Proteus: A Network Service Control Platform for Service Evolution in a Mobile Software Defined Infrastructure

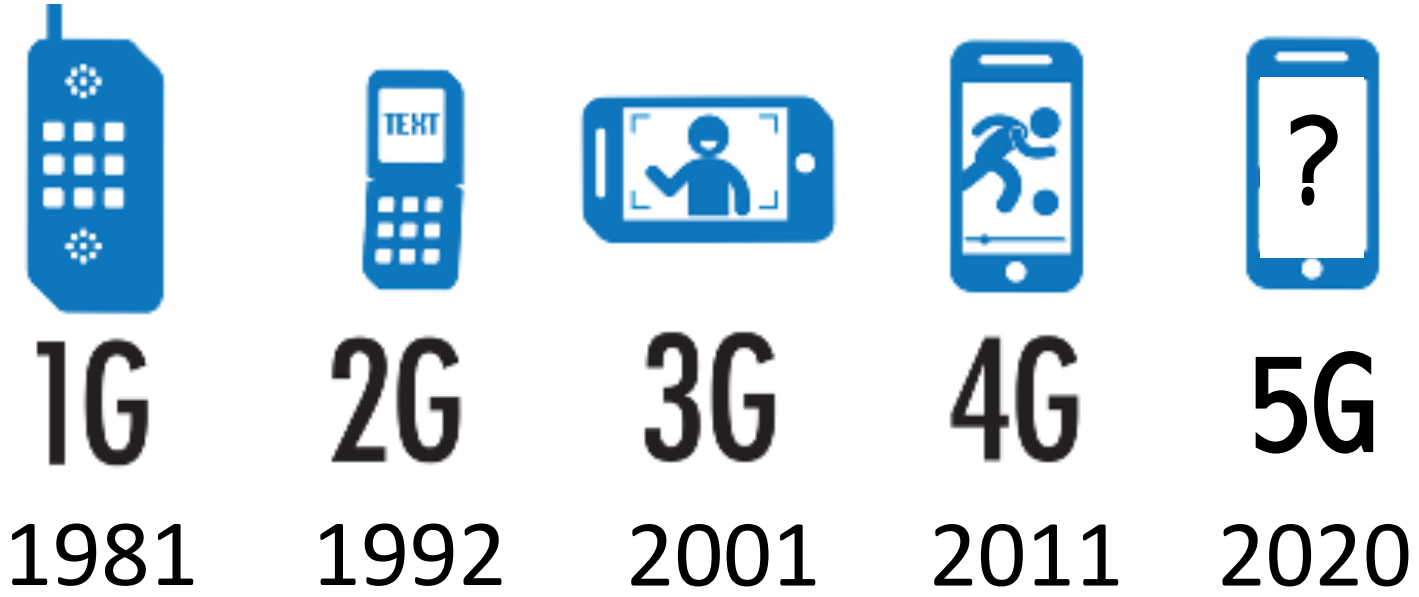
Aisha Syed and Kobus Van der Merwe

THE UNIVERSITY OF UTAH

This work was supported by the National Science Foundation under grant numbers 1305384 and 1302688.

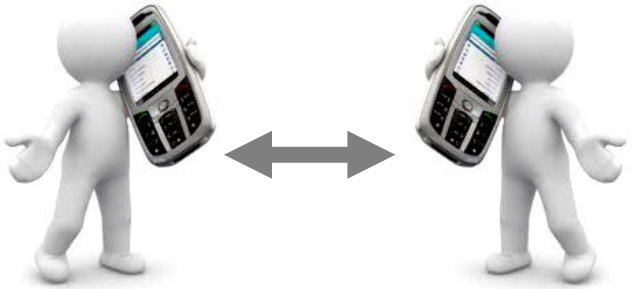
Motivation

- Mobile network service deployment and evolution very slow



Motivation

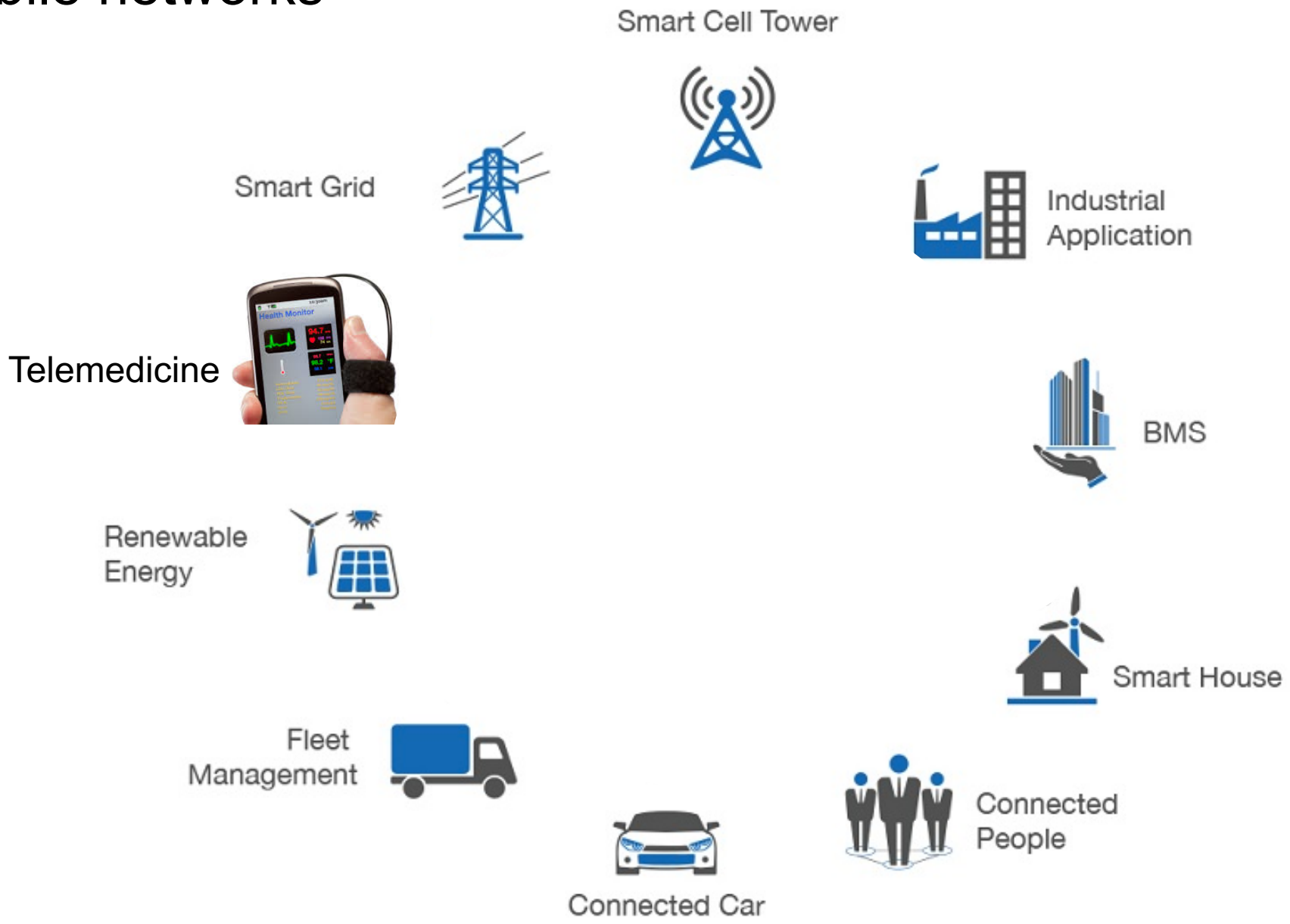
- Monolithic service abstraction: mobile broadband



Human-to-human

Human-to-machine

- Future mobile networks



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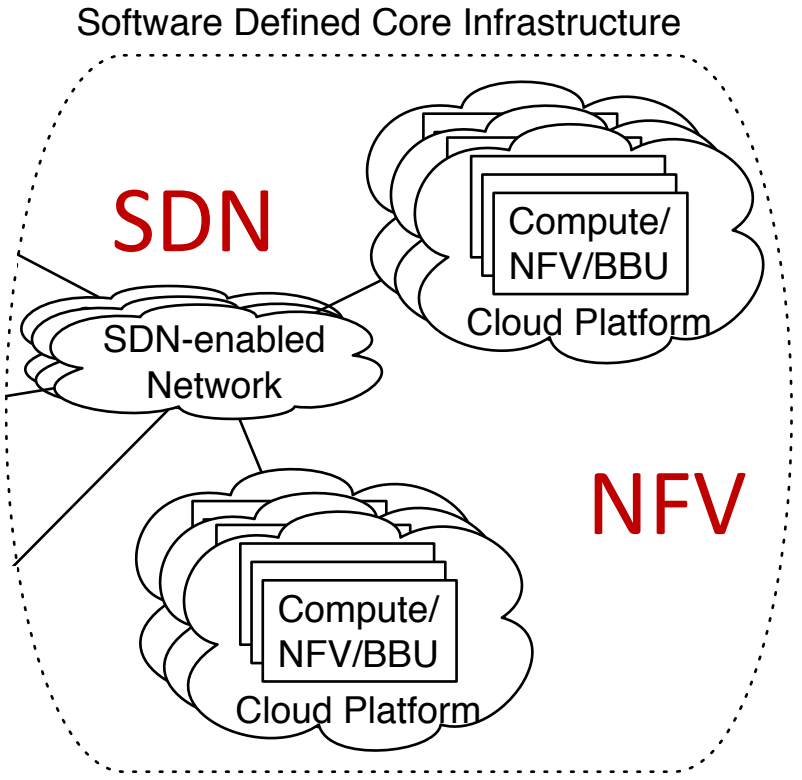

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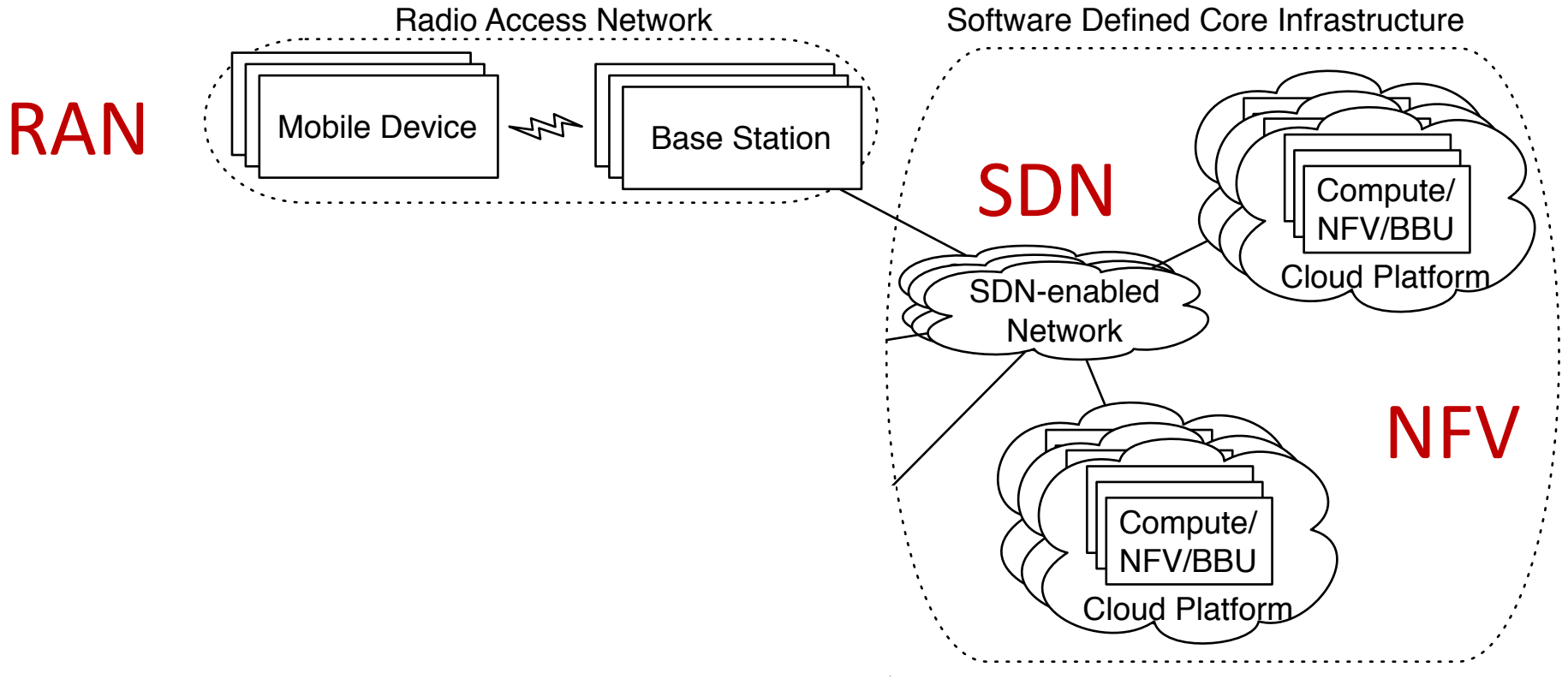

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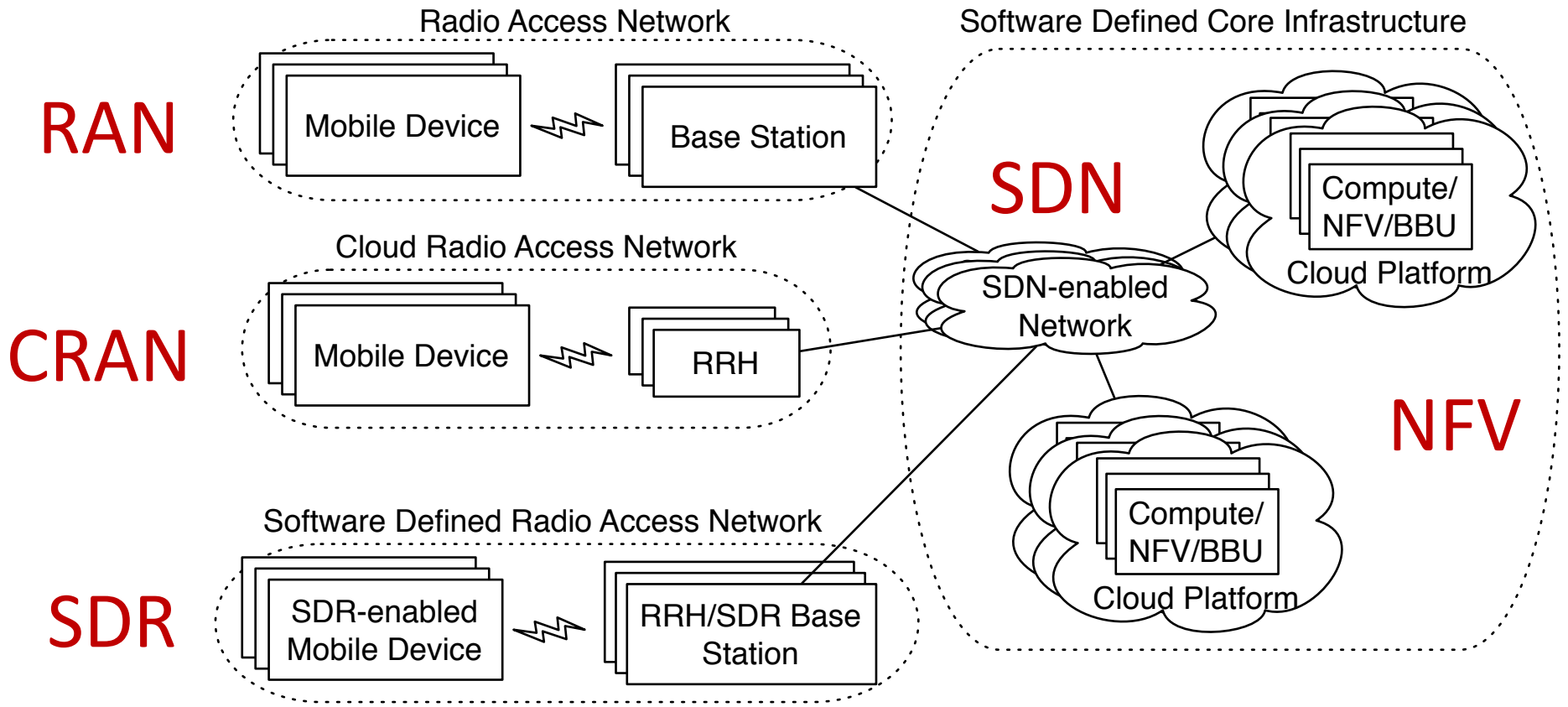

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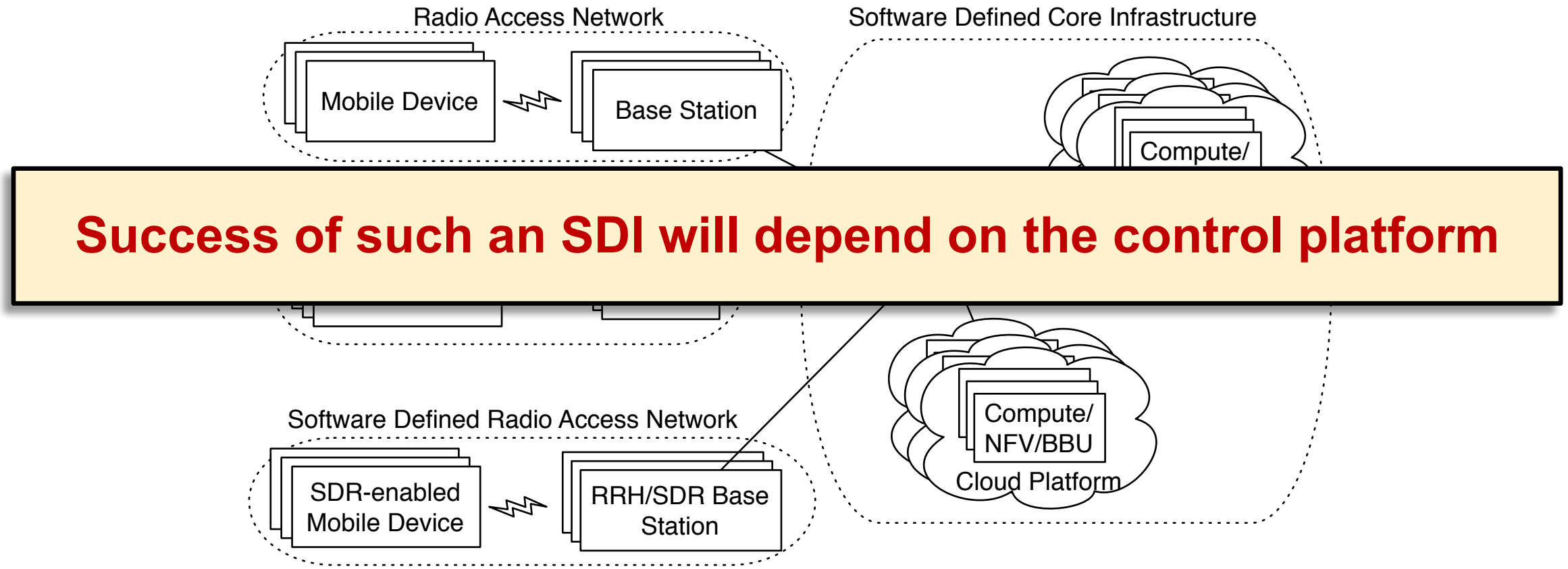

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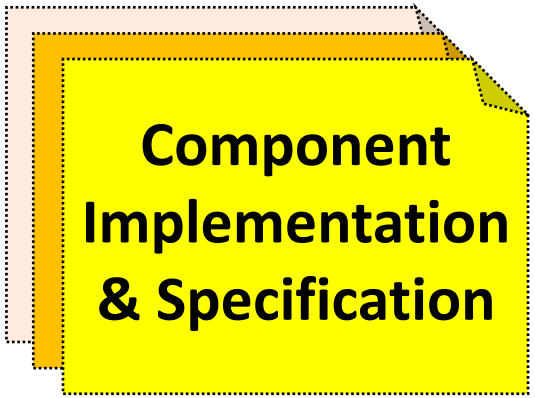

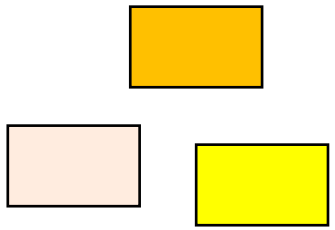

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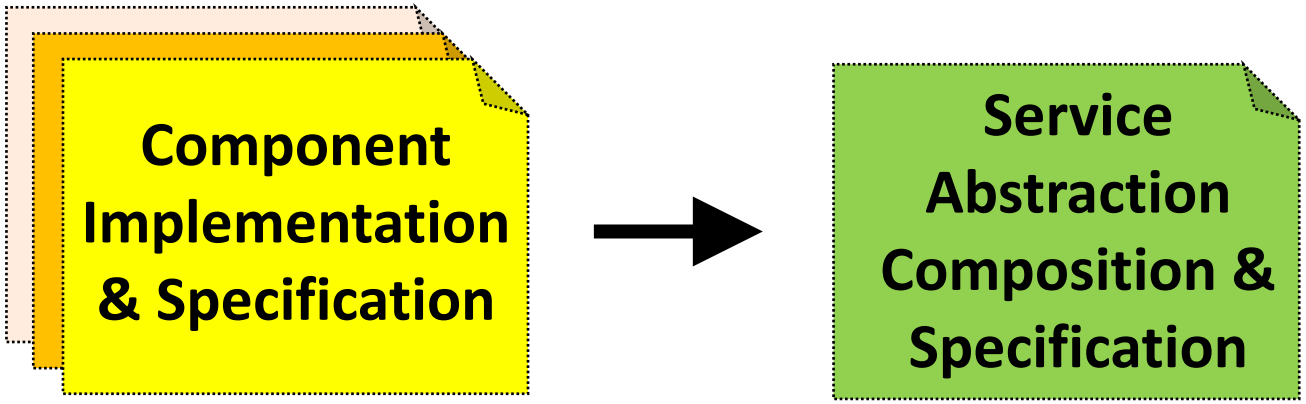

