A Refactoring Approach for Optimizing Mobile Networks

Ashwin Rao
University of Helsinki

A Refactoring Approach for Optimizing Mobile Networks
Matteo Pozza, Ashwin Rao, Armir Abujari,
Claudio Pallazi, Hannu Flinck, and Sasu Tarkoma
Under submission *– Short Paper to ACM CoNEXT 2016*

State Space Analysis to Refactor the Mobile Core
Heikki Lindholm, Lirim Osmani, Hannu Flinck, Sasu Tarkoma, and Ashwin Rao.
In Proc. of AllThingsCellular Workshop 2015

Building Blocks for an Elastic Mobile Core
Lirim Osmani, Binoy Chemmegate, Heikki Lindholm,
Ashwin Rao, Hannu Flinck, and Sasu Tarkoma
In ACM CoNEXT Student Workshop 2014.

Background

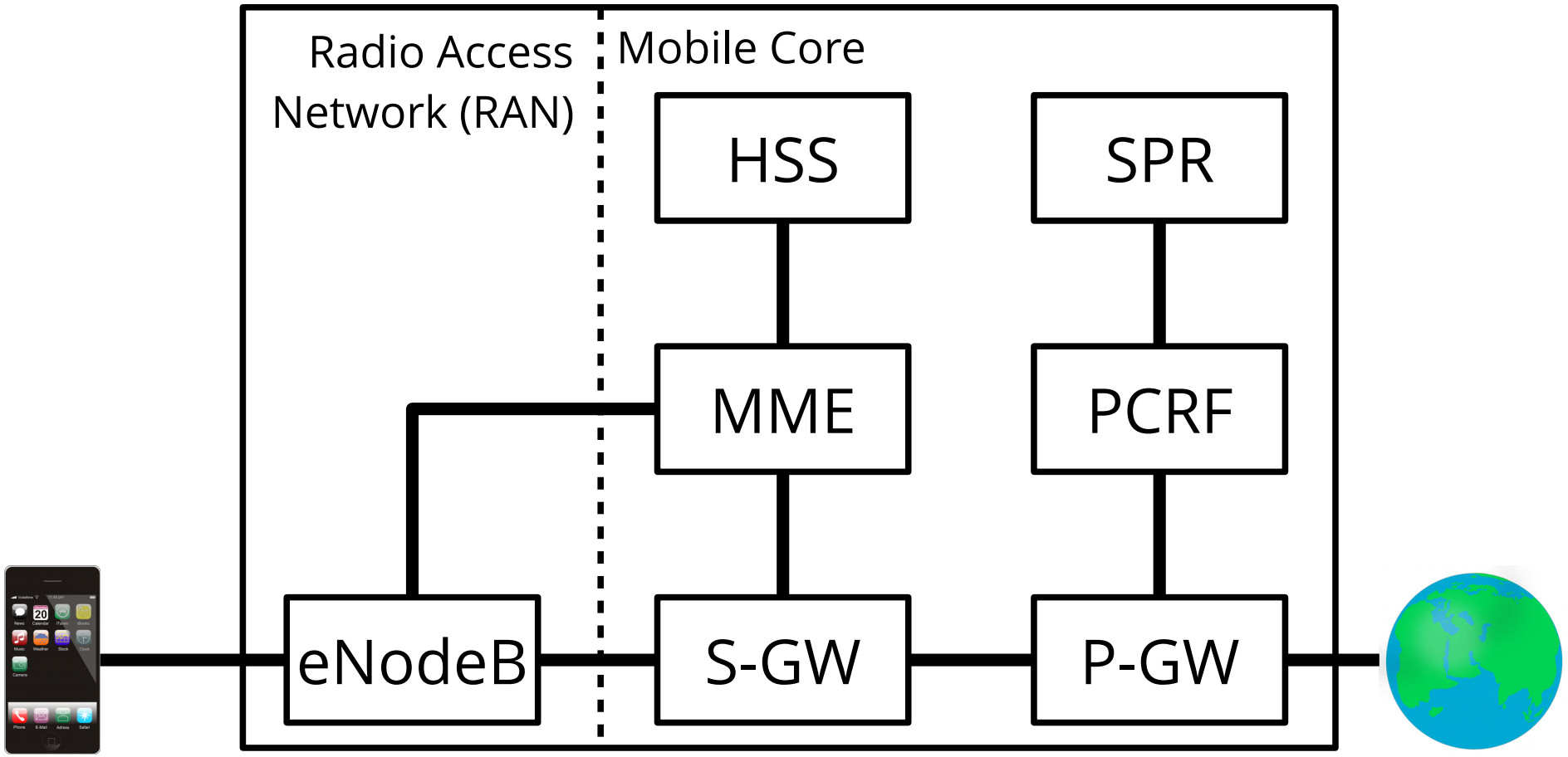
- Mobile networks are expecting an influx of verticals with varying demands
  - Low latency e.g., for haptic feedback
  - Gbps uplink/downlink e.g., for high quality video
  - High mobility e.g., for serving high speed trains

