions and network control, which become directly programmable!
- With OpenFlow, the forwarding plane can be reconfigured according to the needs of applications and network services.
- With OpenFlow, IP traffics can be redirected (*from the Internet PoPs to the anchor points*) as the separated flows, in the operator's transport network to support IP mobility.
- Traffic redirection can be supported without involving any IP address translation or modification.
- Network Virtualization is a promising approach for future Internet architecture (*SND is the most famous technology*)

How OpenFlow-based SDN architecture could be used to support session continuity? (How!)

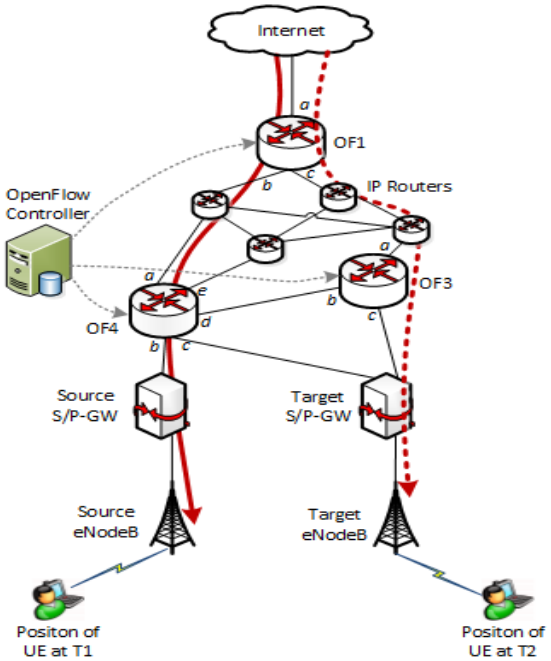
- *Modify-State* used to modify flow-tables in O.F switches.
- *Set-Field* action, used to modify packets' header in O.F switches.
- *Output* action identifies the output interface in O.F switches.
- A combination of *above mentioned command* provide per-flow forwarding and redirection dynamically
- Flow tables and action in O.F switches are added/modified by the OC.



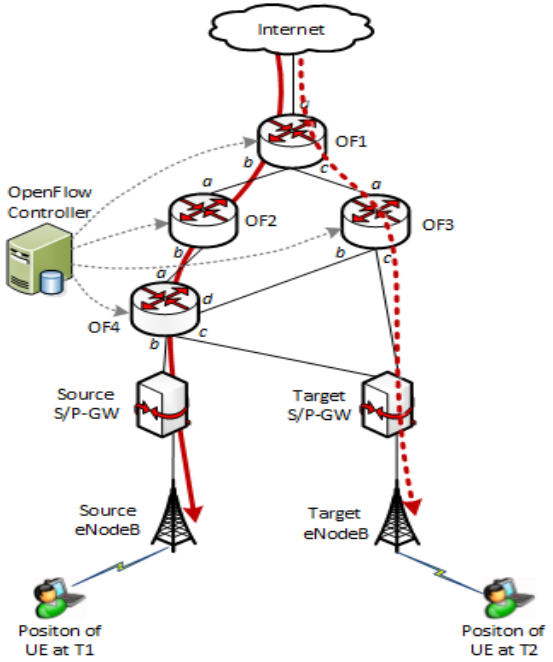
Which OpenFlow-based SDN approach!

- ***Full OpenFlow :*** All routers in the transport network are OpenFlow-enabled and no modification of the packets is needed .

- ***Partial OpenFlow :*** Only the routers placed at the edges of the transport network are OpenFlow-enabled . Packets' headers must be modified at the edge of the transport network (at the Ingress and Egress switches).



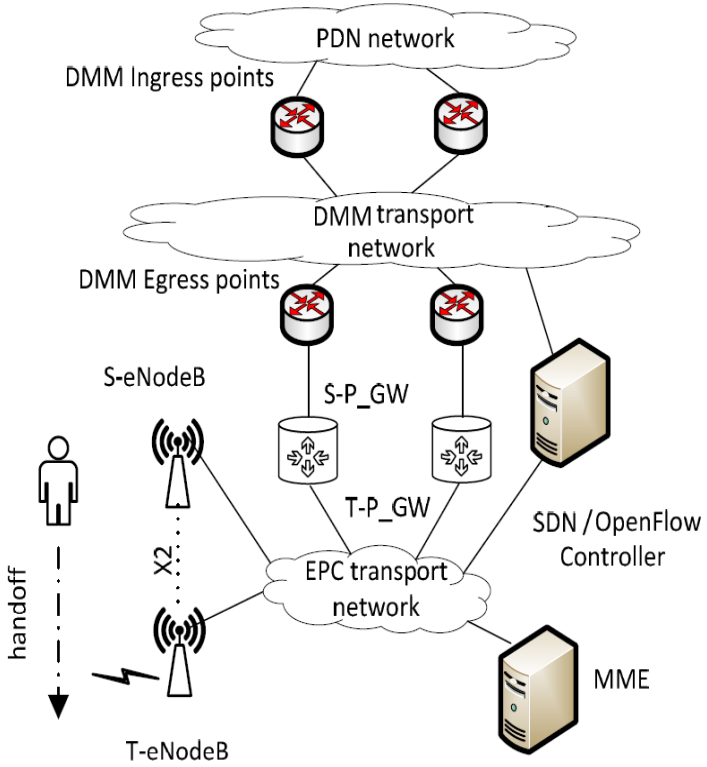
Partial OpenFlow



Full OpenFlow

Evaluation and Validation

- The proposed solutions, are evaluated within the NS3-LENA simulation environment.



- Intend to implement a prototype in OpenStack virtualization test bed as a supplementary validation.

THANKS FOR YOUR ATTENTION

m.karimzadeh@utwente.nl