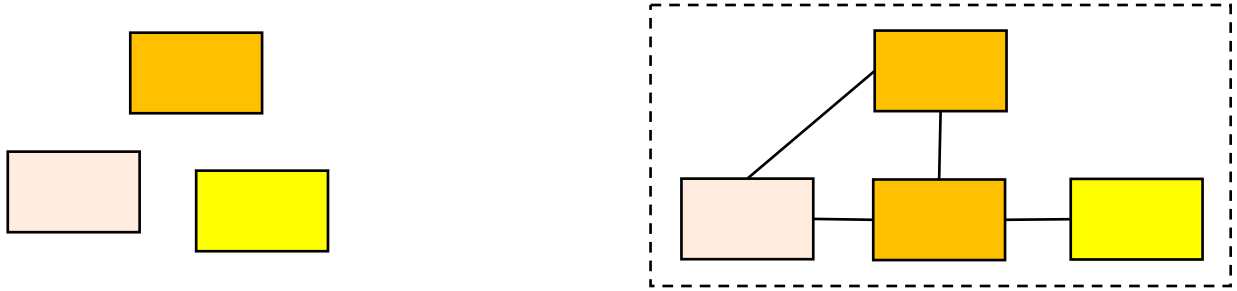

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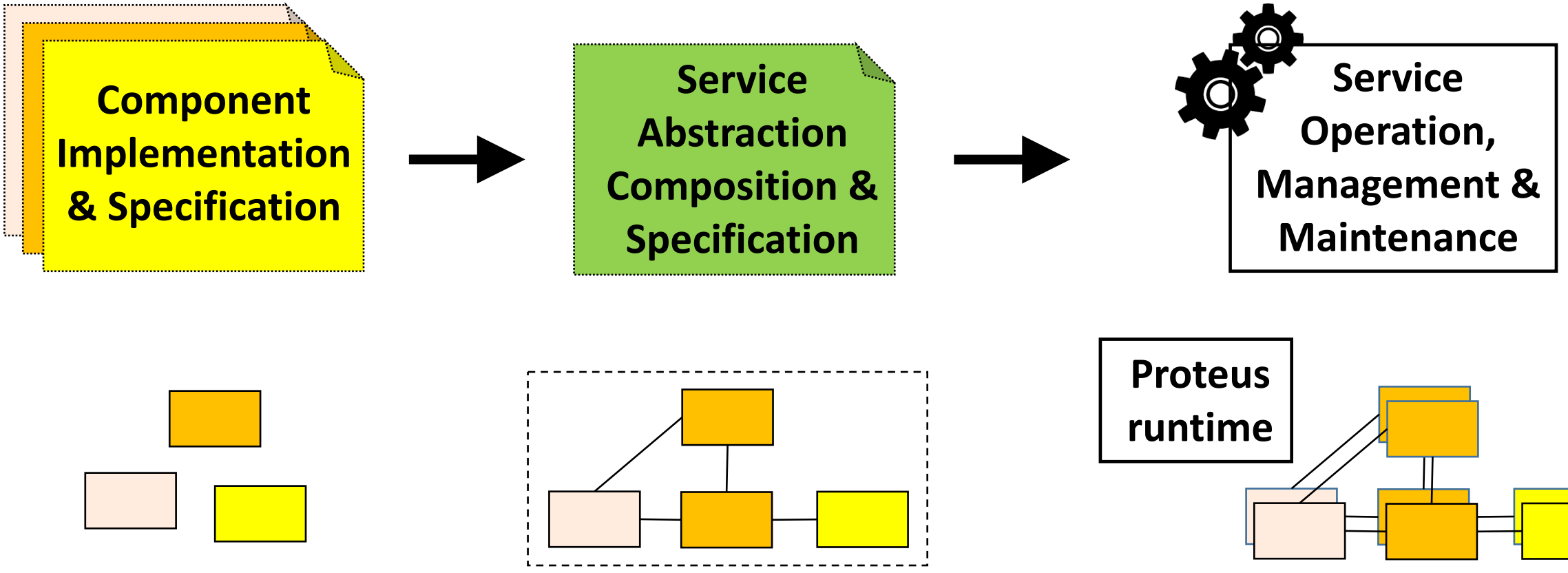

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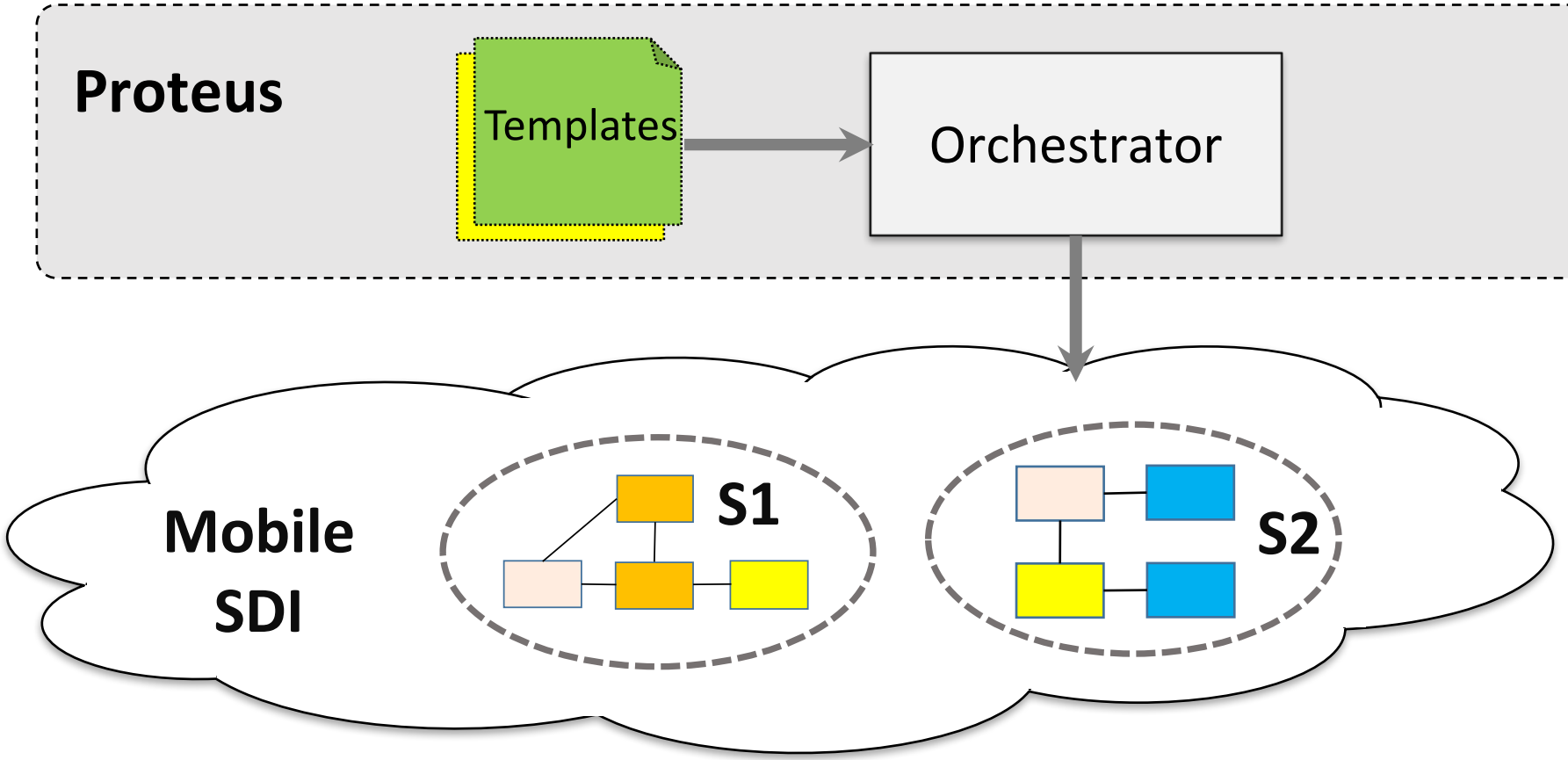

Challenges and Design Principles

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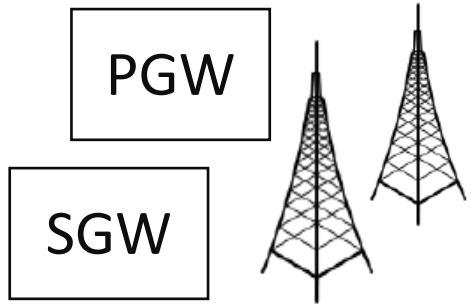

Physical Mobile resources

Compute

Network

Challenges and Design Principles

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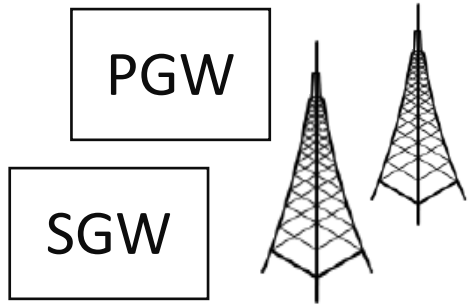
Proteus Abstraction Layer



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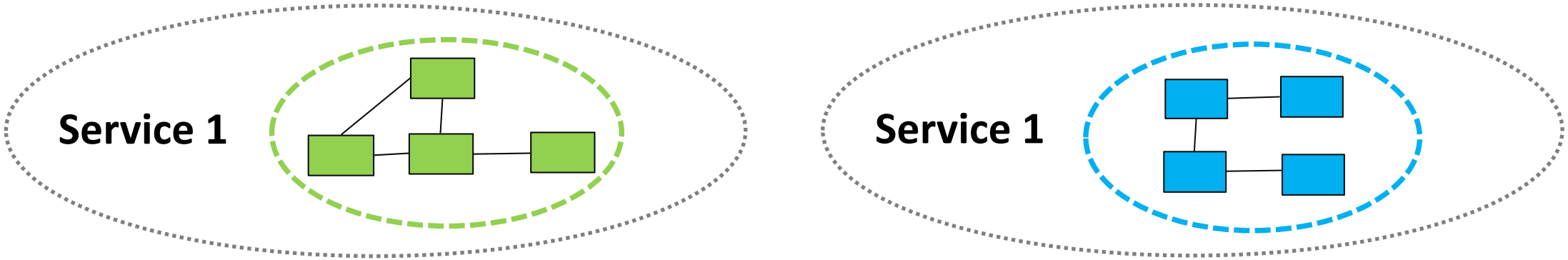

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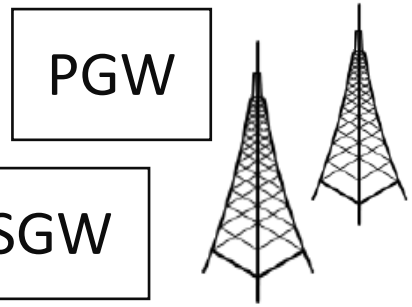

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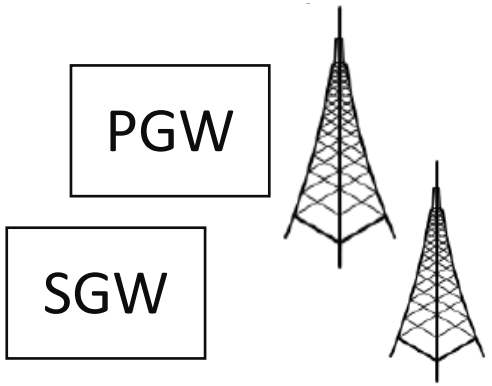

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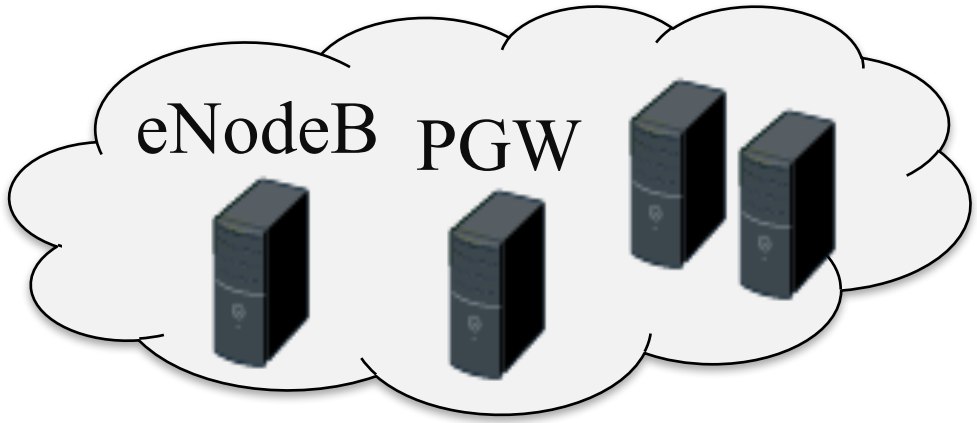

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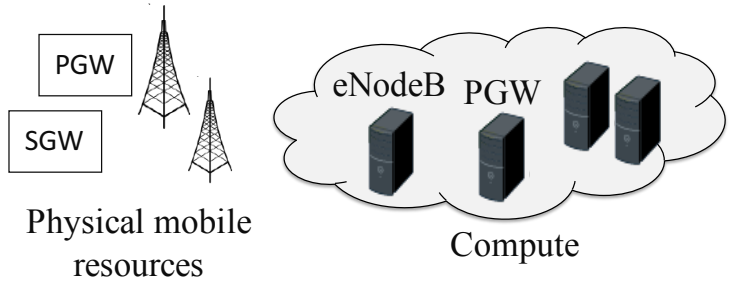

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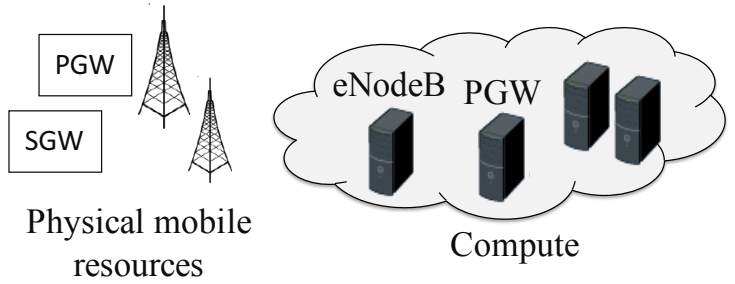

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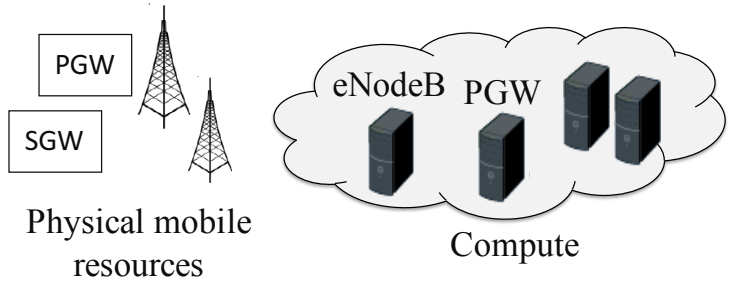

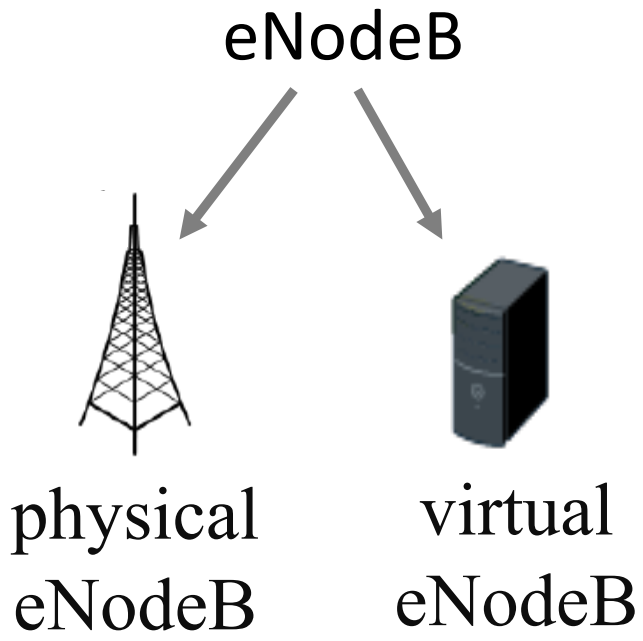

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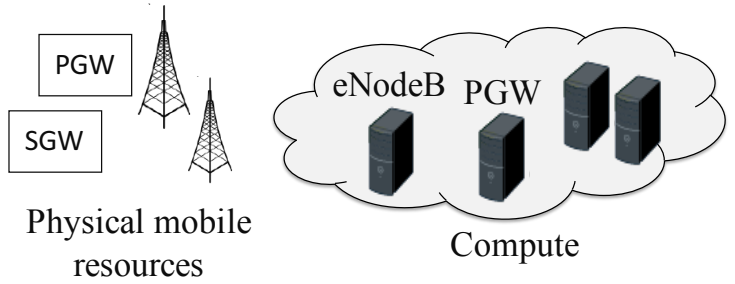

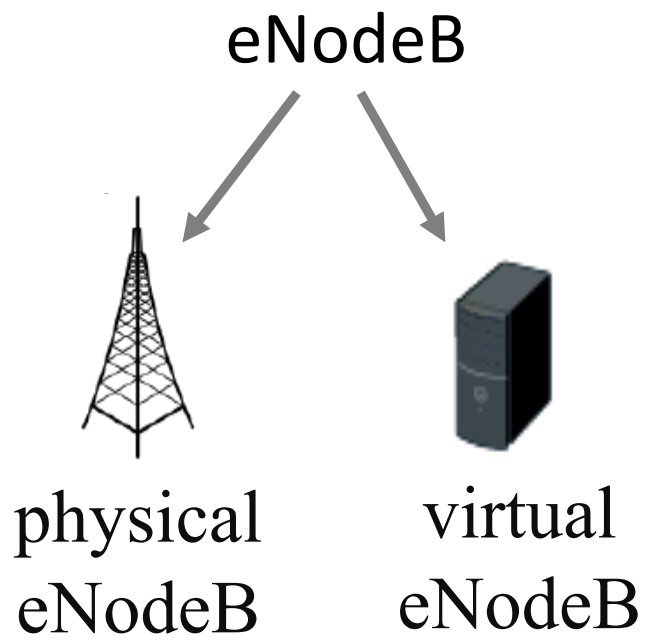

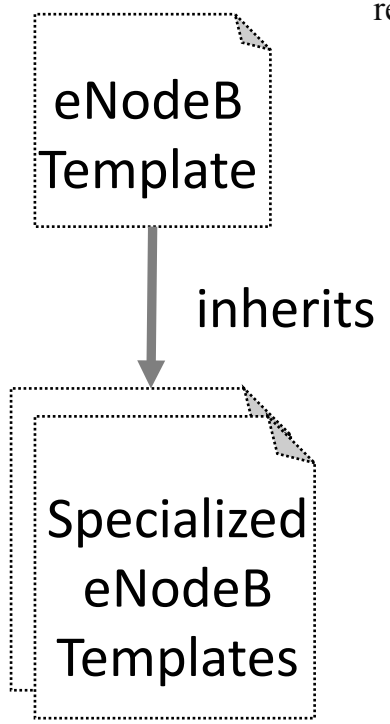

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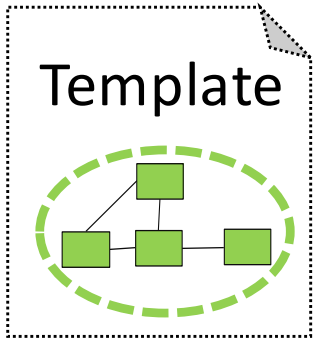

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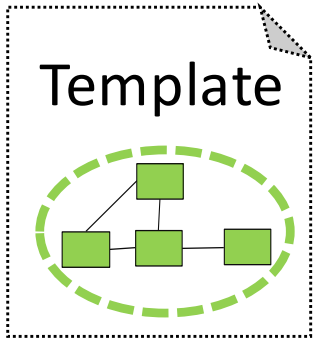