Each vertical is expected to arrive with a unique set of requirements

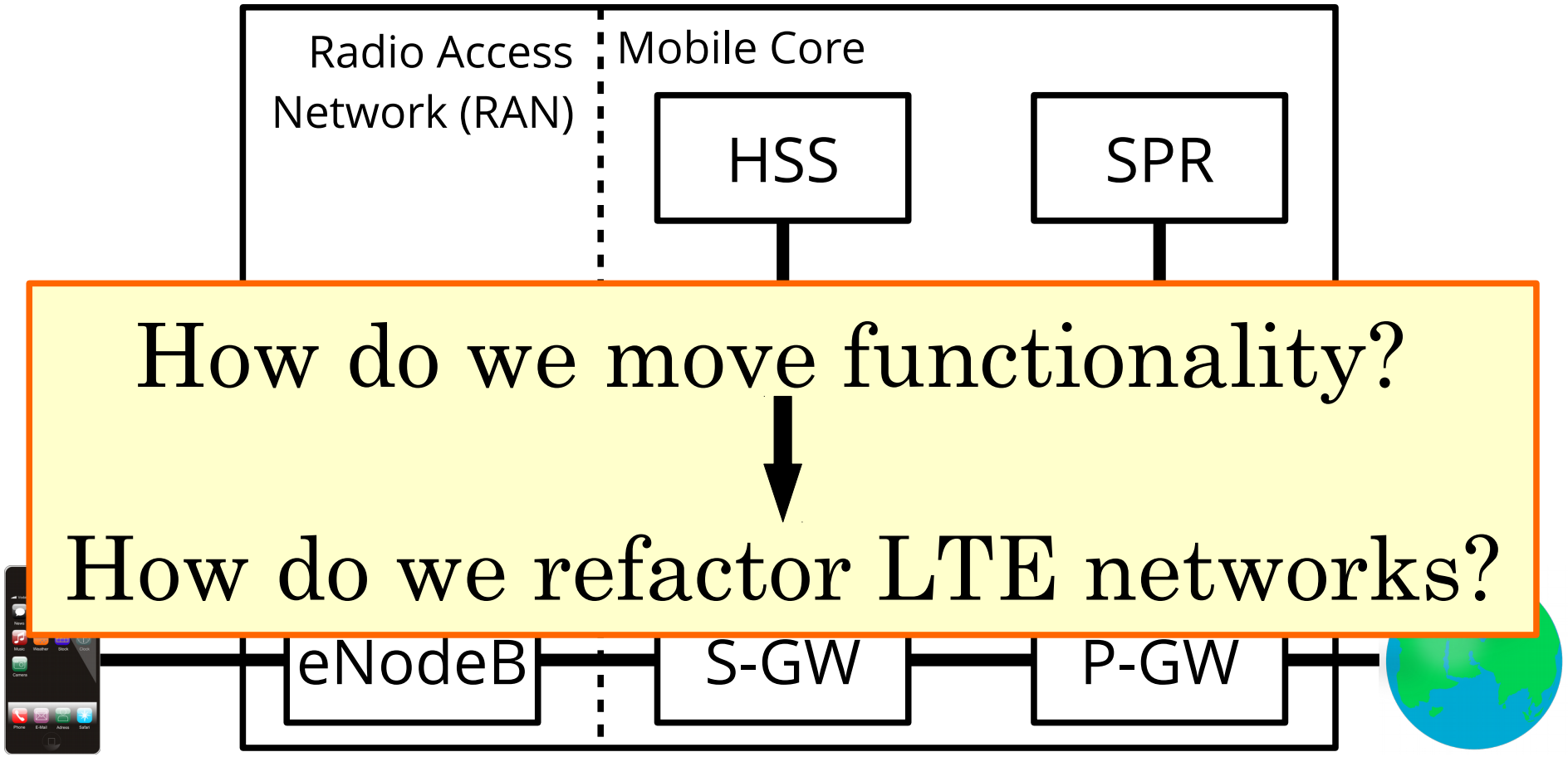
Scaling Mobile Networks

- Why can't current LTE networks meet these demands?
  - Telephony Centric – IP traffic an afterthought
  - Convoluted Control and Data Plane
- Approaches to address this issue
  - Move functionality to the Edge
  - Move functionality to the Cloud (NFV)

