A Virtual SDN-enabled LTE EPC Architecture: a case study for S-/P-Gateways functions

11. November 2013
IEEE SDN for Future Networks and Services (SDN4FNS)

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Why change the current EPC architecture?

- Current EPC built out of **monolithic** entities on dedicated hardware
- **Inflexible** and lacks dynamic deployment
- Induces **high cost** to setup and maintain
How to change EPC architecture?

Deployment platform for network functions in software

Cloud Computing

Software Defined Networks

Network Functions Virtualisation

Network abstraction and flexible dynamic programmability

Enabler for cost, energy consumption and space reduction by sharing, isolating and splitting of network functions [1]

What do NFV and SDN bring to the mobile core?

- Potential for reducing energy consumption
- Potential for a reduced capex and opex cost
EPC potential for virtualization?

• Control-plane EPC nodes such as MME, HSS, PCRF, etc... impose not much effort to virtualize and migrate to an operator’s cloud

• Focus of our study is the data-plane coupled EPC nodes: S-GW and P-GW
Study steps

1. S-GW/P-GW functions analysis
2. SDN (OpenFlow) realization of derived functions
3. Deployment architectures for the virtual SDN-enabled S-GW and P-GW
- Control-related functions can be integrated in an SDN controller
- Forwarding rules and data forwarding are fundamental functions of a basic OF switch
- Packet filtering (P-GW) can be provided based on the IP-five tuple [2] starting from OF 1.0
- Charging (P-GW) and GTP header matching (S-GW&P-GW) still need further evaluation

Charging frameworks

- Module to collect offline CDRs based on OF stats
- Optimize OF stats to match different charging models

- Of switch keeps no data flow state
- Not possible to allocate triggers on switch
- Module to keep track of charging events and update accordingly
GTP matching frameworks

- GTP: IP-tunneling protocol used to encapsulate signaling and data in EPC

a) Controller handling GTP matching
b) Middlebox handling GTP matching
c) NE+ with customized HW
d) NE+ with SW platform
Functions deployment possibilities?

1) Full Cloud Migration

+ noticeable cost savings
+ control-plane scalability
+ standard OF switch
- still very centralized
- All data traffic to cloud
- SDN is not fully exploited
Functions deployment possibilities?

2) Control-plane Cloud Migration

- control-plane flexibility
- data-plane scalability
- on-demand data plane resources
  - enhanced OF switch
  - data overhead between cloud and transport network
  - cost savings are reduced
Functions deployment possibilities?

3) Signaling control Cloud Migration

- possible less configuration delay
- possible less data overhead
- more resilient to cloud outages or connection failures

- cloud migration is minimal
- global network view is not available anymore
## Functions deployment possibilities?

### 4) Scenario based Cloud Migration

- **Possible offloading of certain EPC operations or service types**
- **Highest scalability and flexibility**
- State sync overhead
- Orchestration between functions is needed
- Additional cost induced
Conclusion and Outlook

Study goals?
• Performance evaluation and trade-offs
  • Exchanged data overhead
  • Observed additional delays
  • Cost evaluation

Optimal functions’ splitting solution considering all given parameters

Outlook
Thank you for your attention

Questions?