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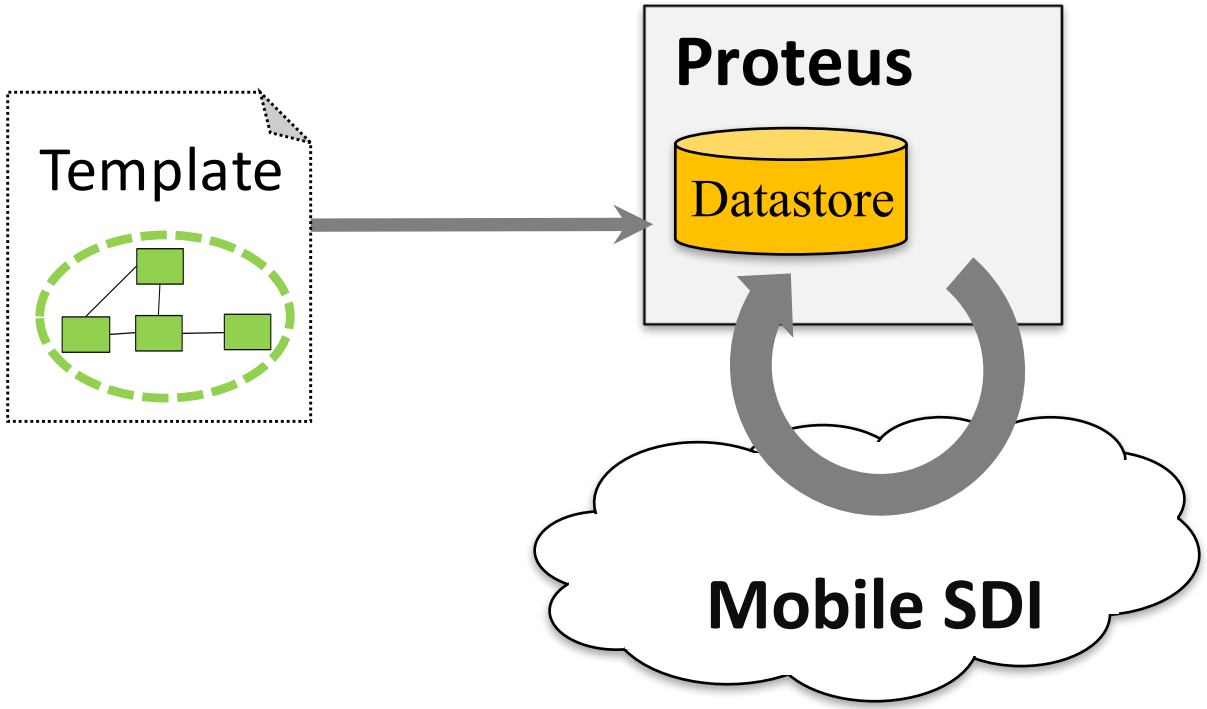

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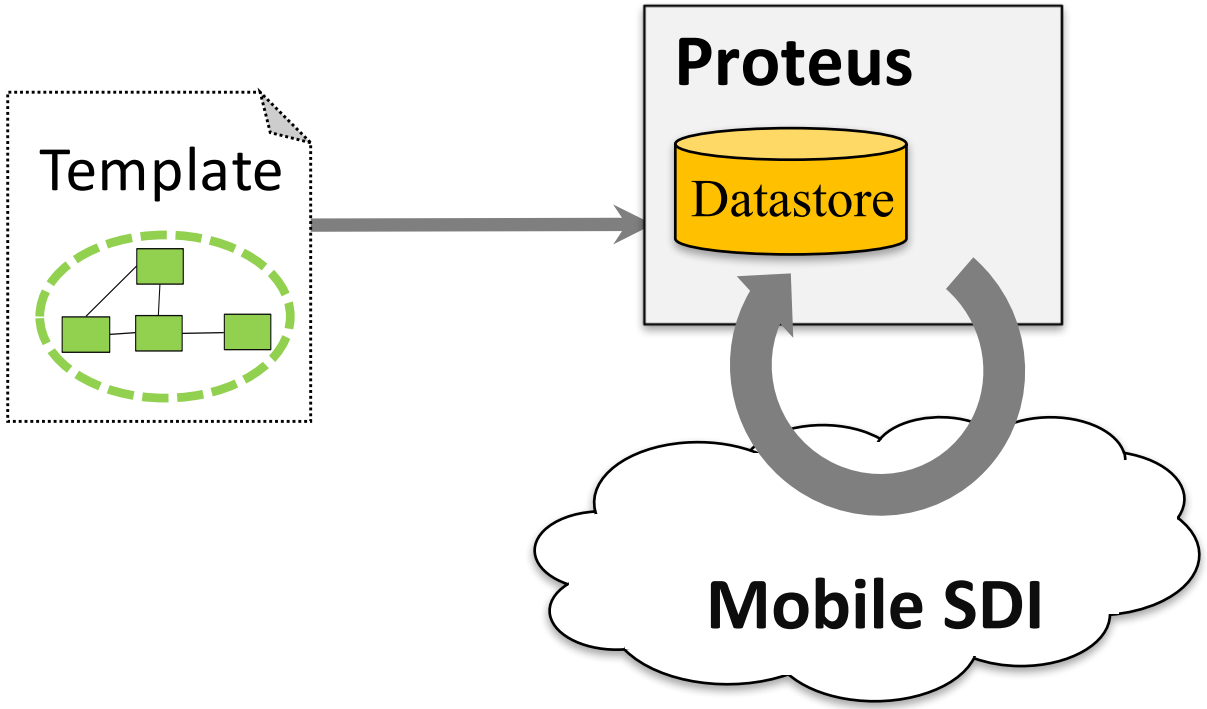

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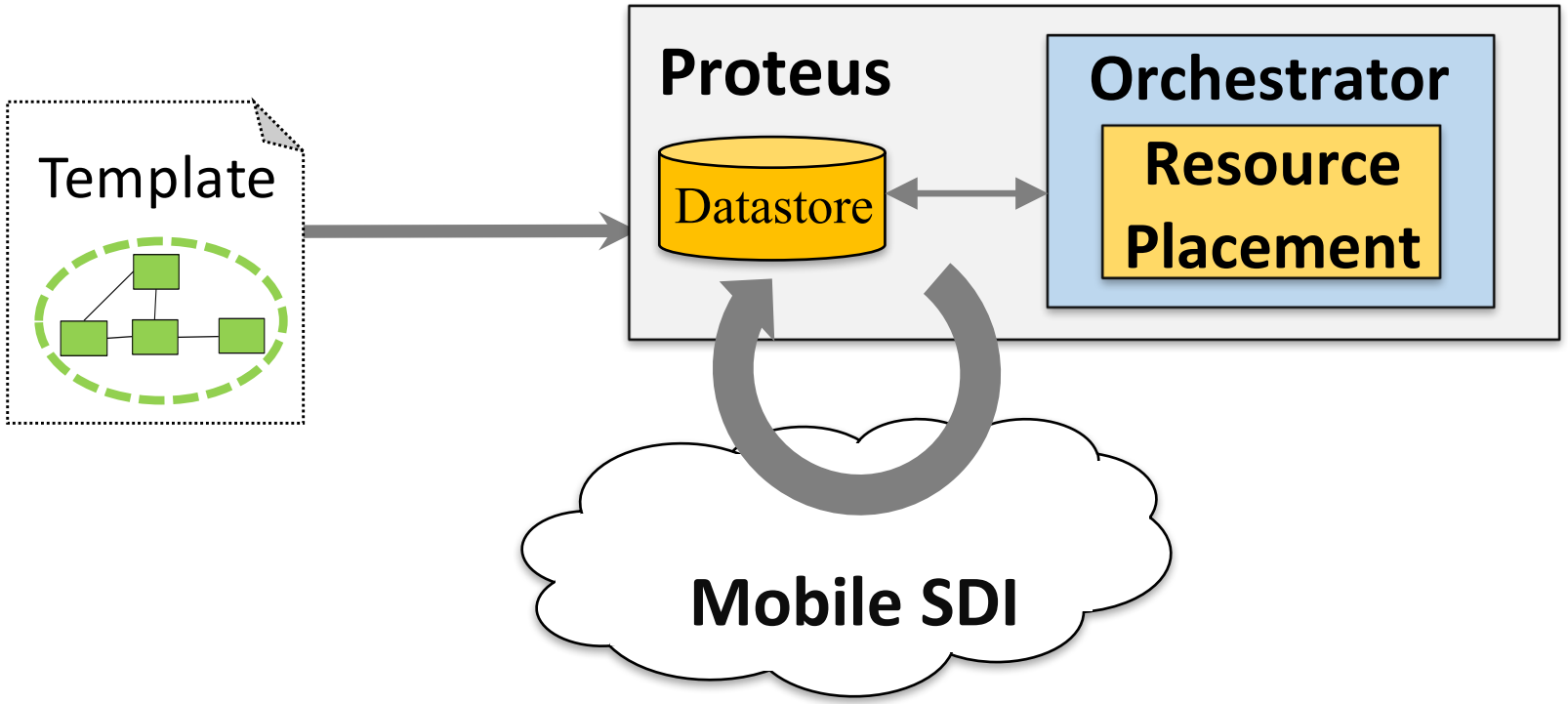

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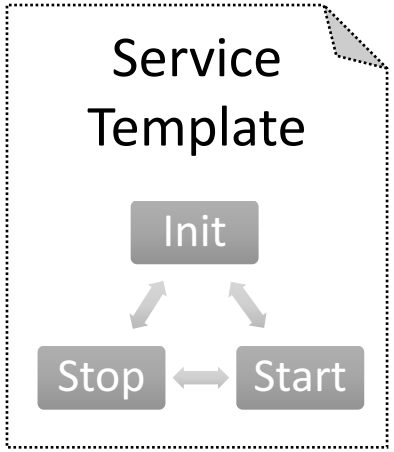

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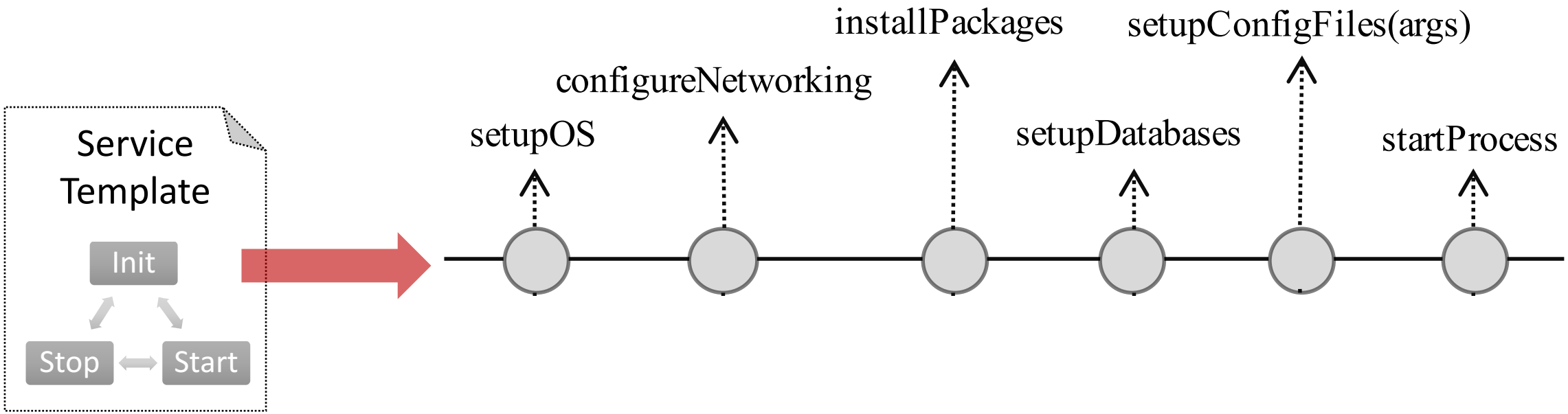

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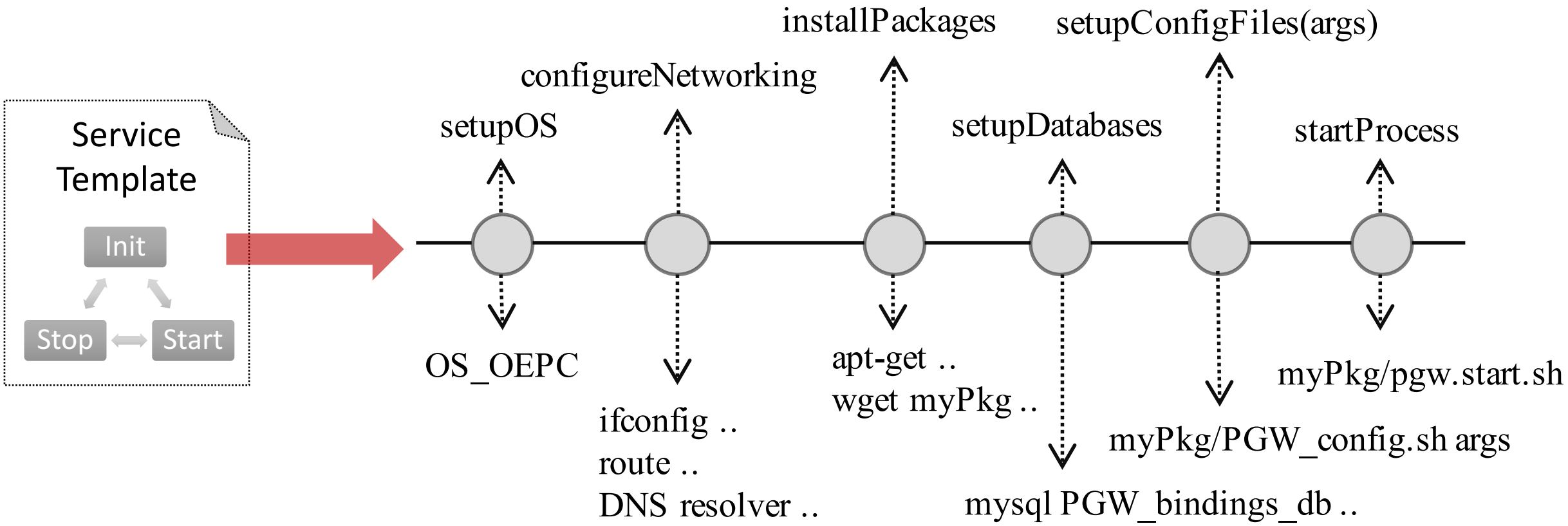

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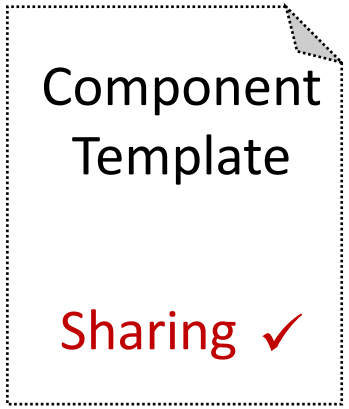

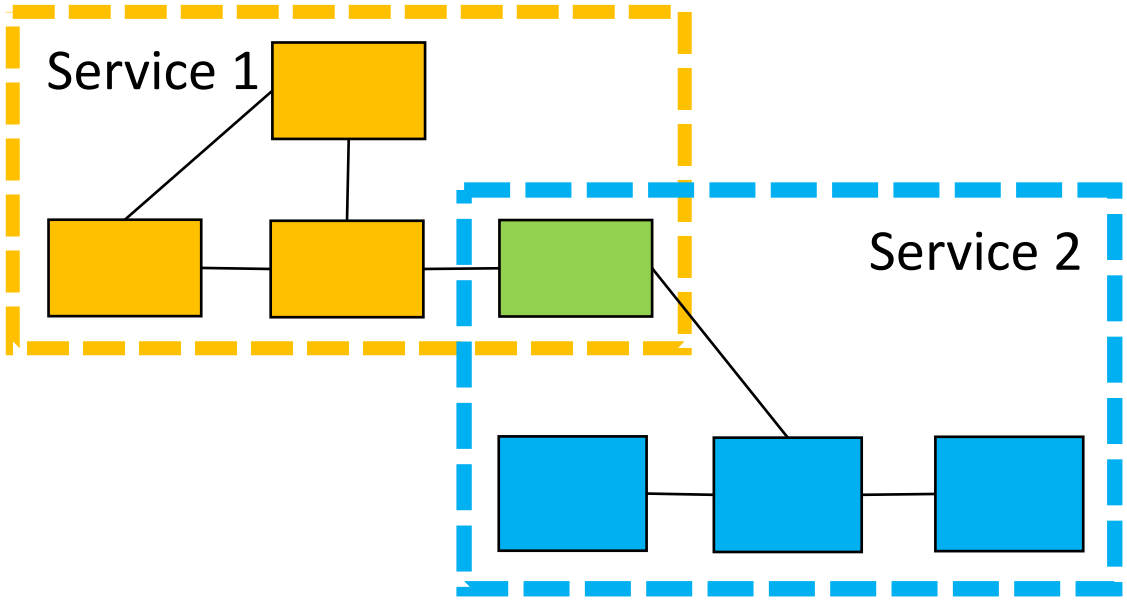

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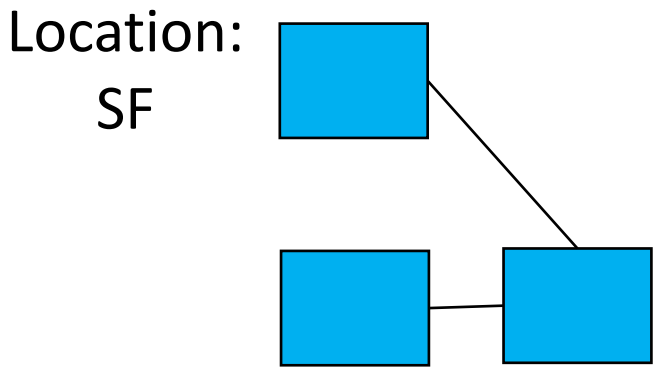

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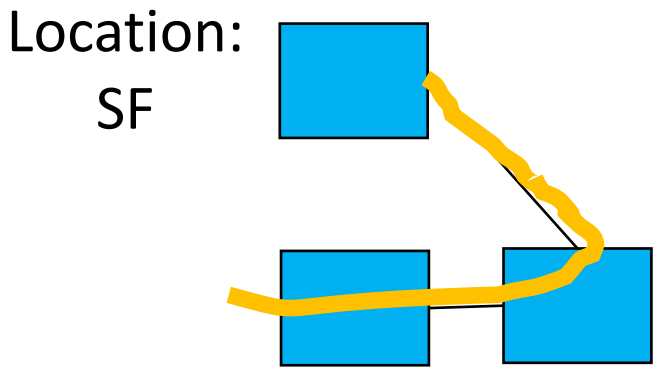

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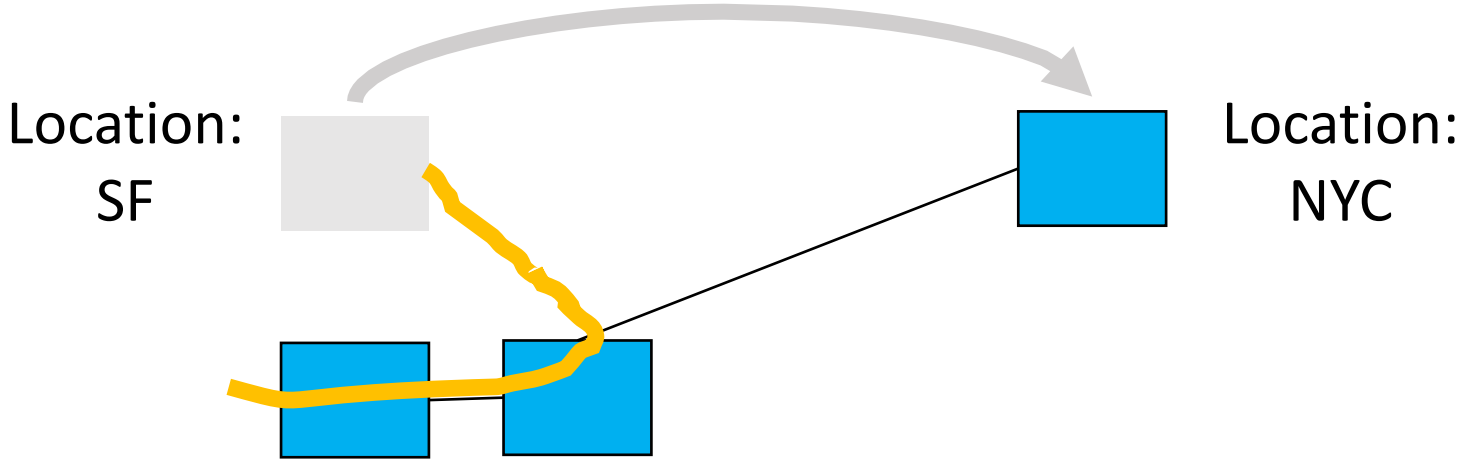