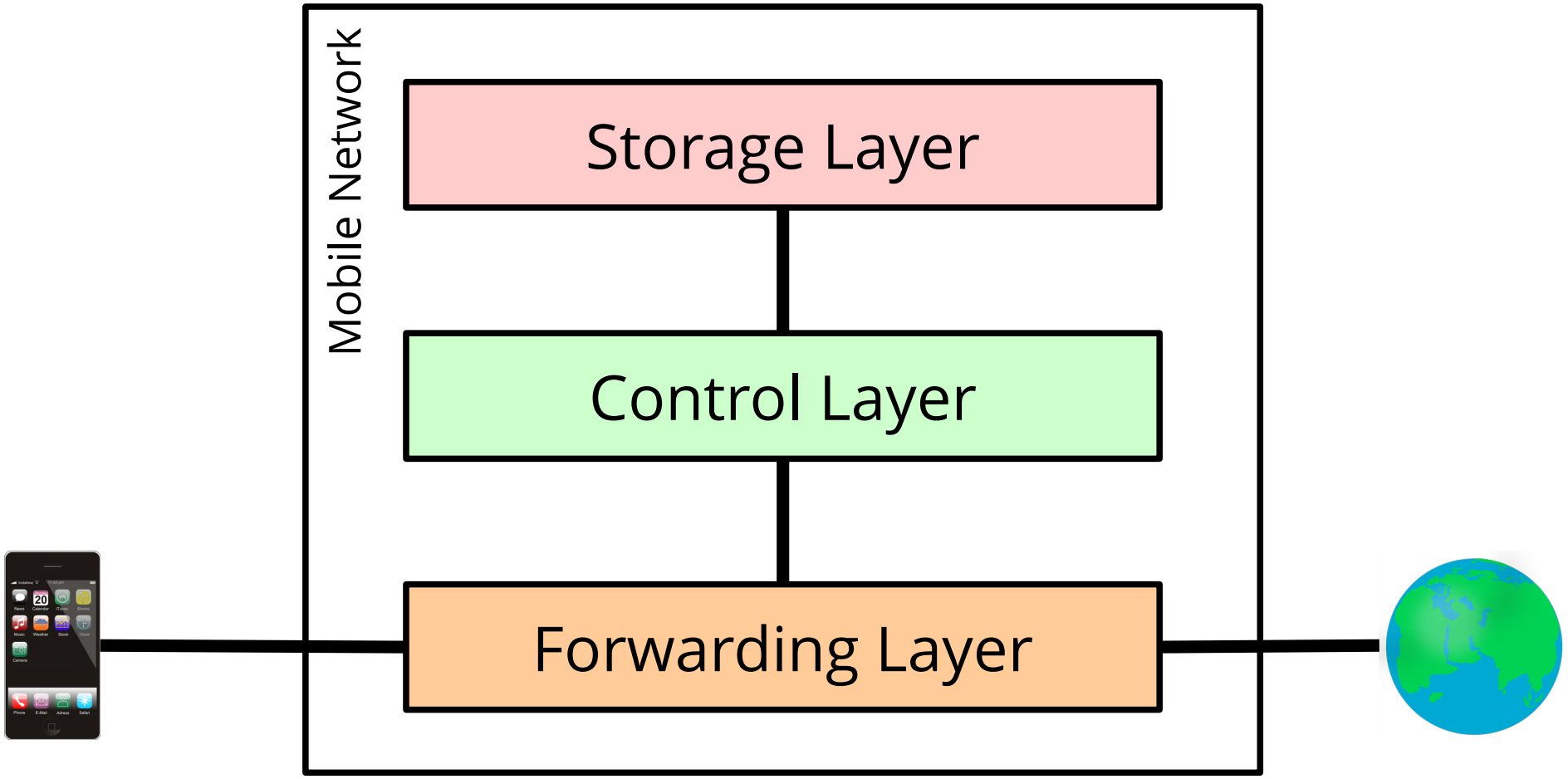
4G (LTE) Network



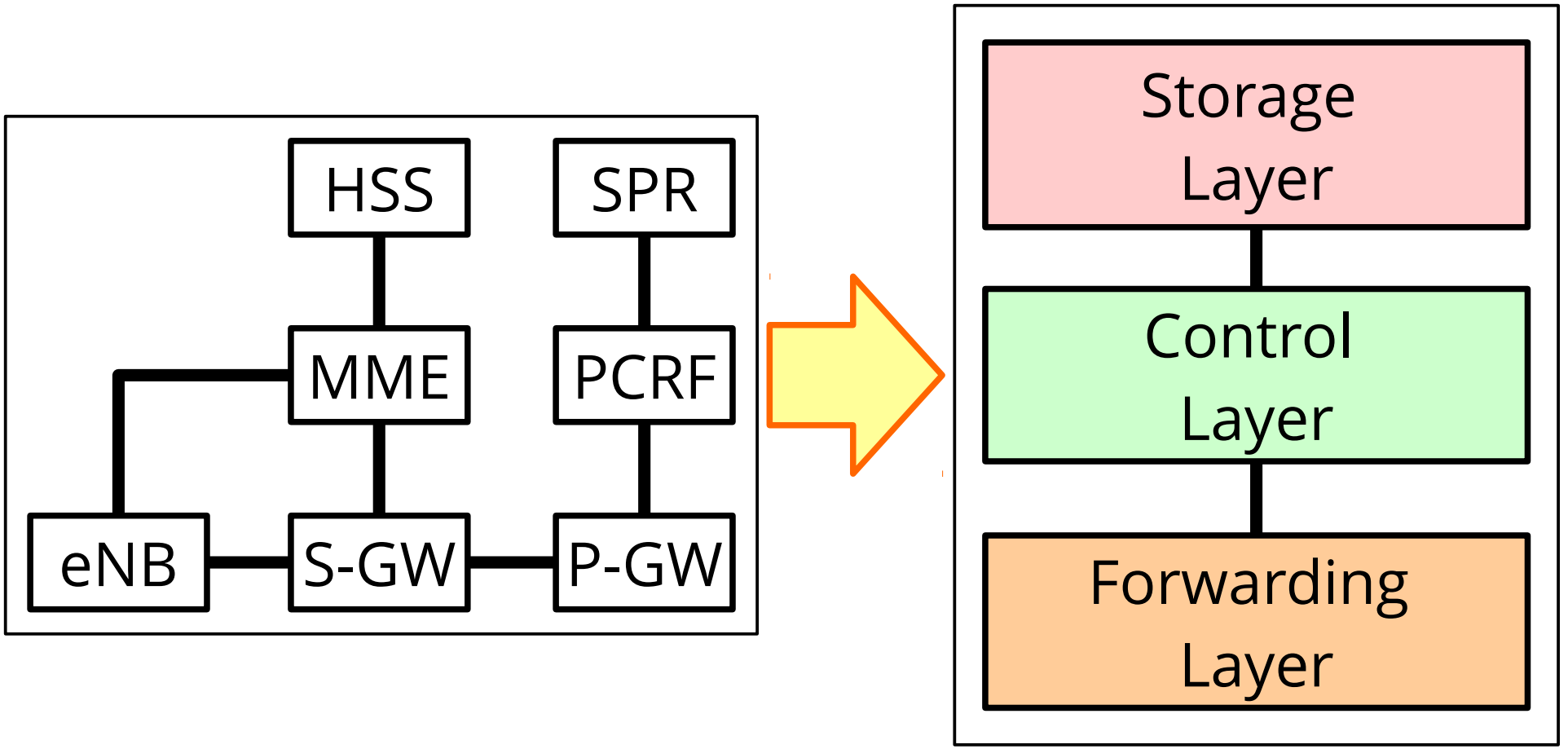
4G (LTE) Network



Three Layer Abstractions



Modularization Objective

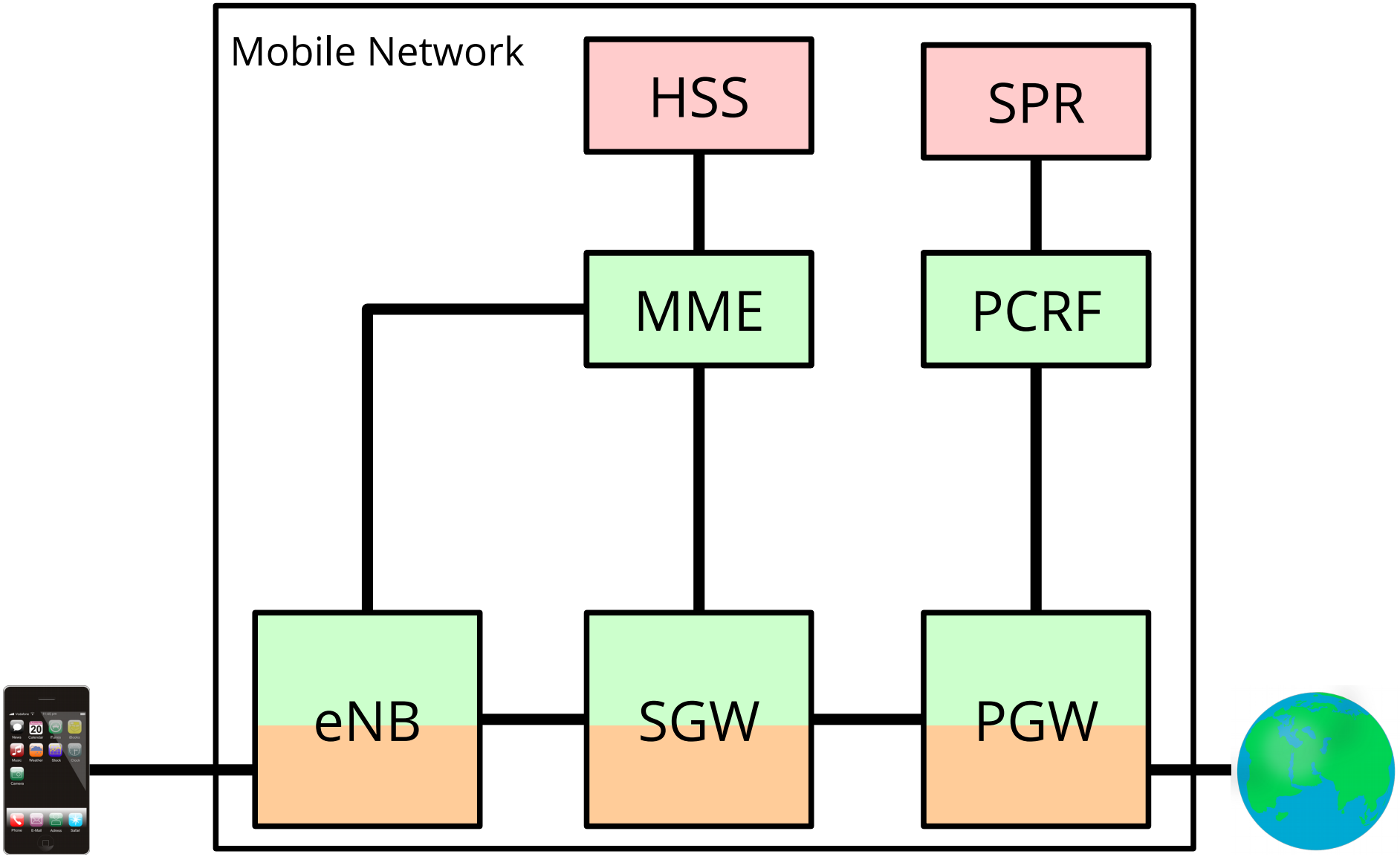


Identifying Roles of Network Functions

- Identify ***state variables*** used by network functions to maintain the UE state
- Study ***signals exchanged*** between network functions ***to update these state variables during procedures***
  - Initial Attach
  - Active to Idle
  - Idle to Active
  - Handovers

Procedure	***#signals***
Initial Attach	35
Active to Idle	6
Idle to Active (UE)	13
Idle to Active (Net)	17
Handover (S1H)	22

