Quo vadis, 5G?

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For Future Communications Summit | Lisbon, Portugal, Nov 27-28, 2019
Operational mobile network evolution

User A

Network 1

Network 2

AMF
NRF
UPF
SMF
UDM

2020
2022
2025
2027
2030

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The death of the so-called central office

User Type B
User Type A
User Type C
User Type D

AMF
SMF
AMF
AMF
UPF1
SMF
NRF
NRF
UDM
UDM
UPF2
UPF3
Data Center 2
Data Center 1
Data Center 3
BS1
BS2
BS3
Network 1
Network 2
EDC1
EDC2
Network 3
Data Center 3

2020
2022
2025
2027
2030

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What should the future mobile system achieve?

Currently:
- Flexibility contradicts efficiency
- Efficiency thwarts correctness
- Correctness limits flexibility

None of these are fundamental
What ultimately matters is the service provided to the end user, not to the operator ➔ We need to finally switch to a fully user-centric paradigm
How to dynamically choose instances in runtime for CP/DP?

Planning approaches are not suitable here ➔ Non-local runtime scheduling is a fundamental problem to be solved
Guaranteeing Execution Correctness

Like in distributed databases, we will need conflict free E2E allocations.

➔ Need distributed, network-suitable mechanisms for resource allocations.
How to conceive of 6G?

- 6G: a distributed platform for the execution of user workloads
  - Any resources, anywhere

- Fully user-centric
  - All participants are users who **contribute their resources** and want to **use their services**
  - Decentralization as the central paradigm: owner-controlled, dependable resource sharing

- With integrated, invisible mechanisms for
  - Pervasive runtime heterogeneous resource control (pre-allocation)
  - Non-local scheduling (runtime selection of the processing instance)
  - Distributed allocation conflict treatment (resolving deadlocks, race conditions, etc)
  - Network Garbage Collection

This is not about what, this is about how

Tricky to parameterize
6G = AI as a Service

- We can come up with mechanisms for each of these areas
- Problem: these are usually use-case dependent
- Solution: AI
  
  while there is improvement
  - export mutable parameters to a learning agent as current policy $\pi$
  - receive from agent a new candidate policy $\pi'$
  - apply $\pi'$, measure improvement, send feedback to the agent

- However, note that this AI should be for all users and different applications

$\Rightarrow$ 6G = AI as a Service

- Towards “AI sockets”
- Available at any point in the future system
- Implementation-agnostic

```
create_new_model(parameters)
destroy_model()
supply_data (vector X)
inference(state_x)
apply_learning(vector_x)
```
Conclusion

• If 5G was about slicing, 6G should be all about fusion
  - Fusing Local and Global; Clouds and Networks (in-compute networking, in-network compute);
    User Resources; User Equipment and Network; Wireless, Optical and Fixed domains
  - Fusing sciences: distributed systems and networking, artificial intelligence and networking

• If 5G was about connecting things to brains, 6G should become the brain
  - System-scientific approach required
  - We need several instrumentations of AI; again, not limited to operators
  - We need different models, federated AI, but also fully distributed AI
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References


August 30 – September 2, 2020, Dagstuhl Seminar 20361 Towards More Flexible and Automated Communication Networks (https://www.dagstuhl.de/20361)