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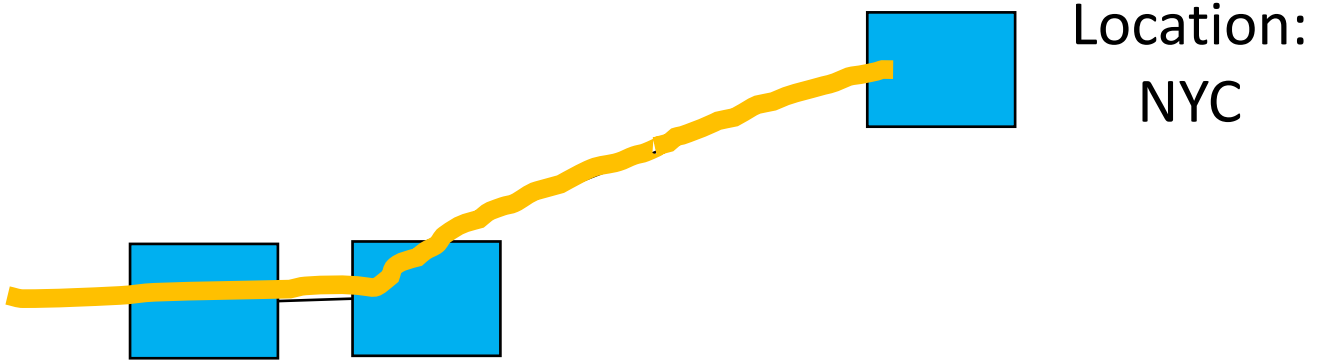
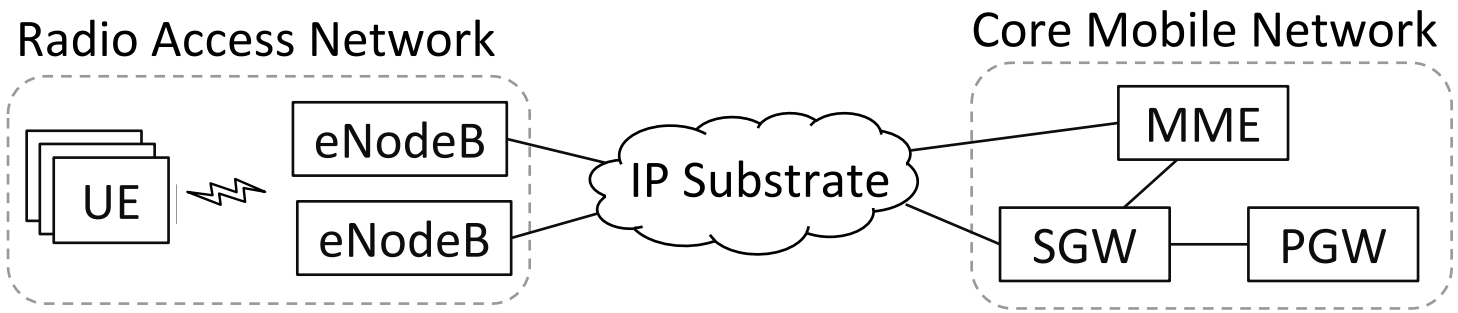


Use Cases



LTE/EPC: Standard mobile broadband service

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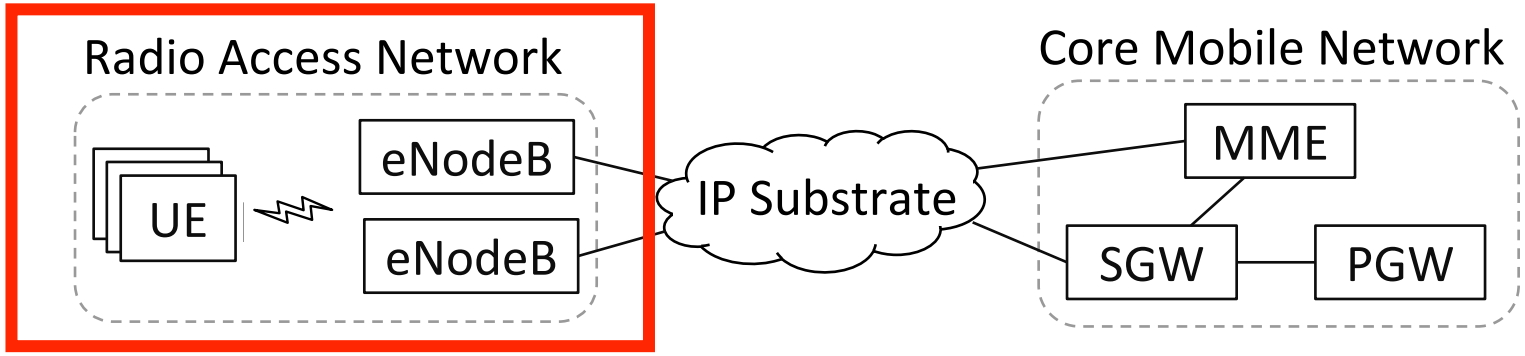

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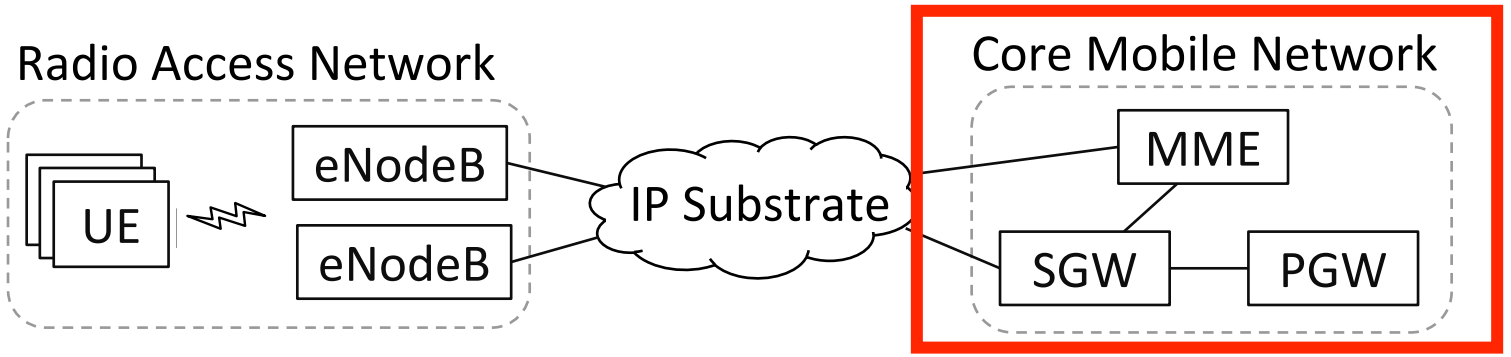

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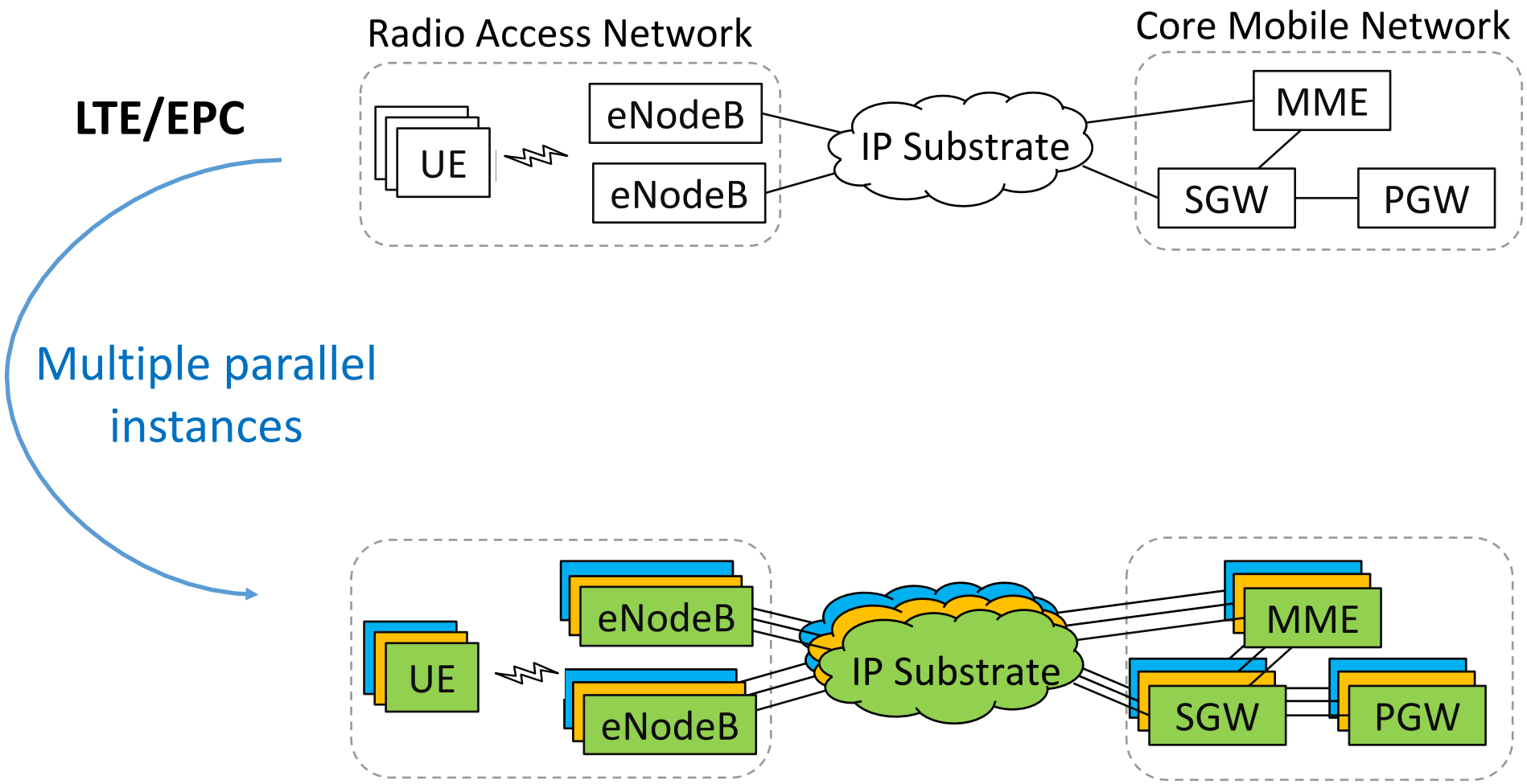
Use Case: Hosted Multiplicity



Use Case: SCALE

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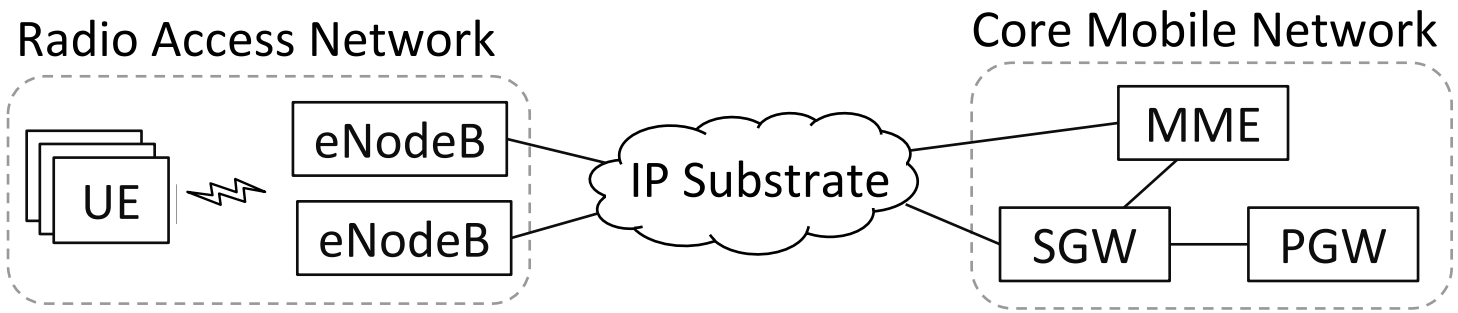

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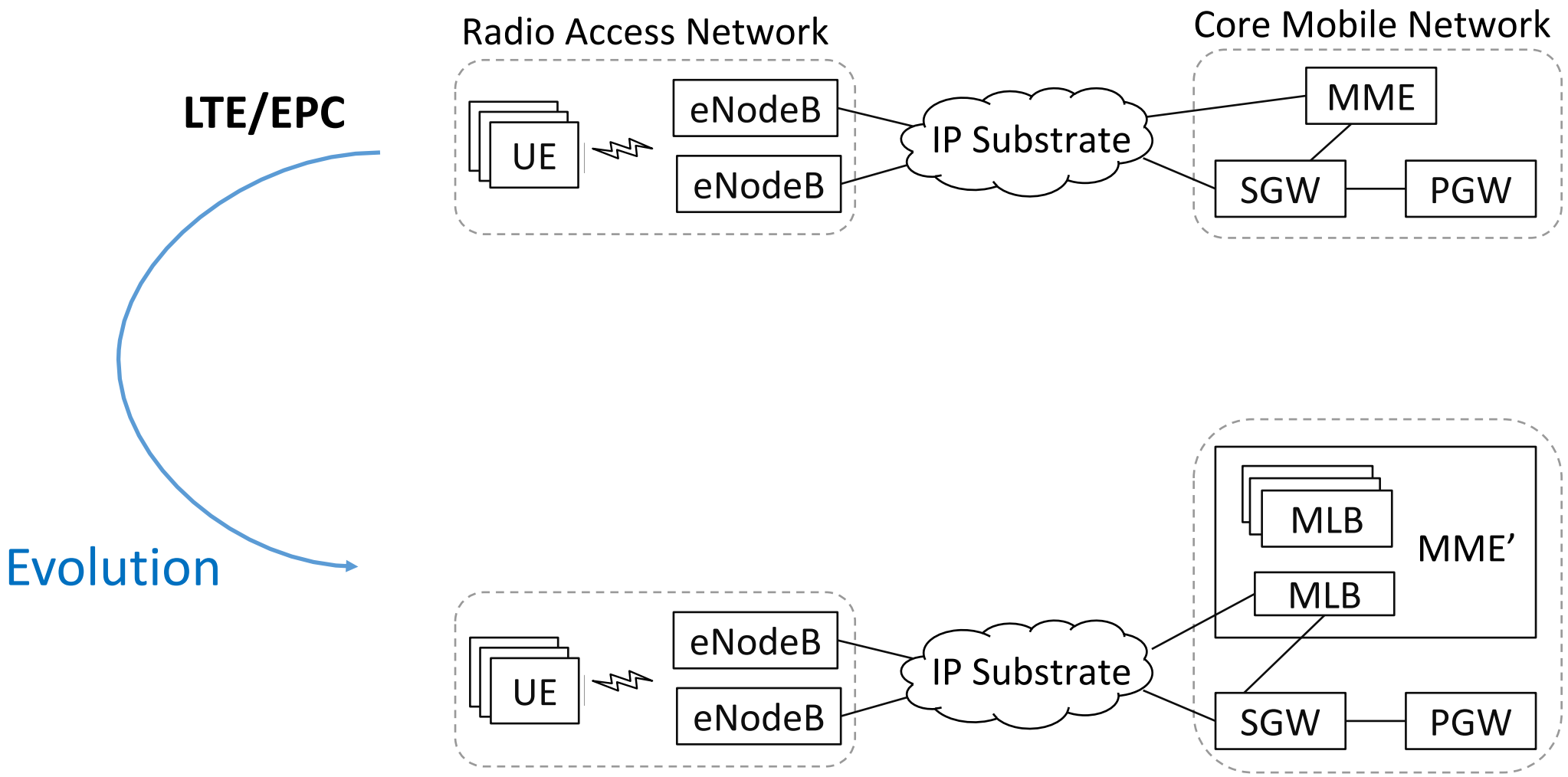

SCALE [Banerjee et al., CoNEXT 2015]

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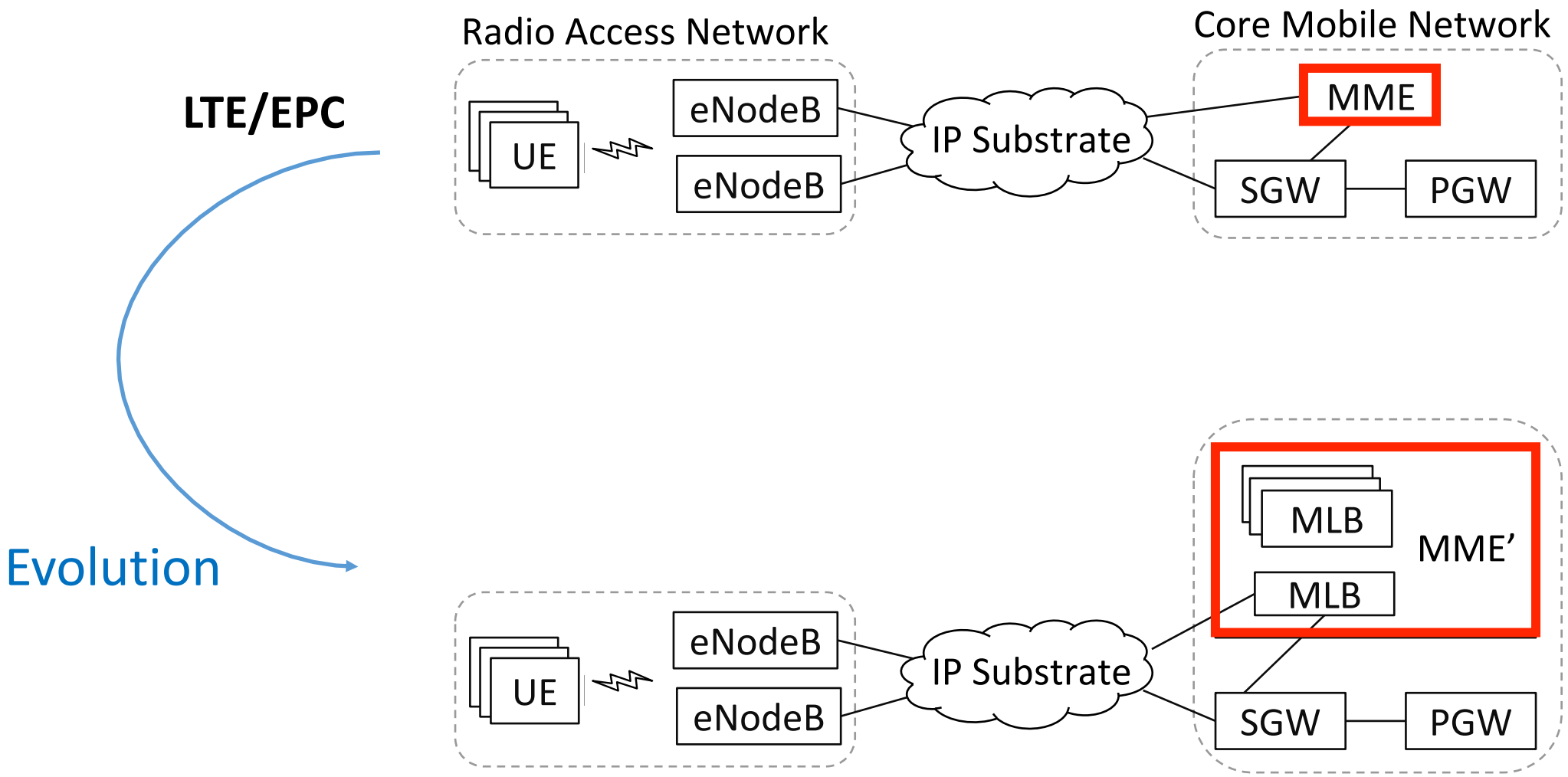

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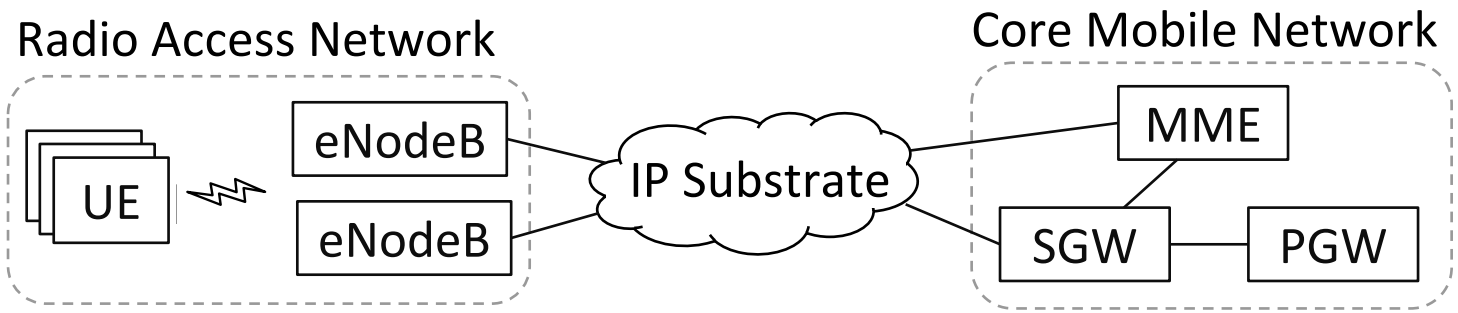