Identifying Modules



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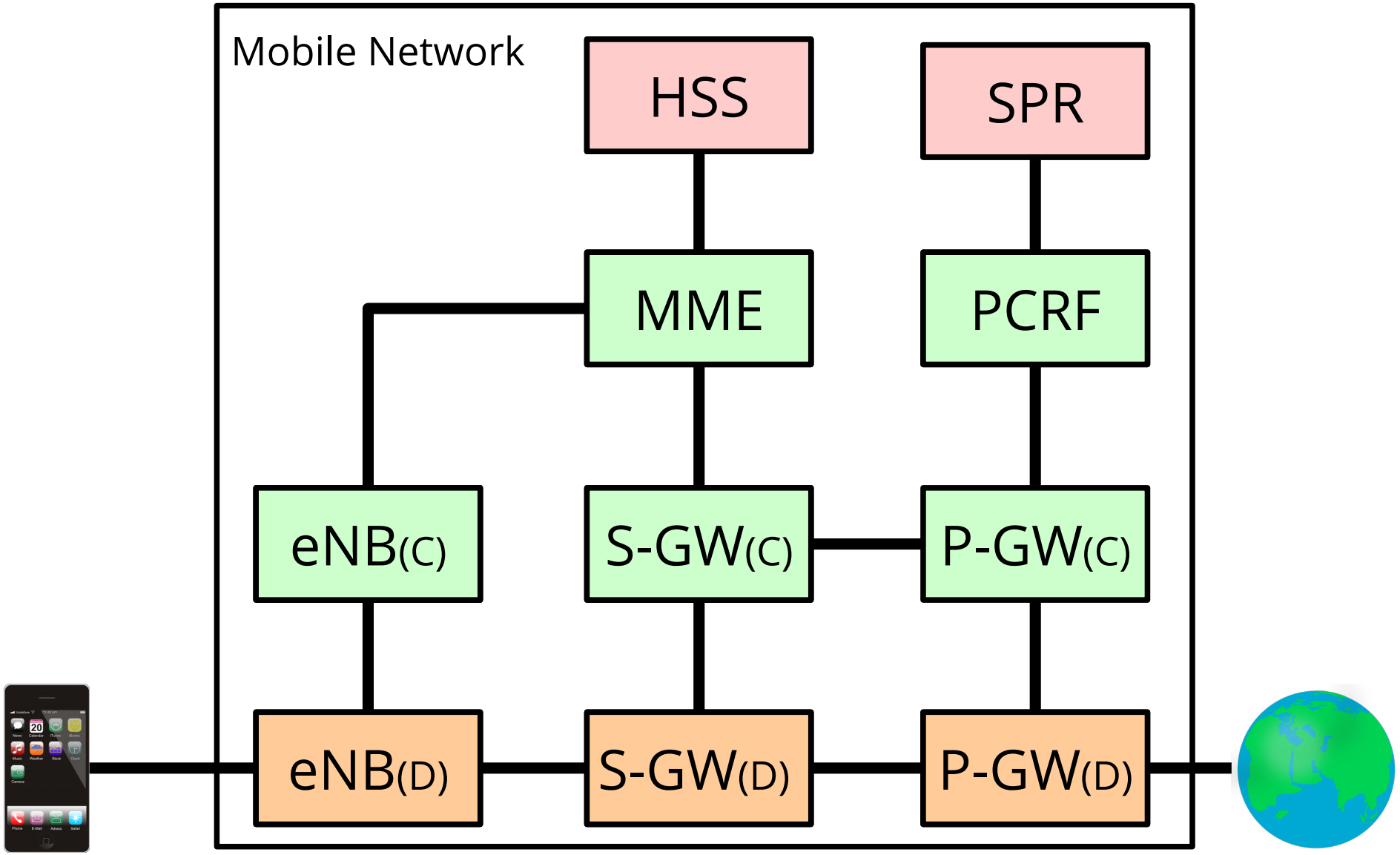
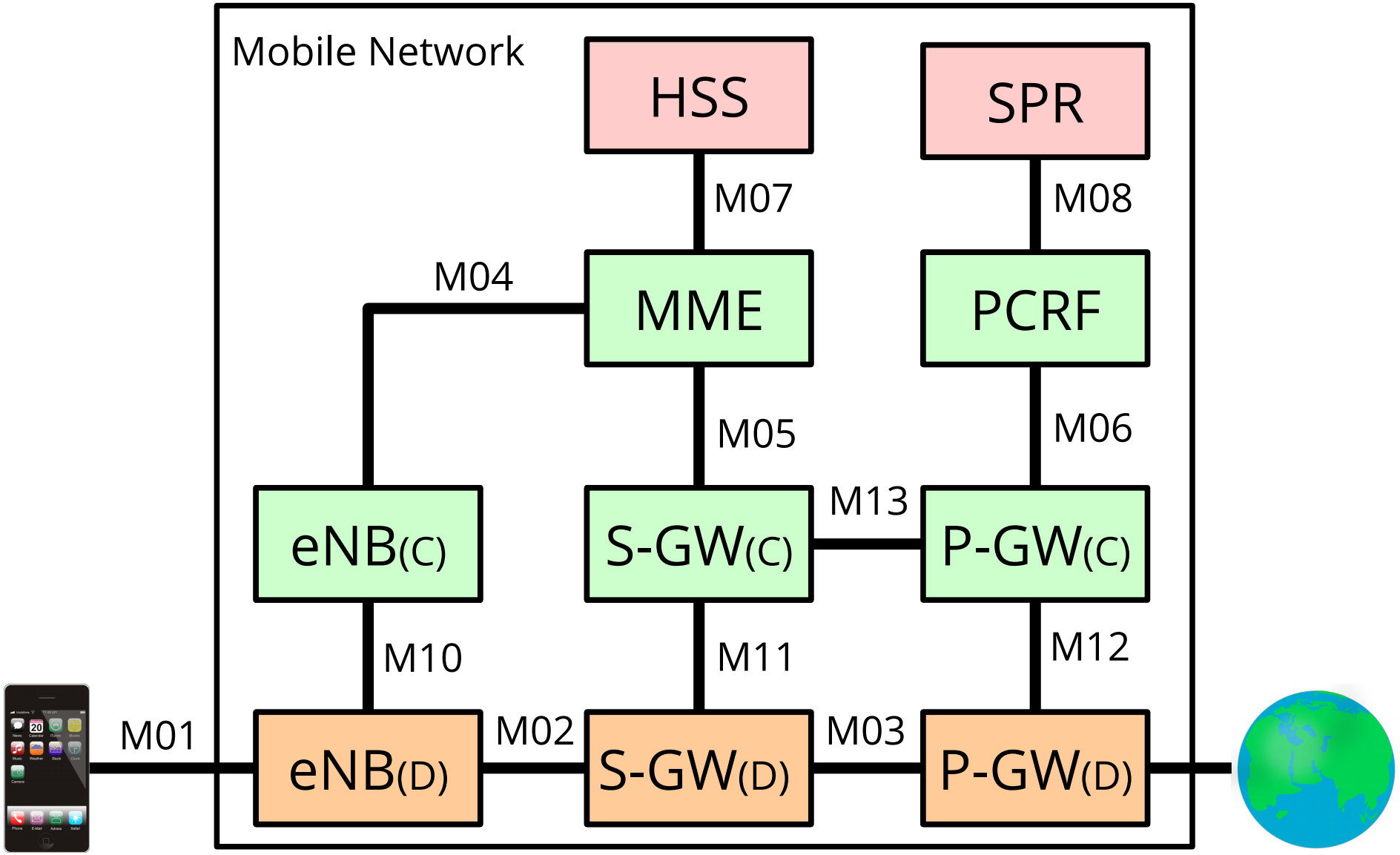


