

Resilient Cloud-Network Placement and Mapping for Multi-Domain and Multi-tenant Access C-RAN

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- 2- Cloud Radio Access Network (C-RAN)
- 3- Resilient Cloud-Network Placement and Mapping for Multi-Domain and Multi-tenant Access C-RAN
- 4- Illustrative Example

Cloud Computing and Access



[6] T. Taleb, M. Corici, C. Parada, A. Jamakovic, S. Ruffino, G. Karagiannis, and T. Magedanz, "EASE: EPC as a Service to Ease Mobile Core Network Deployment over Cloud", IEEE Network, 2015

Mobile access to the Cloud is crowded!



- By 2019, 4G will be 26 percent of connections and 68 percent of total traffic.
- By 2019, a **4G connection will generate 10 times more traffic on average** than a non-4G connection [7].



[7] Cisco Visual Networking Index: Global Mobile, Data Traffic Forecast Update, 2014–2019, White paper, Feb. 2015

Proposed solution for the crowd, C-RAN



Excerpt 1: Cloud RAN Concept



Cloud Radio Access Network (C-RAN): might offer:

•Flexibility, robustness and scalability for access networks infrastructure, to deal with the crowd ! [8].

•Cost-effective solution for mobile/access network operators by centralizing resources for saving CAPEX and OPEX costs [8].

Source: China Mobile

RRU (Remote Radio Heads)

[8] CRAN White Paper: Green Evolution of Wireless Access Networks, China Mobile Research Institute, Tech. Rep., 2013.



- Resiliency is essential for Base Band processing Units (BBUs).
 Physical and logical failures.
- **Multi-tenancy,** a C-RAN provider should share its capacity with others providers by using virtualization [8,9].
- **Multi-domain,** a C-RAN provider should preserve the tenants privacy while sharing with multiple infrastructure providers [8,9].

[8] CRAN White Paper: Green Evolution of Wireless Access Networks, China Mobile Research Institute, Tech. Rep., 2013. Page 6 [9]FURTHER STUDY ON CRITICAL C-RAN TECHNOLOGIES, Next Generation Tech. Rep., 2015



- **Integration** of C-RAN infrastructure providers with Cloud providers using metro optical networks.
- **Cloud BBU hotel** scheme using access network function virtualization (A-NFV) using VM BBUs.
- Multi-tenancy and multi-domain capabilities.

Our Proposed Integration and Cloud BBU

Integrated Infrastructure



Our Proposed Access Cloud Network



Resiliency problems





Resilient Access Cloud Network Placement and Mapping Problem



Given:

- Multi-provider infrastructure (i.e., Multiple domains).
- ACN requests (i.e., Multiple tenants).

Output:

- Resilient ACN placement and mapping.
 - Connectivity failures survivability.
 - Processing failures survivability.

Goal:

• Minimize the Resource.

Resilient Access Cloud Network Placement and Mapping Approach

- Connectivity failures survivability.
 - Redundant virtual links (1+1 virtual link protection)
 - Survivability constraint (avoiding network failures)

- Processing failures survivability.
 - Backup VM BBU (1+1 processing protection).
 - Redundant placement.

Resilient Access Cloud Network Placement and Mapping Approach



OUR PROPOSED APPROACH

Protection for any:

A. Single physical failures

-Processing : in servers, in a rack and in a cloud provider.

-Connectivity : in a metropolitan optical network.

B. Single logical failures

- -VM-BBU failure / software
- Cyber attack (Byzantine Attack)



- Planning version of our approach and obtaining results.
- Review of the concepts.

- Wrting a technical report.



[1] D. F. Parkhill, The challenge of the computer utility. USA: Addison-Wesley Professional, 1966.

[2] P. Mell and T. Grance, "The NIST Definition of Cloud Computing," Tech. Rep., July. 2009.

[3] L. Colombus, "Predicting Enterprise Cloud Computing Growth," Forbes, Sept., 2013.

[4] C.Colman-Meixner, M.Tornatore, C.Develder, and, B. Mukherjee," A Survey on Resiliency Techniques in Cloud Computing Infrastructures and Applications, "IEEE Comm, Surv., and Tutorials (Accepted), 2015

[5] A. Gholamhosseinian and A. Khalifeh, "Cloud Computing and Sustainability: Energy Efficiency Aspects", MSc. Thesis, 2012

[6] T. Taleb, M. Corici, C. Parada, A. Jamakovic, S. Ruffino, G. Karagiannis, and T. Magedanz, "EASE: EPC as a Service to Ease Mobile Core Network Deployment over Cloud", IEEE Network, 2015

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[9]FURTHER STUDY ON CRITICAL C-RAN TECHNOLOGIES, Next Generation Tech. Rep., 2015



THANK YOU !!!