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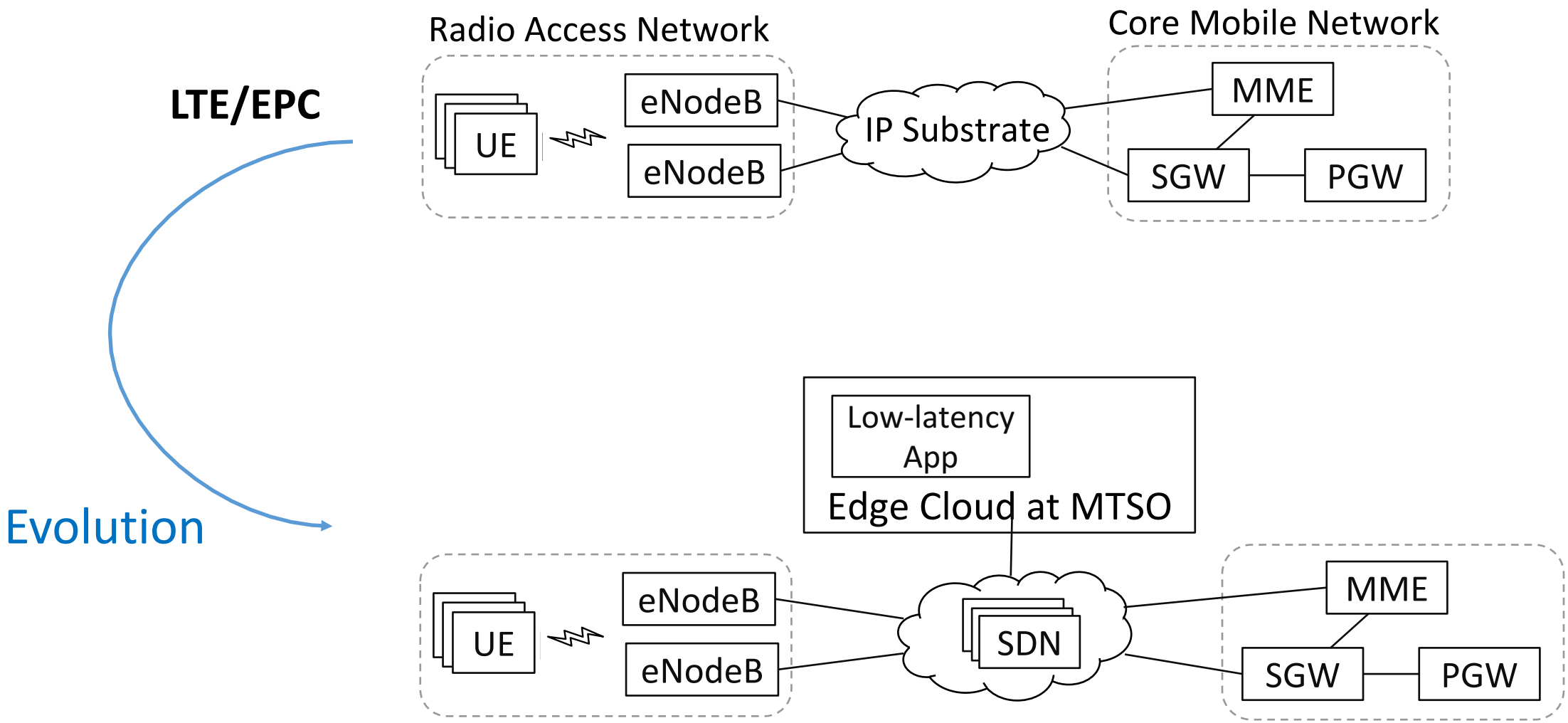

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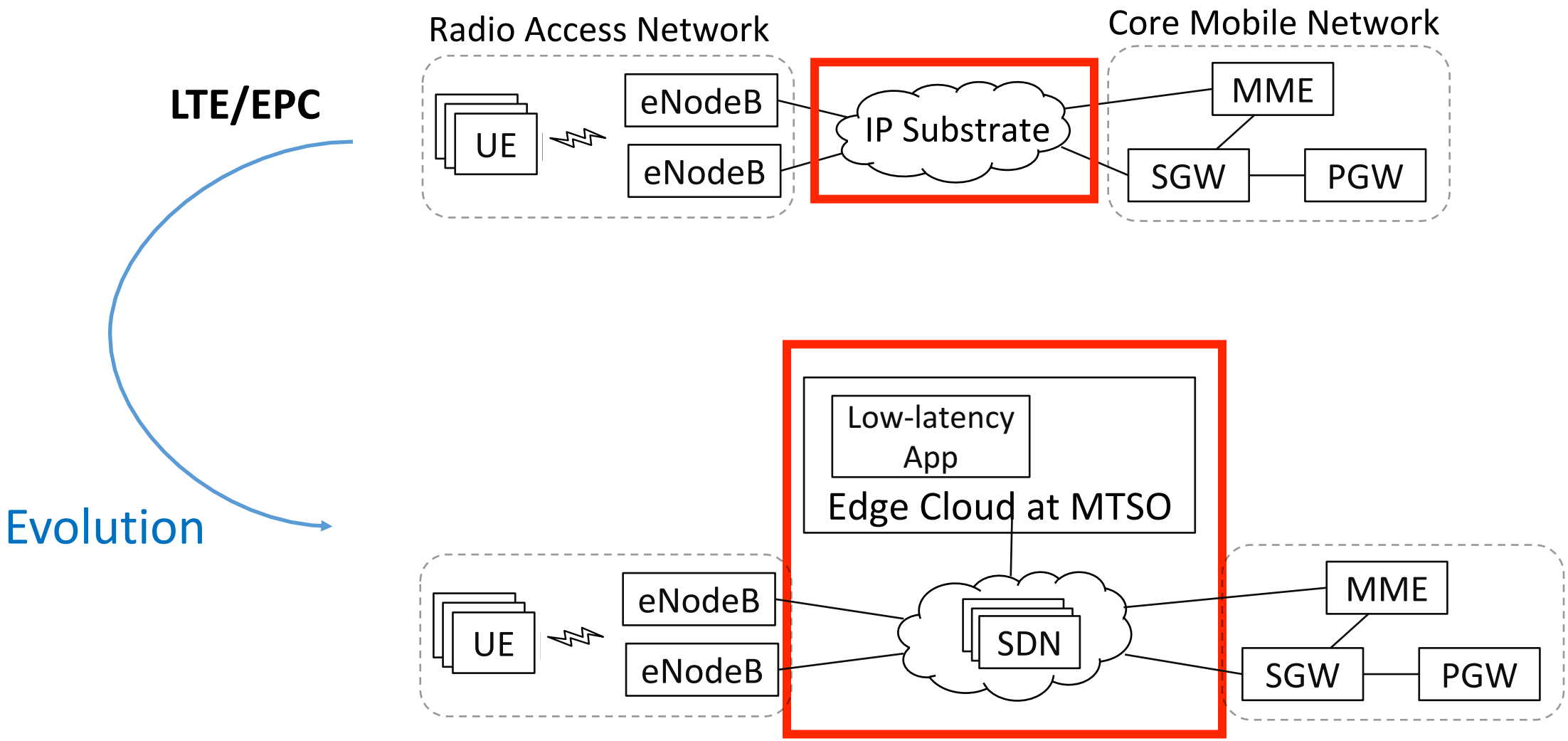

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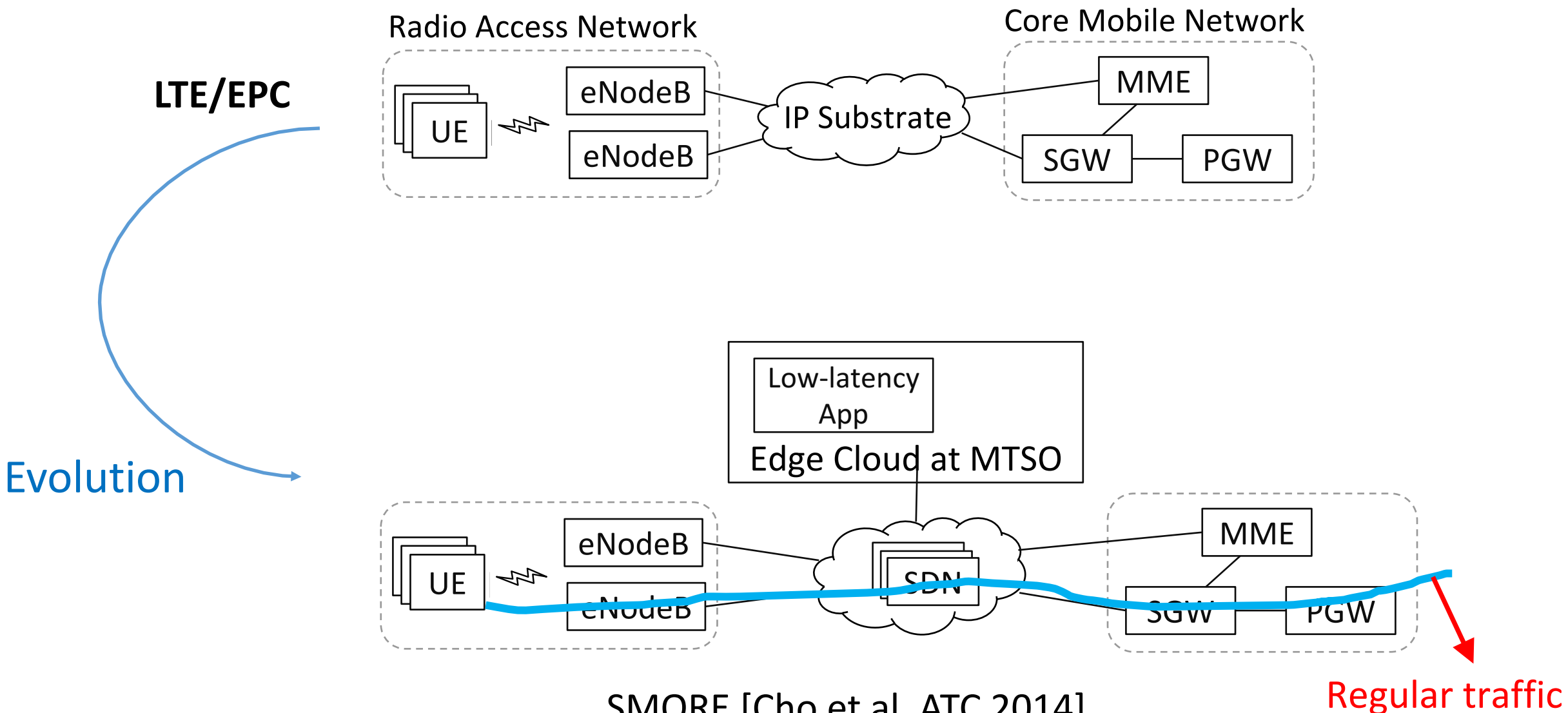

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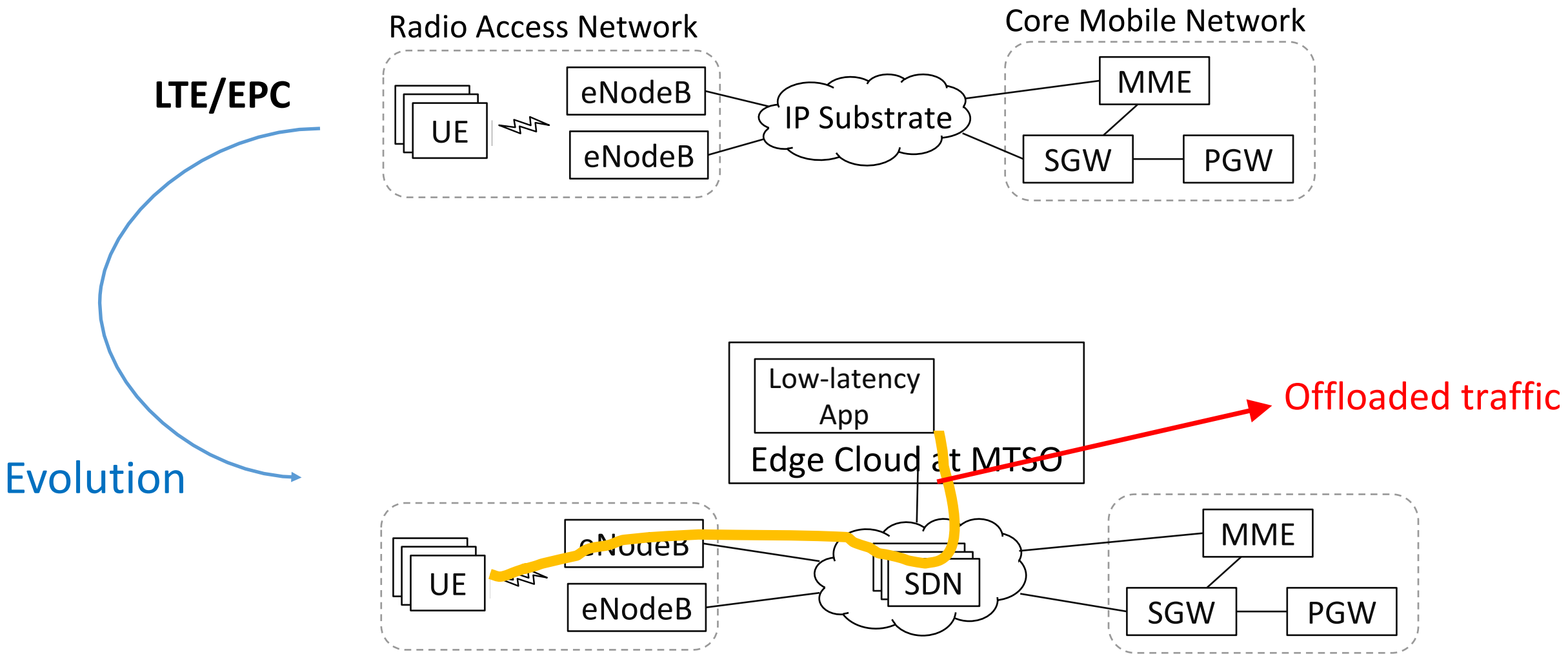

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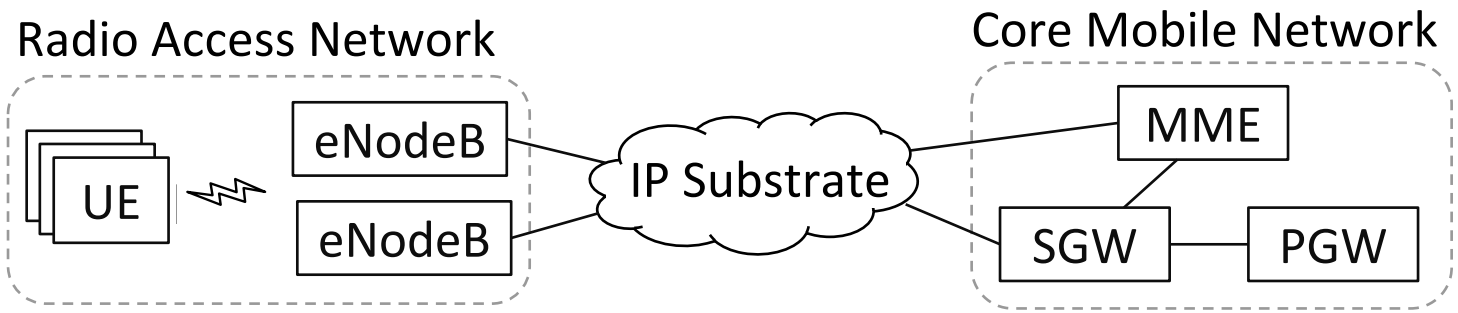
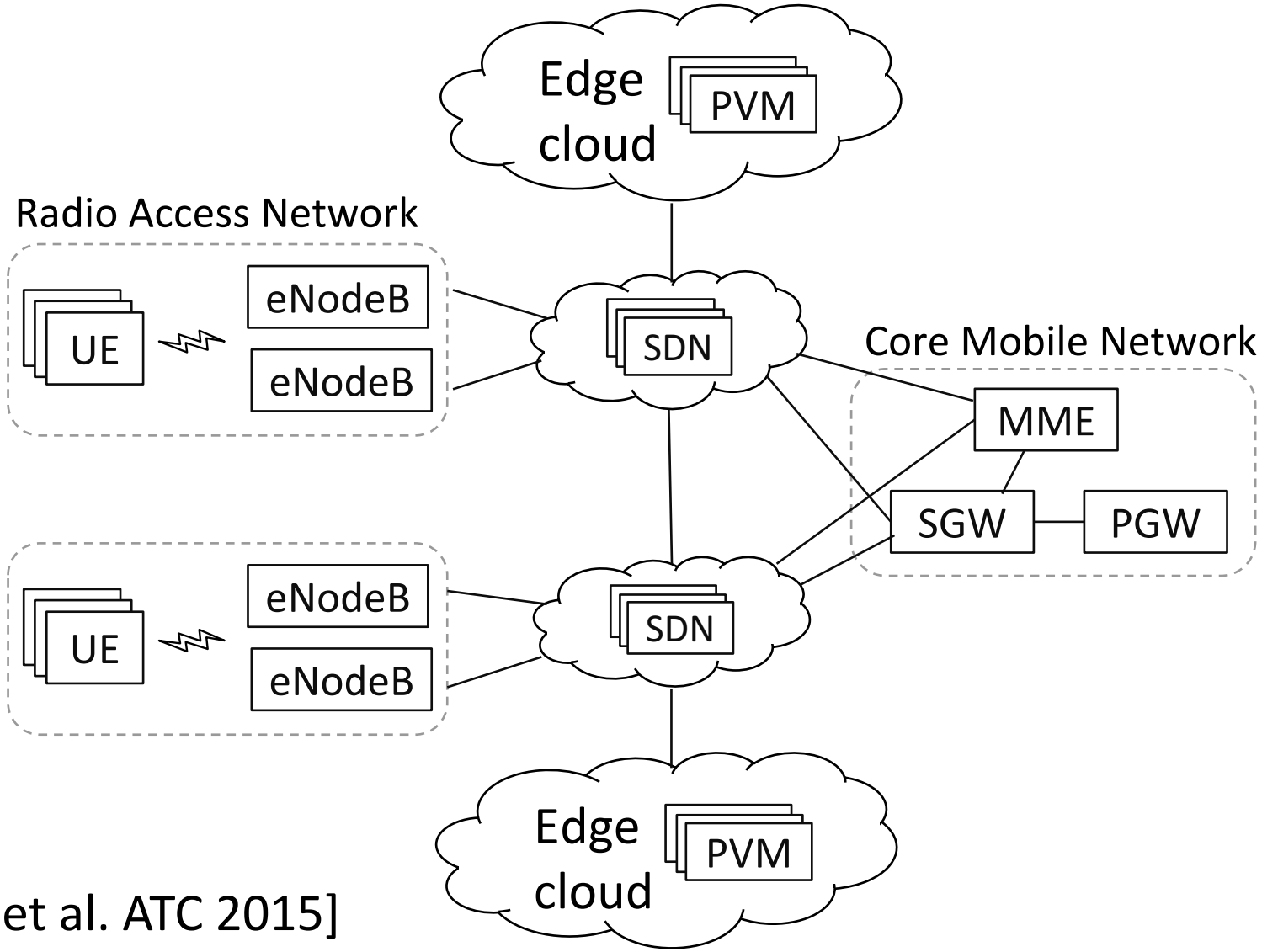


Use Case: MobiScud

Evolution



MobiScud [Wang et al. ATC 2015]

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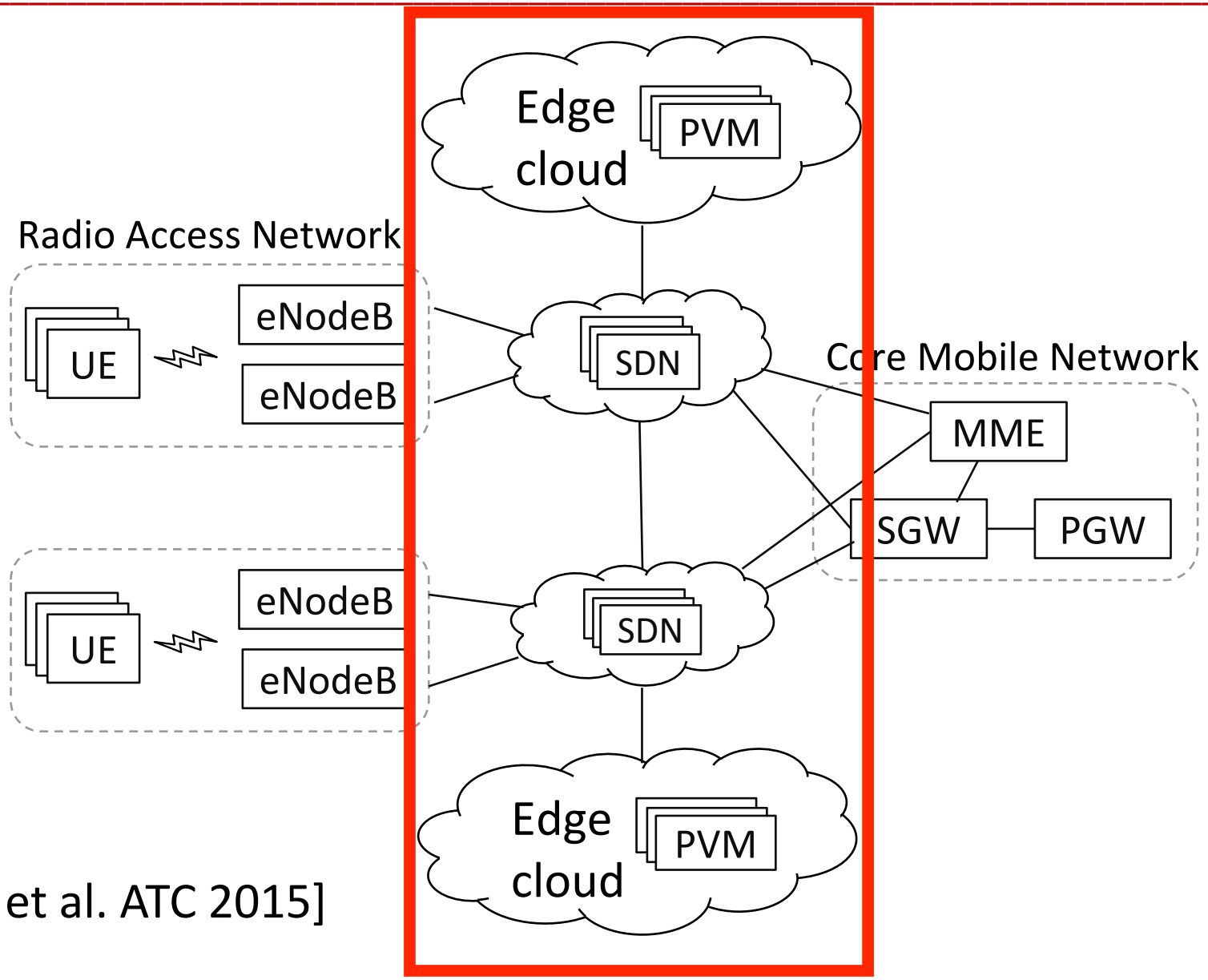

