RECO, SLV and free5GC - a path toward softwarization and virtualization of 5G core networks

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March 25, 2019
Outline

- Background
  - with focus on core networks
- What is 5G?
  - Softwarization and Virtualization
- Our open-source projects
  - Reconfigurable Core (RECO)
  - Service Level Virtualization (SLV)
  - free5GC
What’s wrong with the current 4G core network?
All Propriety Hardware

Specialized Features

Specialized Hardware
High cost
limits innovation
Not flexible
How to solve?
Softwarization and Virtualization
Research topics of softwarization and virtualization

- How to retain the required performance for network entities while it is virtualized?
- How to design and implement the automatic self-management MANO system?
- ...
- How to implement customized VNFs efficiently for a flexible OPEN 5G core network?
Doing research in core networks

- The core networks are very expensive, and it’s not easy to access the source code.
- People usually could only conduct mathematical analysis and simulation to verify their ideas.
- With open-source core networks, researchers can implement and test their proposed algorithms in a real testbed.
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  - free5GC
Reconfigurable Core (RECO)

- [http://reconet.org/reco/](http://reconet.org/reco/)
Reconfigurable Core (RECO)

- **Common modules**
  - common MME libraries which different types of users share. E.g., UDP, SCTP, hash table

- **Object-oriented customized modules**
  - customized modules which differ between different types of users

- **Dynamic Linking Framework**
  - parse descriptor load and initialize corresponding customized modules
Use cases

- For remote-control surgery
- For high-speed users
For remote-control surgery

- Low latency
- High security

GTP module

NAS and S6a module

Healthcare MME

Healthcare Gtp
Healthcare NAS
Base S1ap
Healthcare S6a
For high-speed users

- High mobility ➡️ GTP module
- Frequent handover and location update ➡️ NAS module
Service Level Virtualization (SLV)

- http://reconet.org/slv/
Service Level Virtualization (SLV) for 5GC

SLV: a preliminary implementation of 3GPP R15 Service Based Architecture (SBA)
(1) An entity is decomposed into different service blocks to provide different services.
(2) Tested with commercial handsets and base stations.

- Virtualize the core network at service level
- Create a new component called Service Center to manage customized services

Demo at IEEE 5G World Forum, Santa Clara, CA, USA, July 9-11, 2018
Each function runs as a process on different hardware

Resources are saved & Flexibility is improved
Stage 1 (current release)

- migrating 4G Evolved Packet Core (EPC) into 5GC Service-Based Architecture (SBA)
Contributors

- Released in January 2019
- National Chiao Tung University (12)
  - Chi Chang, Fu-Cheng Chen, Jyh-Cheng Chen, Te-Chih Chiu, Chia-Tso Chu, Wei-Ting Hu, Kuan-Ying Lee, Yi-Bing Jason Lin, Hsun-Chieh Pan, Sebastian Tan, Fu-Lian Weng, Yi-Hua Wu

Released in January 2019
Stage 2: implementing the 5GC features
Contributors

- **Taiwan**
  - National Chiao Tung University (26)
  - National Taichung University of Education (8)
  - Tunghai University (5)
  - National Taichung University of Science and Technology (4)
  - National Chung Cheng University (3)

- **Norway**
  - University of Agder (3)

*Expect to released in September 2019*
Stage 3: a full operational 5GC

- At least one of the application services, such as VoLTE, IPTV, will be supported in this stage.
- Add features: Operation, Administration and Management (OAM) of 5GC, 5G Orchestrator, and Network Slicing.

Expect to released in March 2020
Free the cellular core network
Equipment (1/2)

- LTE Small Cell: Wistron NeWeb OSQ4G-01E2
Equipment (2/2)

- UE1: Sony Xperia T3 D5103
- UE2: ASUS UX410 & D-Link LTE Dongle
- Programmable SIM card programmed by PySIM
This is just a first step.

Please use it, give us feedbacks, and even join us to develop the first comprehensive, free, and open-source 5G core network.
For more information

- Website: https://www.free5gc.org/
- Source code: https://bitbucket.org/nctu_5g/free5gc
Acknowledgments

Chi Chang, Fu-Cheng Chen, Te-Chih Chiu, Chia-Tso Chu, Wei-Ting Hu, Kuan-Ying Lee, Yi-Bing Jason Lin, Hsun-Chieh Pan, Sebastian Tan, Fu-Lian Weng, Yi-Hua Wu, Chia-Lin Lai, Chen-Ying Hsieh, Bo-Jun Qiu, Pin-Fan Ho, and many others.
Thank You