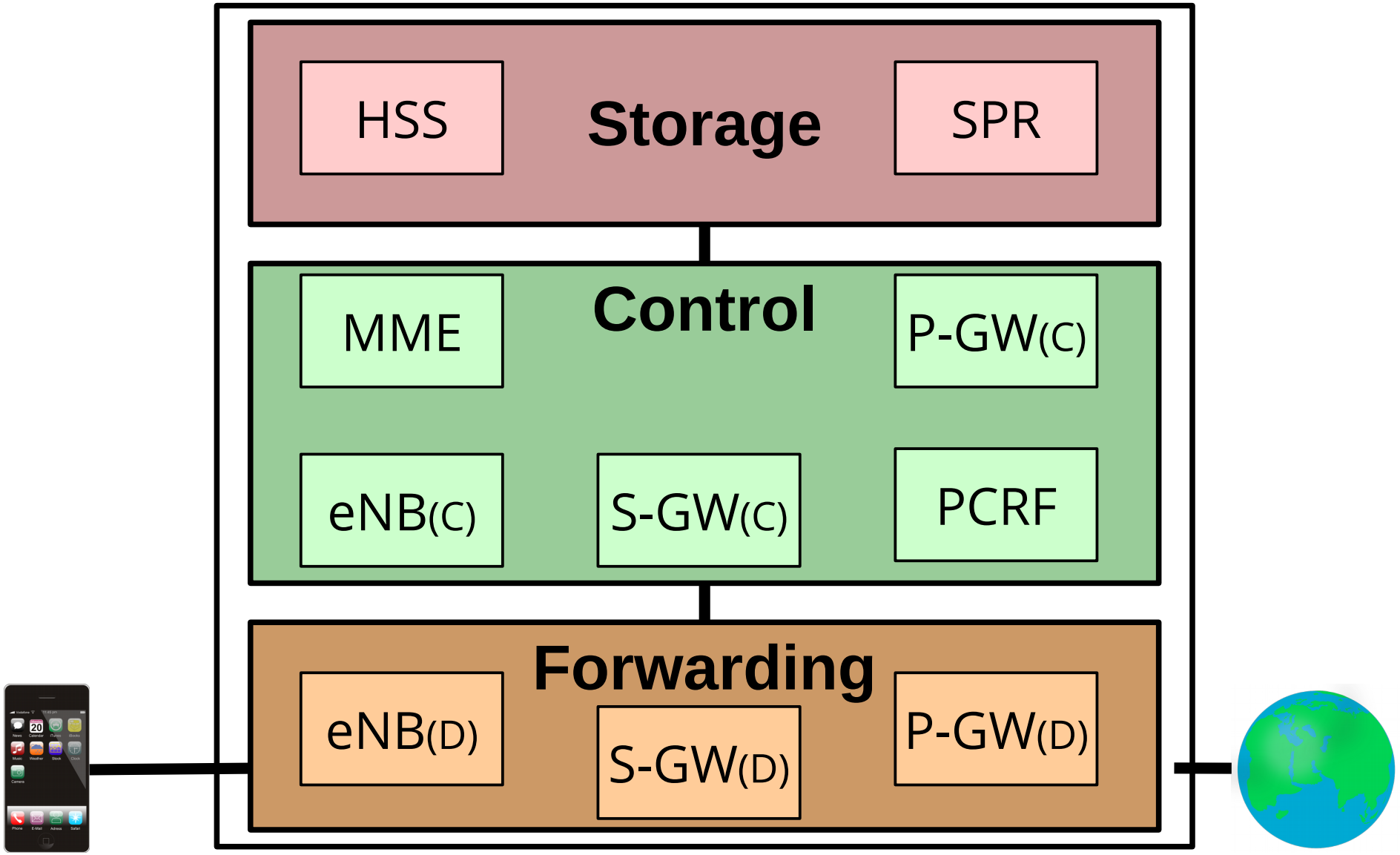
Identifying Modules



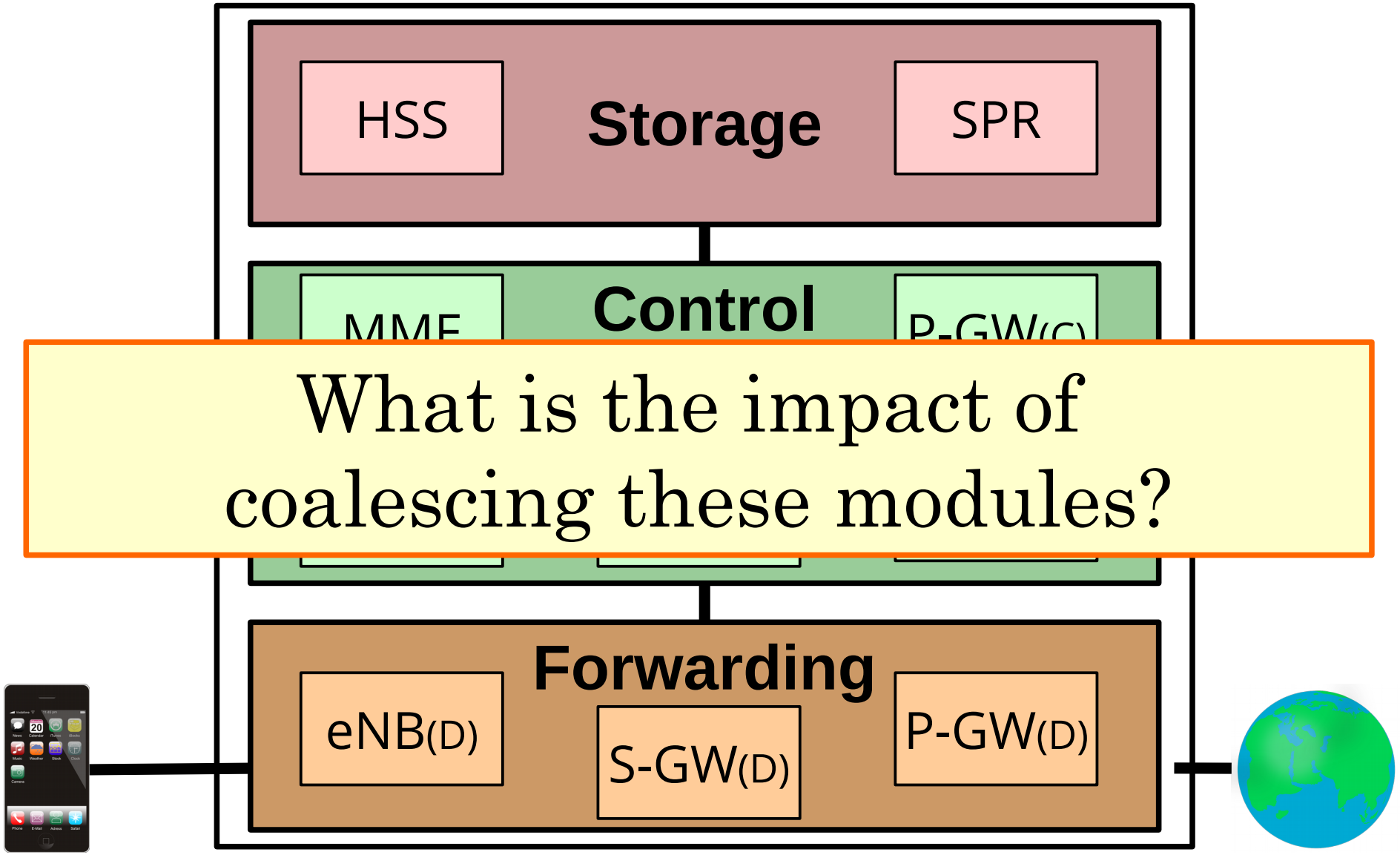
Impact of Splitting Control and Data Planes