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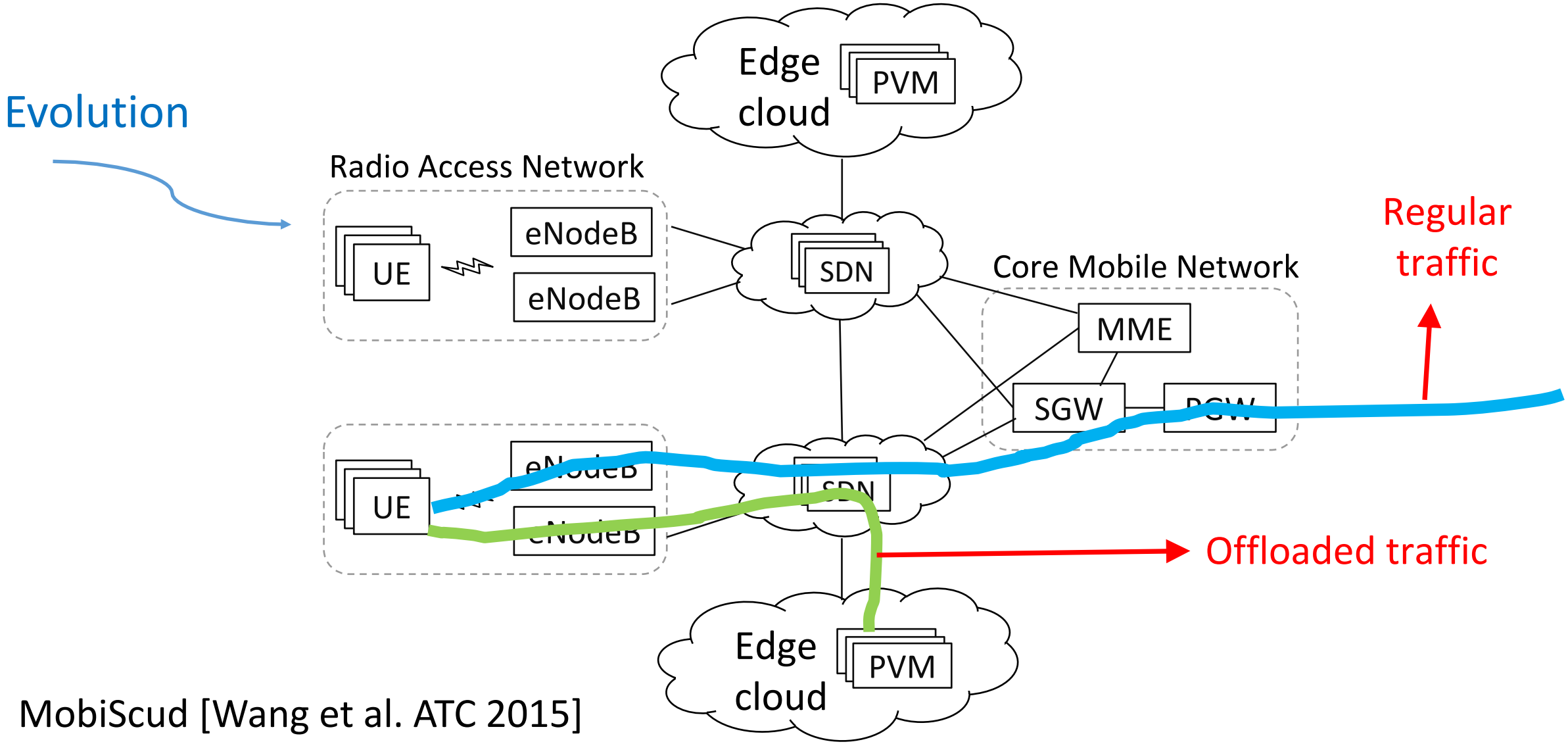

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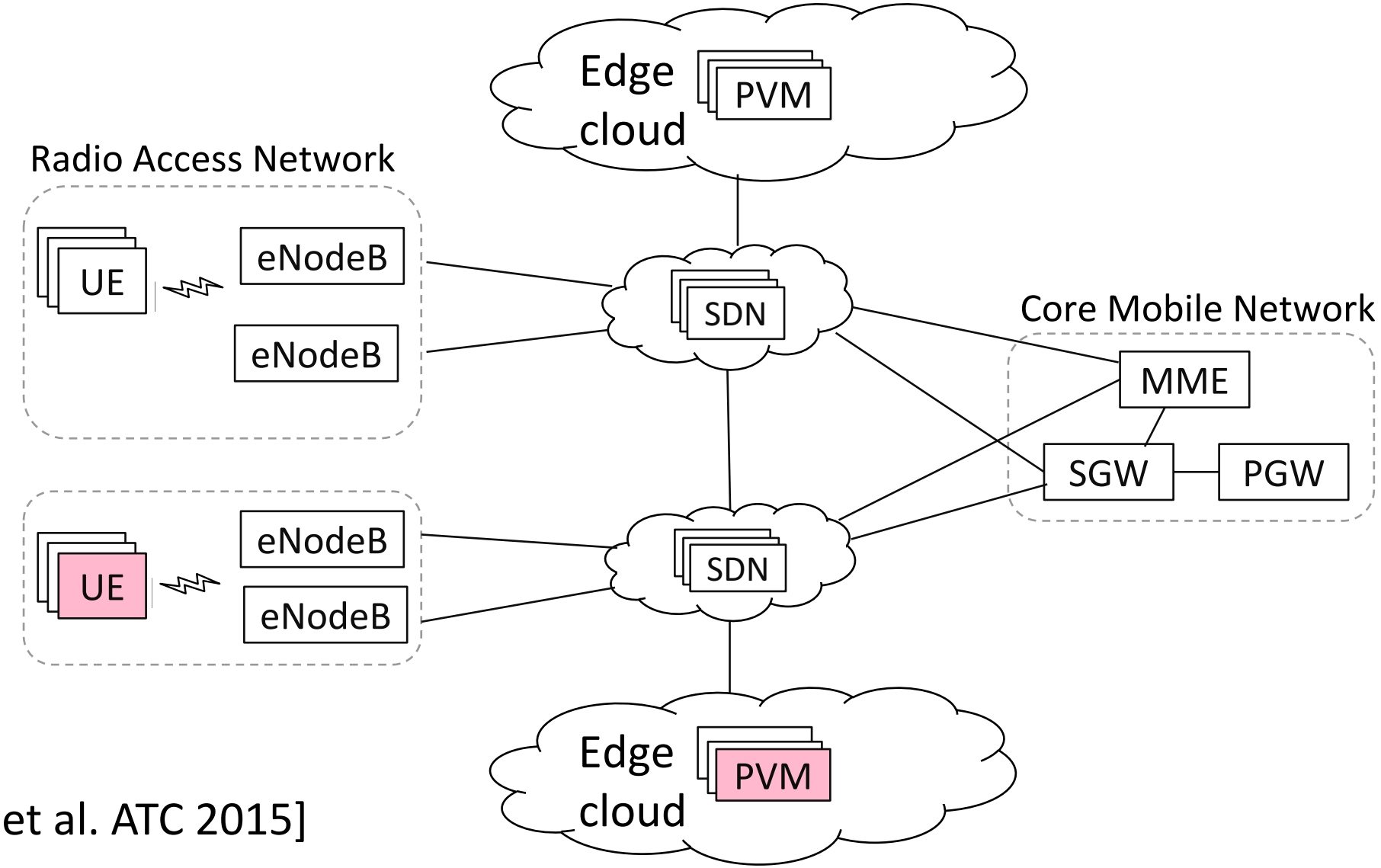

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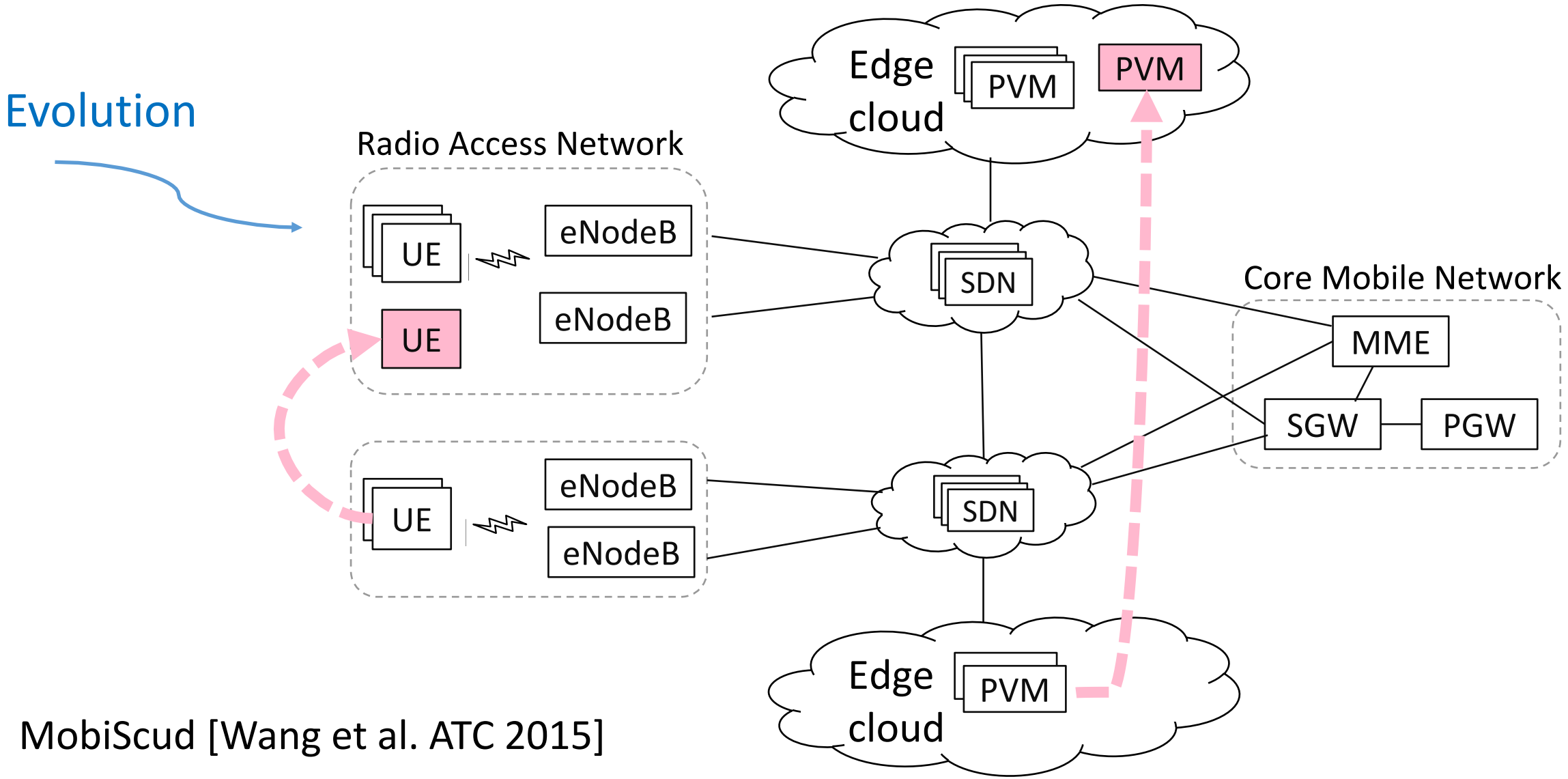

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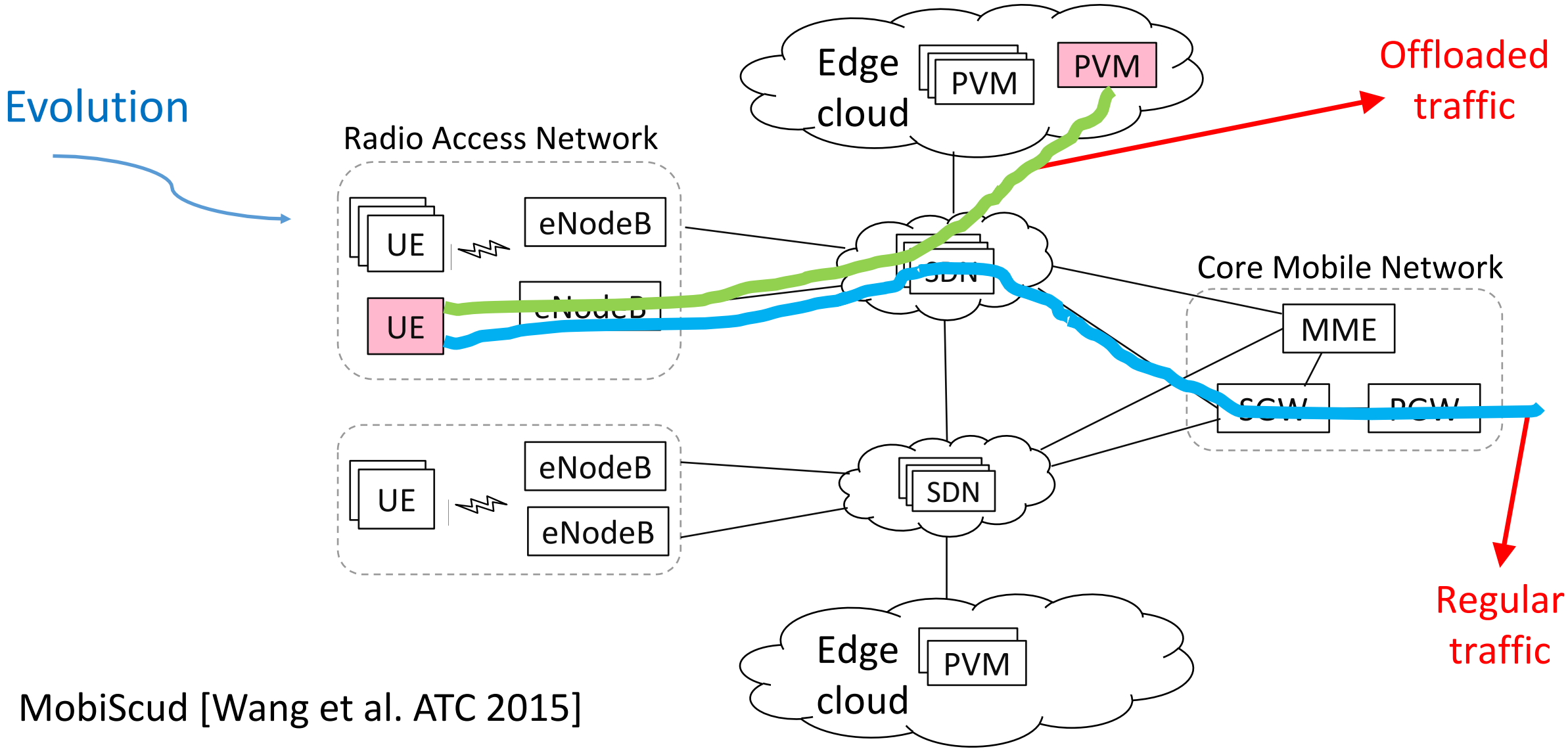
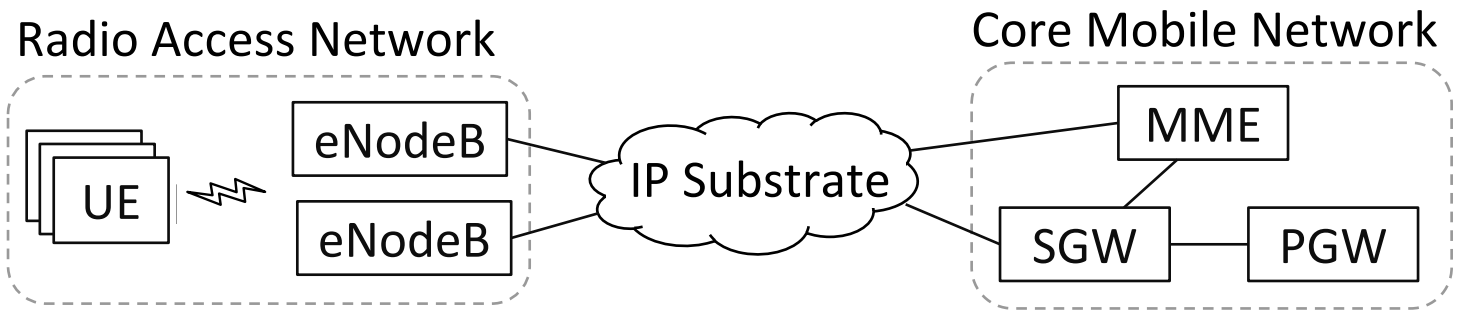


MobiScud [Wang et al. ATC 2015]

Use Case: Specialized EPC for IoT

LTE/EPC



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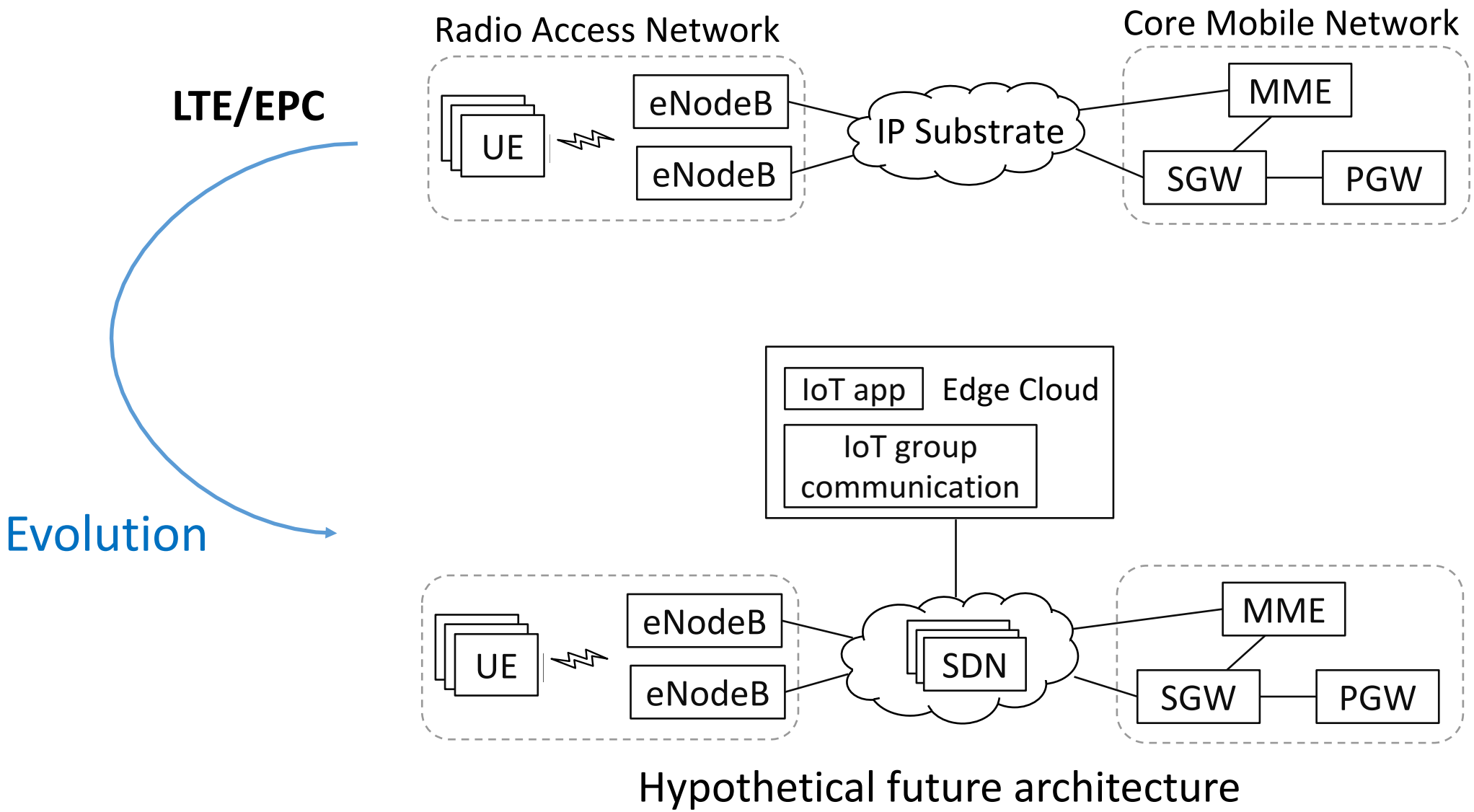
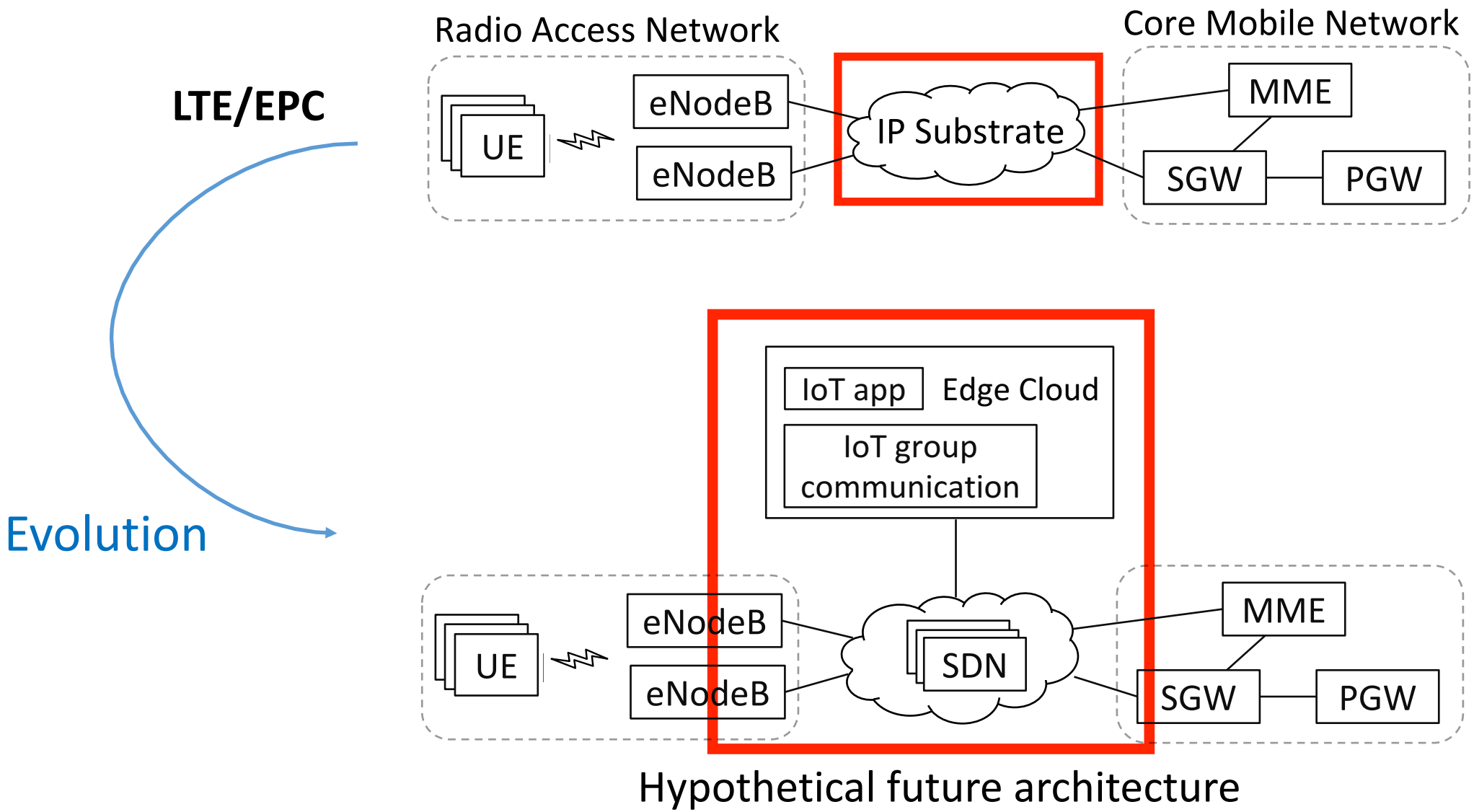


Hypothetical future architecture

Use Case: Specialized EPC for IoT



Hypothetical future architecture

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- 4G LTE/EPC
- Multiple parallel instances
- SCALE (MME replacement with a more elastic version)
- SMORE (selective low-latency offloading)
- MobiScud (selective offloading with PVMs)
- IoT-specific mobile architecture