Implementation	Total number of signals per event				
	Initial Attach	Active to Idle	Idle to Active (UE)	Idle to Active (Net)	Handover (S1H)
LTE (Baseline)	35	6	13	17	22
Modular LTE	57	11	23	29	41

Mapping Modules to Layers

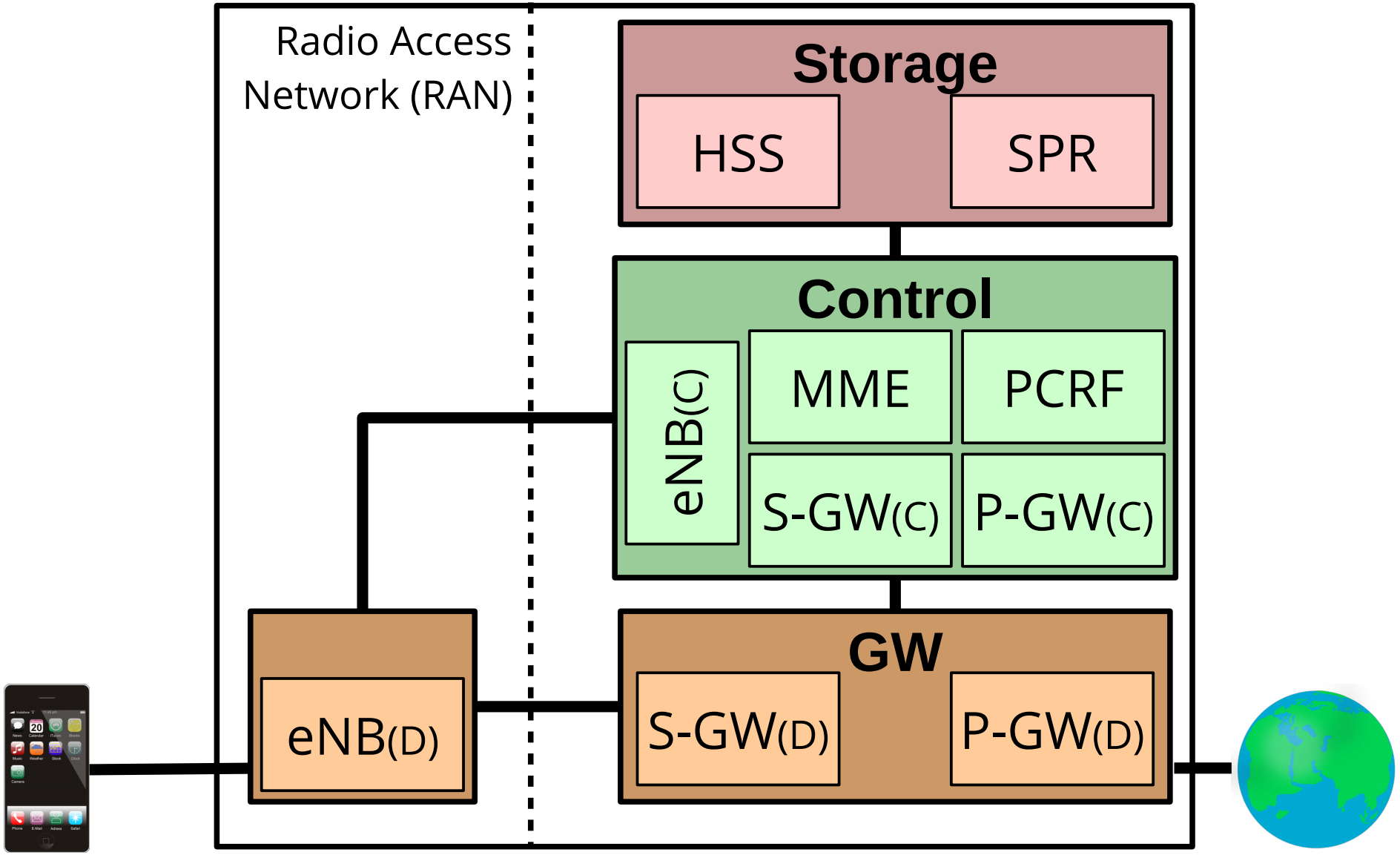


Mapping Modules to Layers

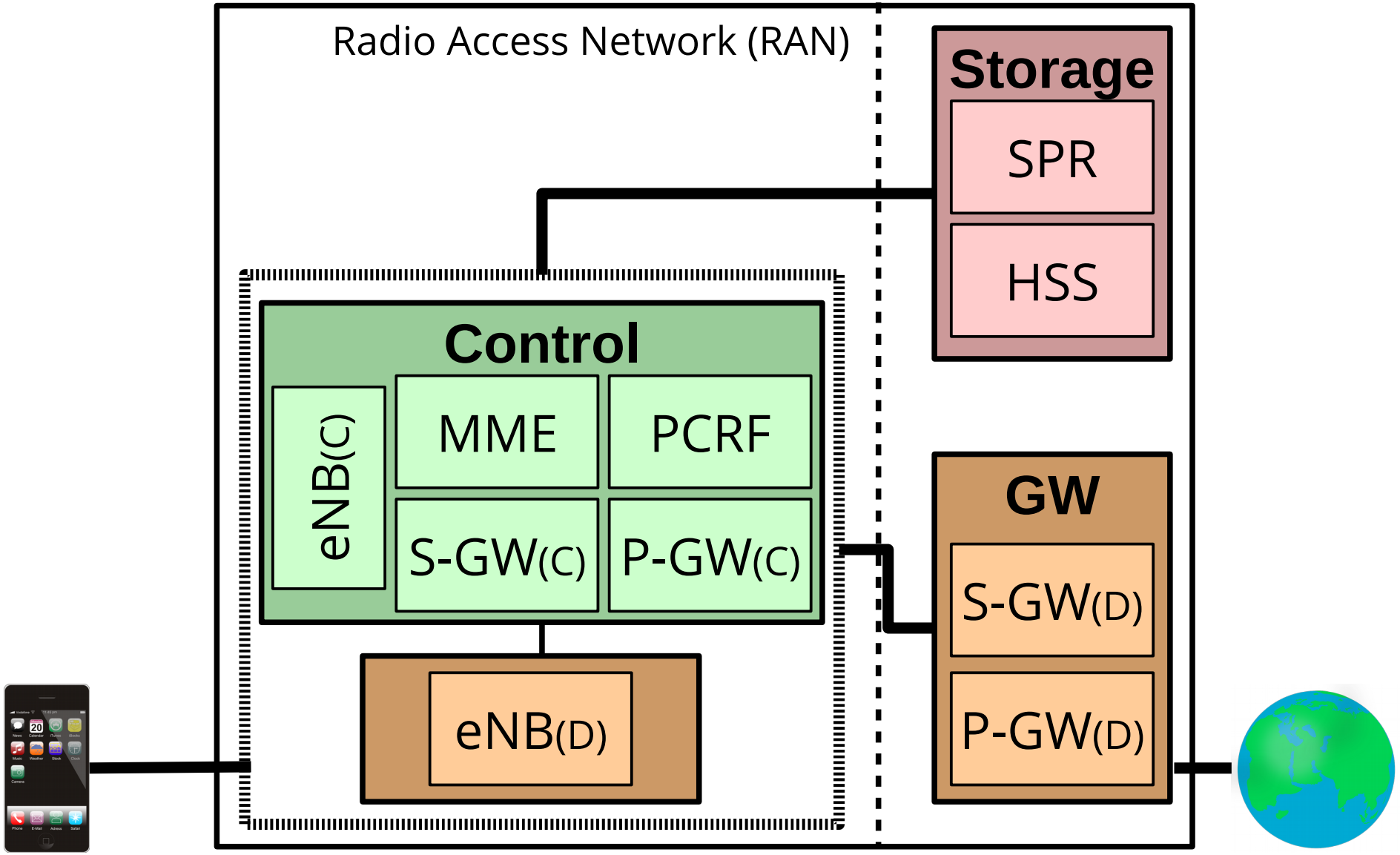


What is the impact of coalescing these modules?

Example 1: Thin Edge



Ex2: Intelligent Edge



Impact of Coalescing Modules

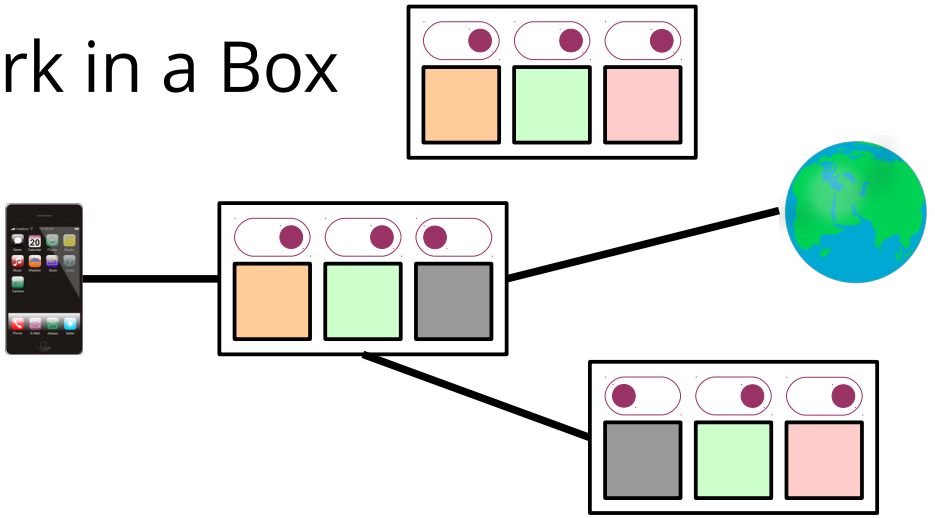
Implementation	Total number of signals per event				
	Initial Attach	Active to Idle	Idle to Active (UE)	Idle to Active (Net)	Handover (S1H)
LTE (Baseline)	35	6	13	17	22
Thin Edge	24	6	13	16	16
Intelligent Edge	17	3	10	12	12

Summary and Future Work

- Abstract the roles of the network functions
- Modularize the network functions
- Explore scenarios for coalescing the modules

Summary and Future Work

- Abstract the roles of the network functions
- Modularize the network functions
- Explore scenarios for coalescing the modules
  - Modules can become part of solutions for backward compatibility with next generation networks
  - Network in a Box



Thank You!

ashwin.rao@helsinki.fi