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  - cloud-like mobile network abstractions
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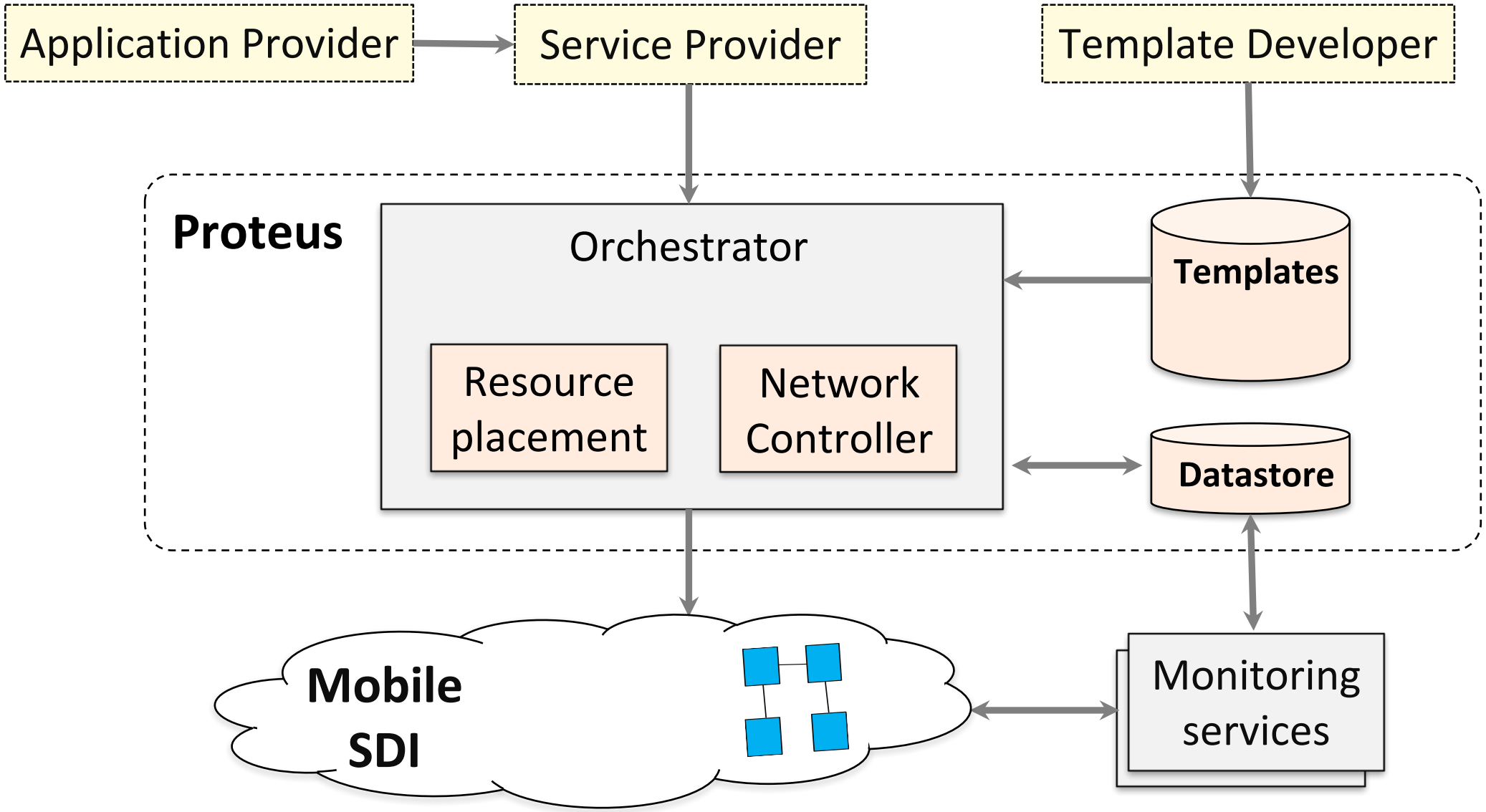
Application Provider
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Template Developer
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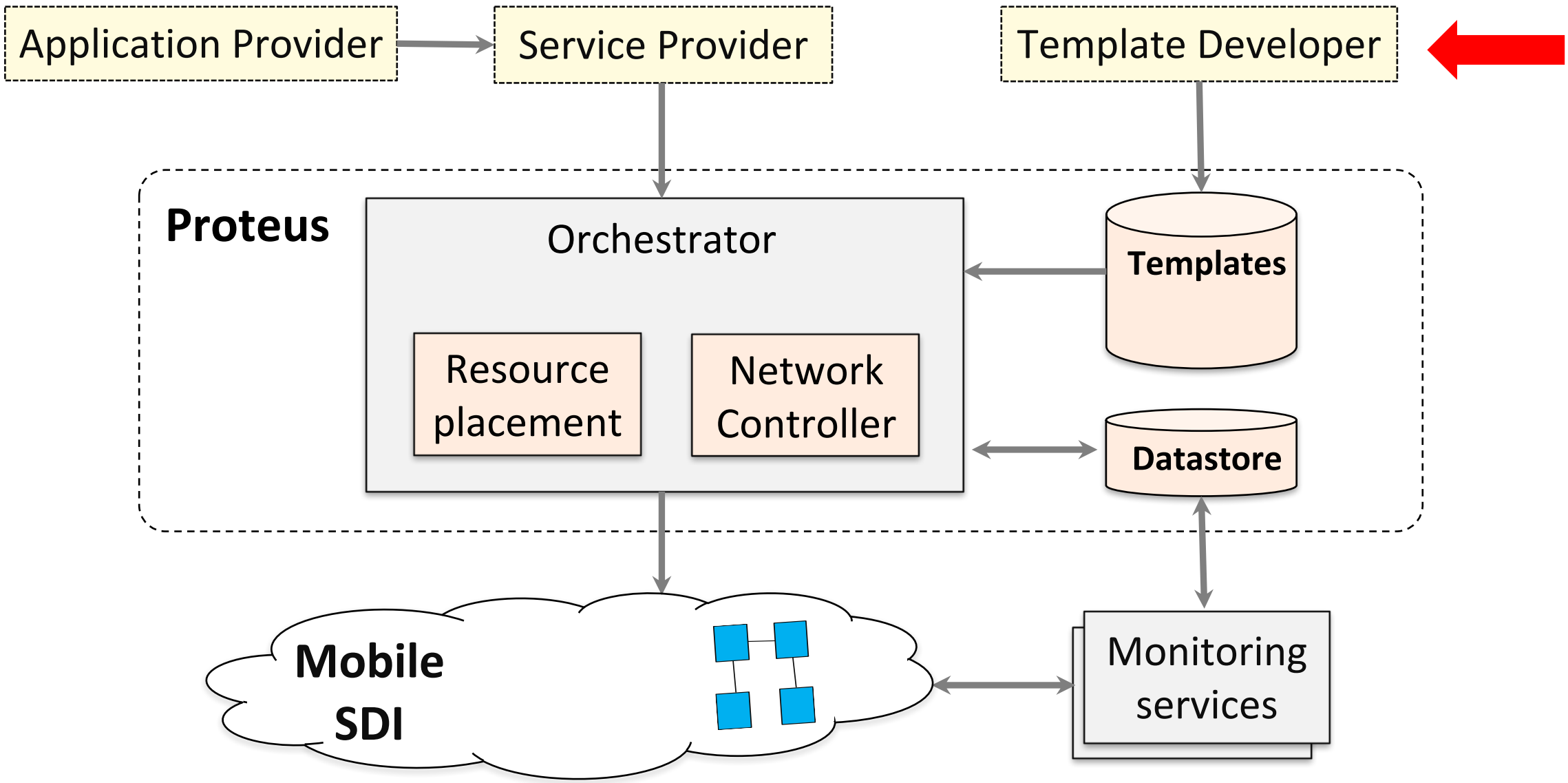
Network Controller
Templates
Datastore
Mobile SDI
Monitoring services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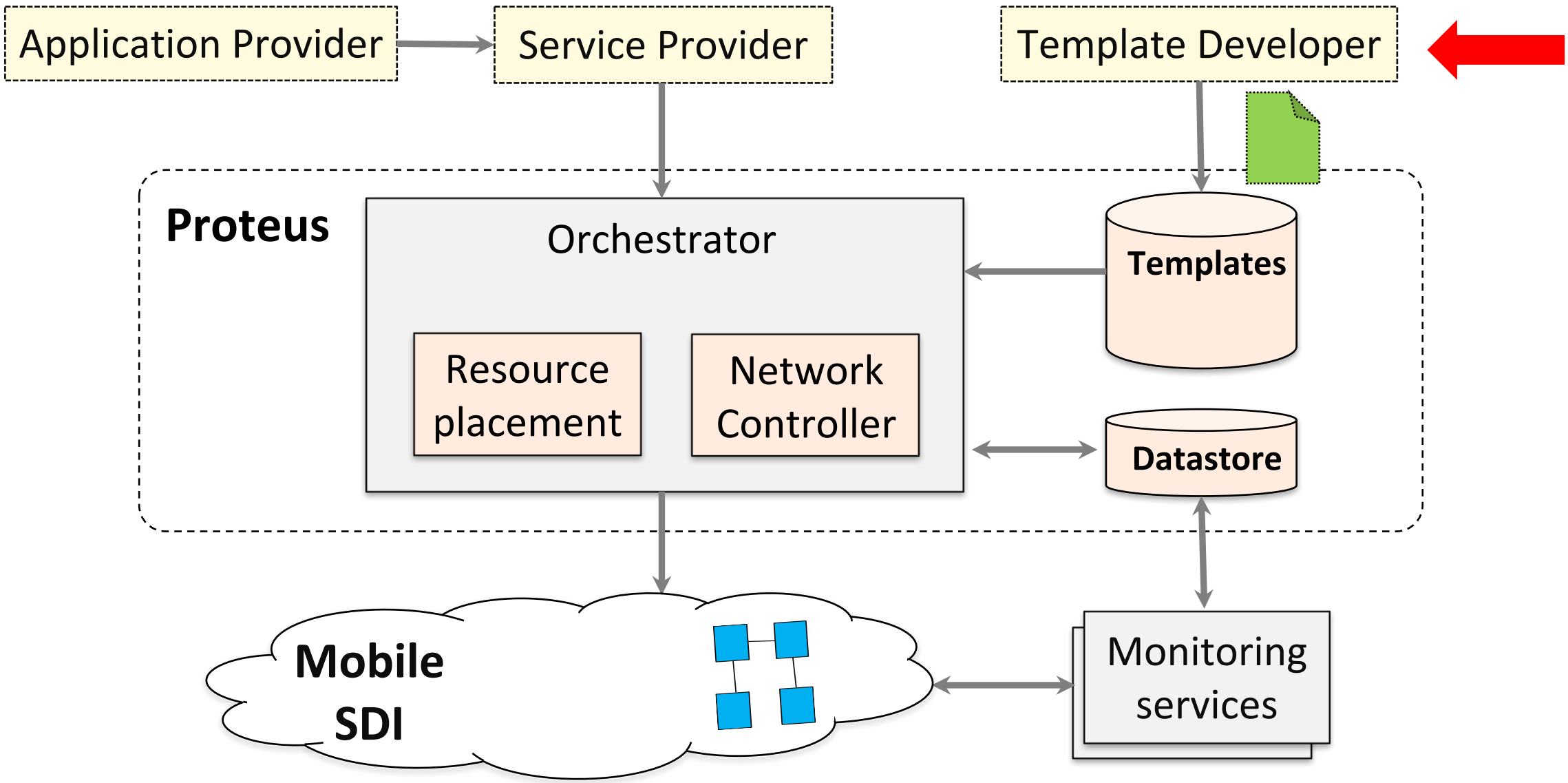
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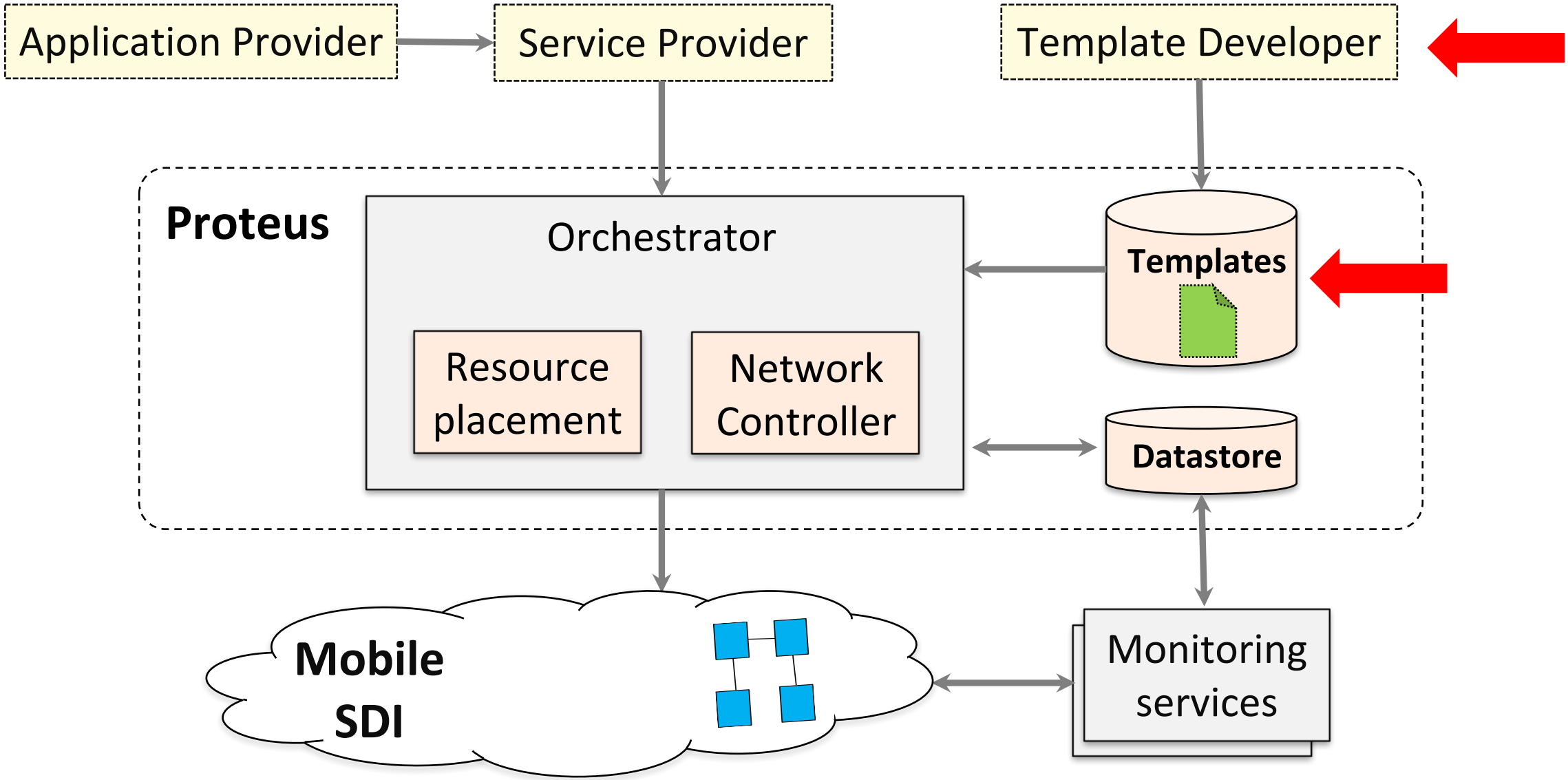
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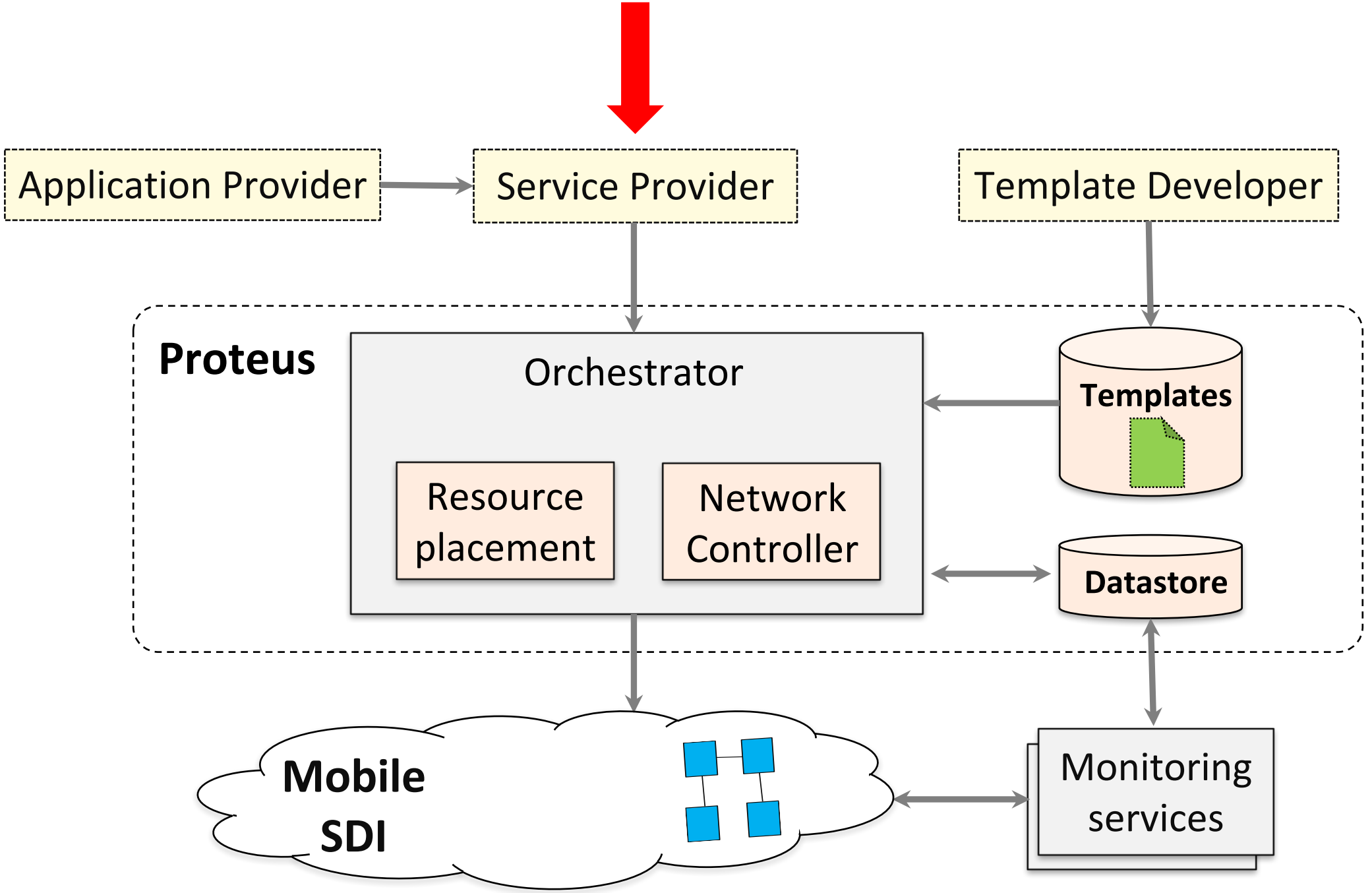
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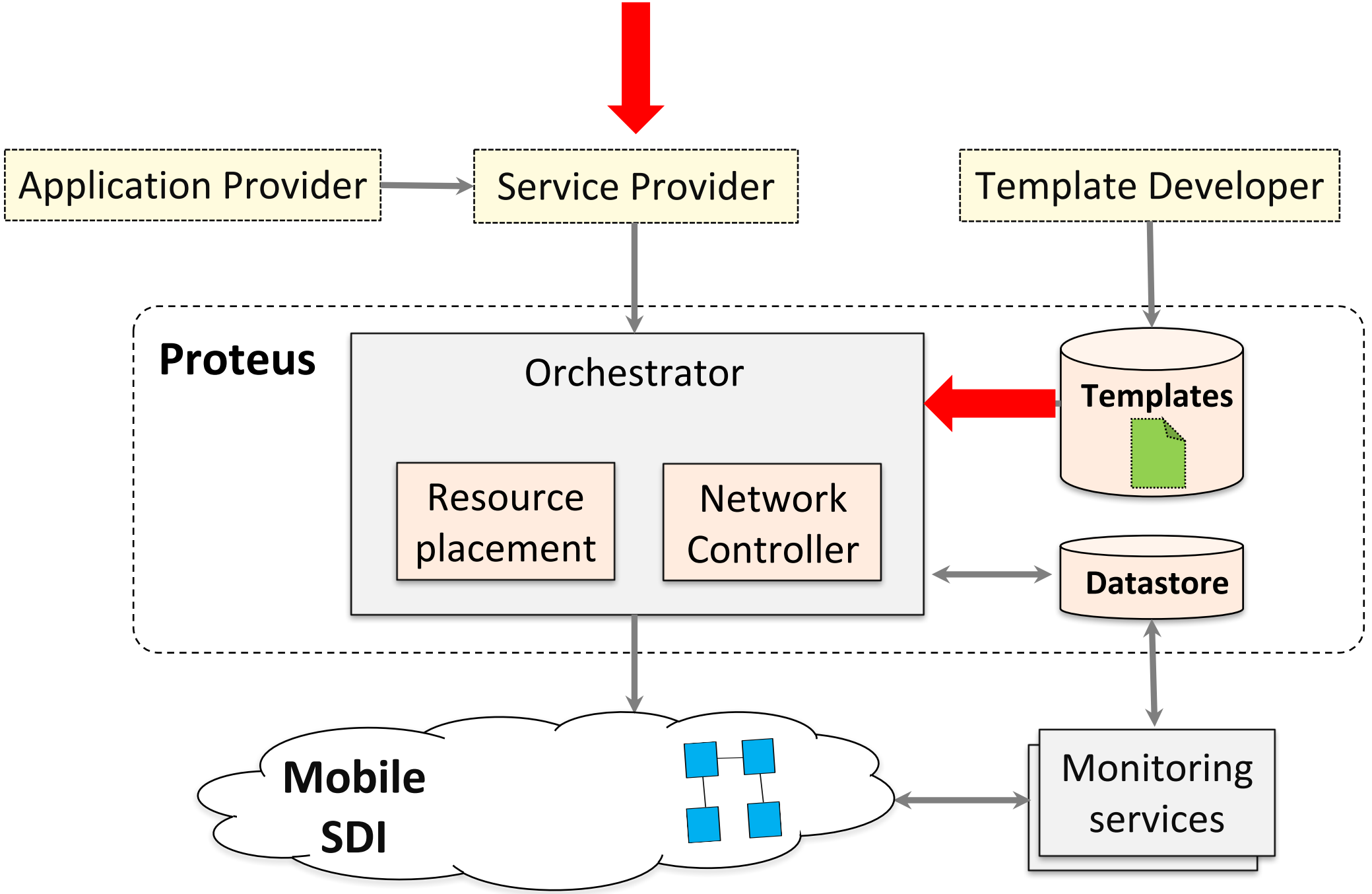
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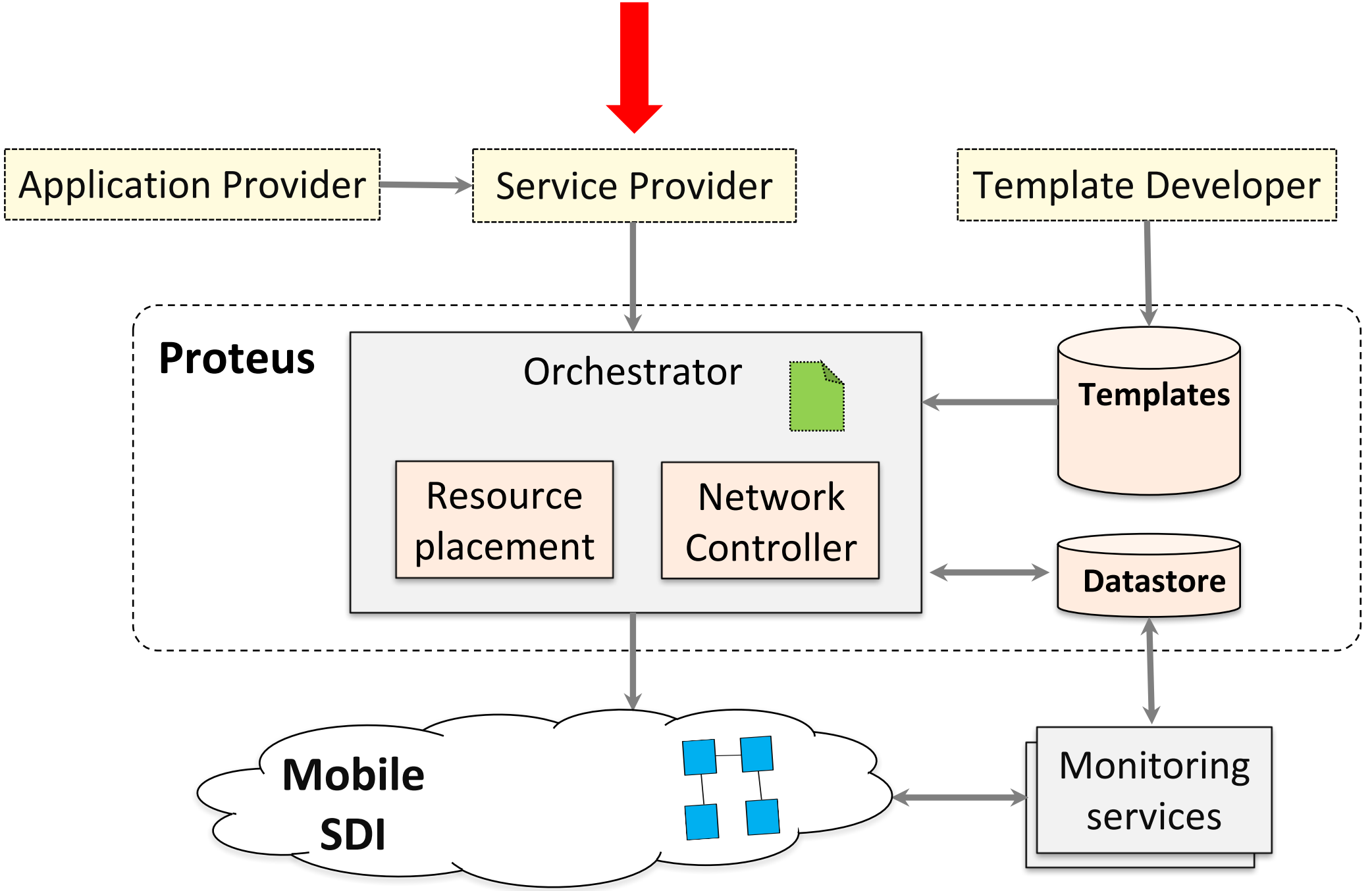
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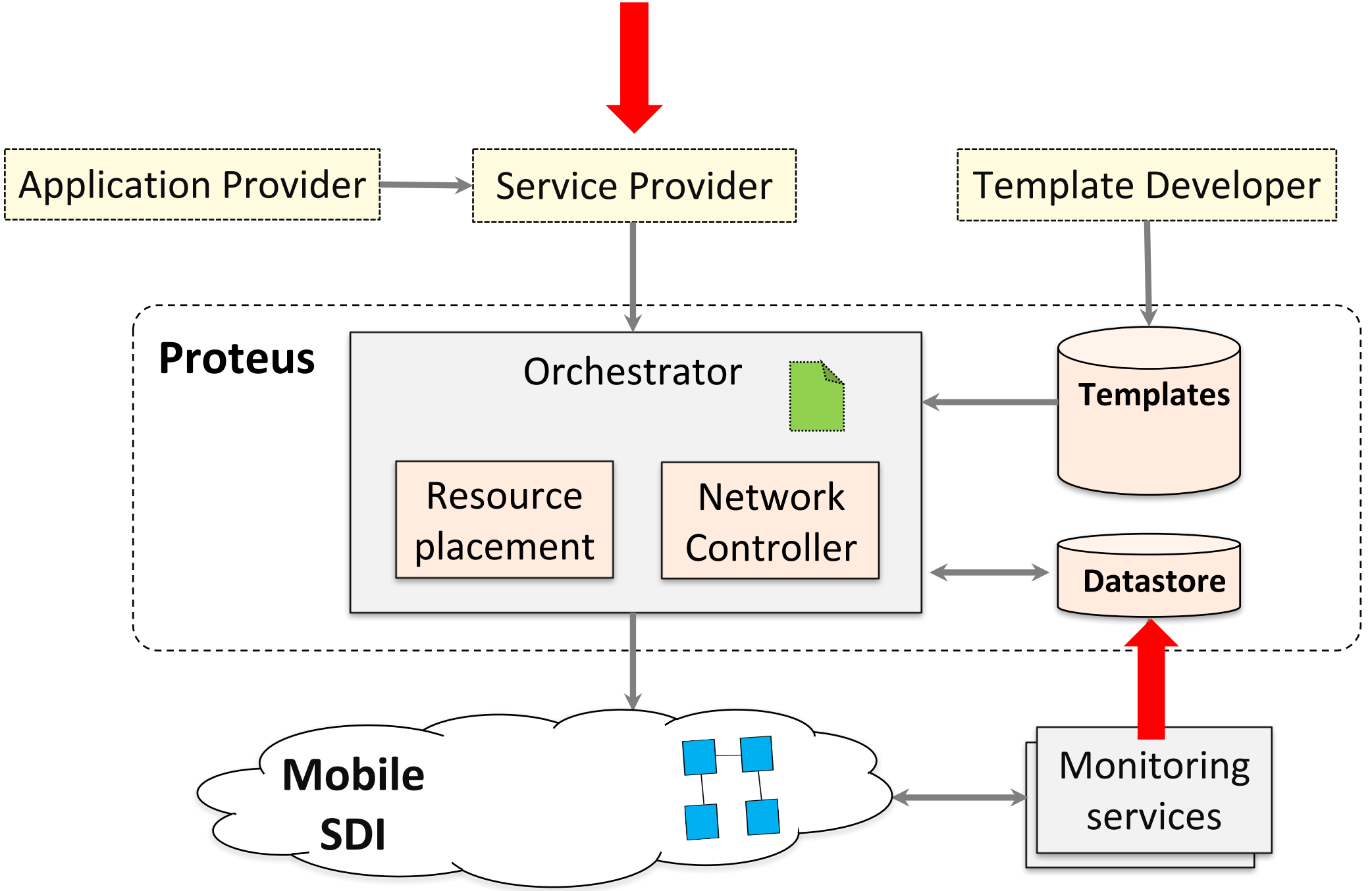
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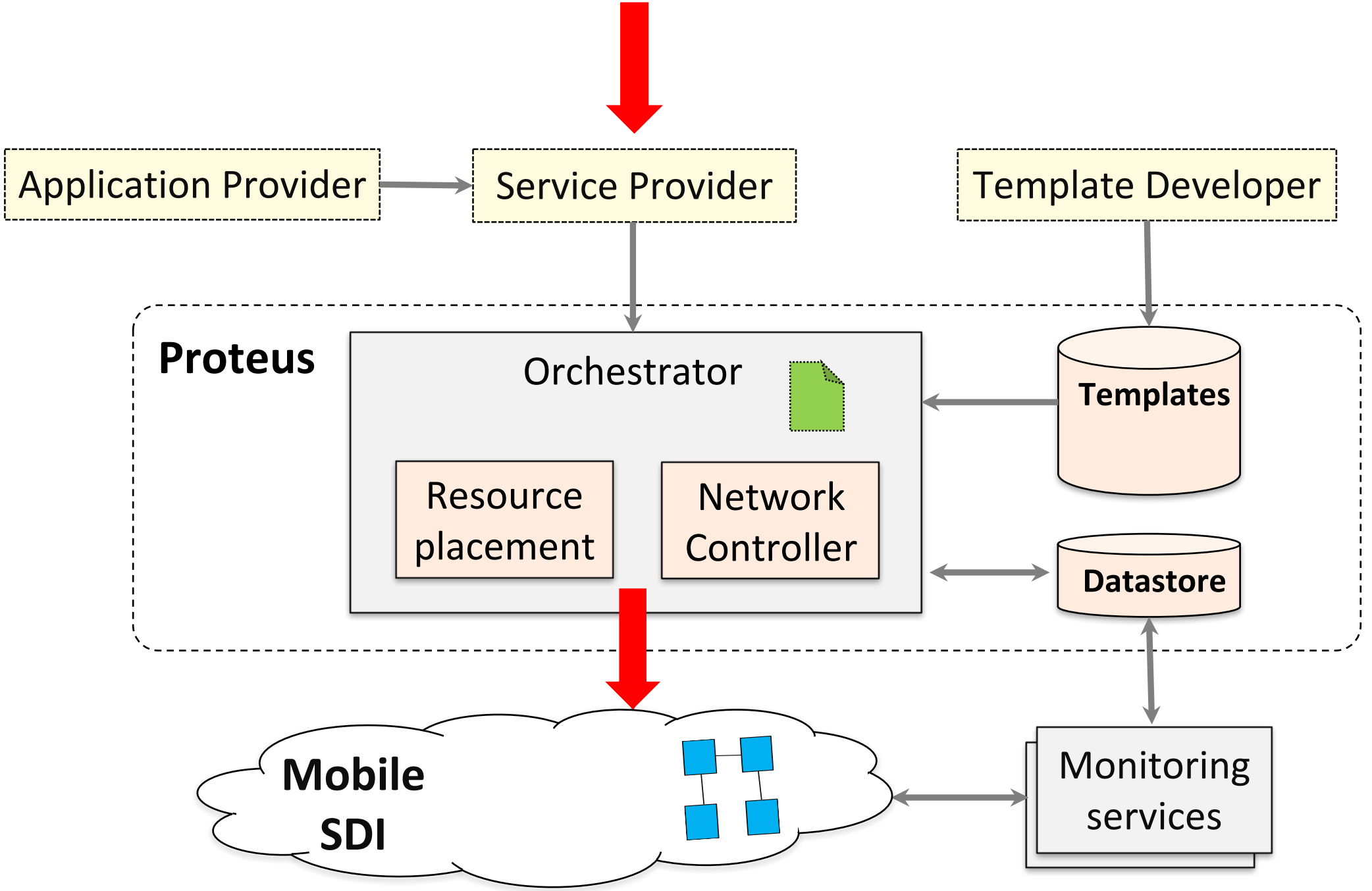
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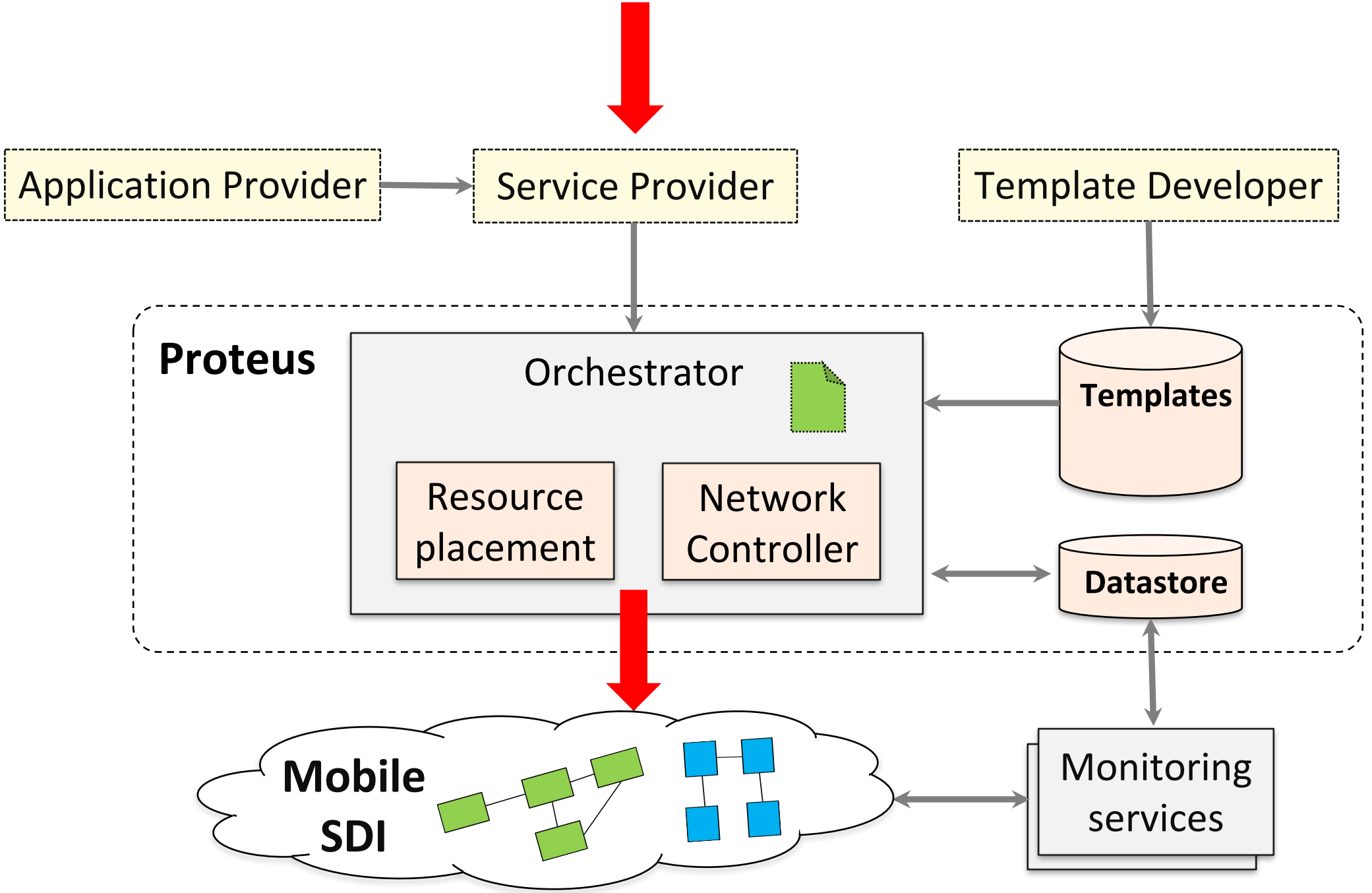
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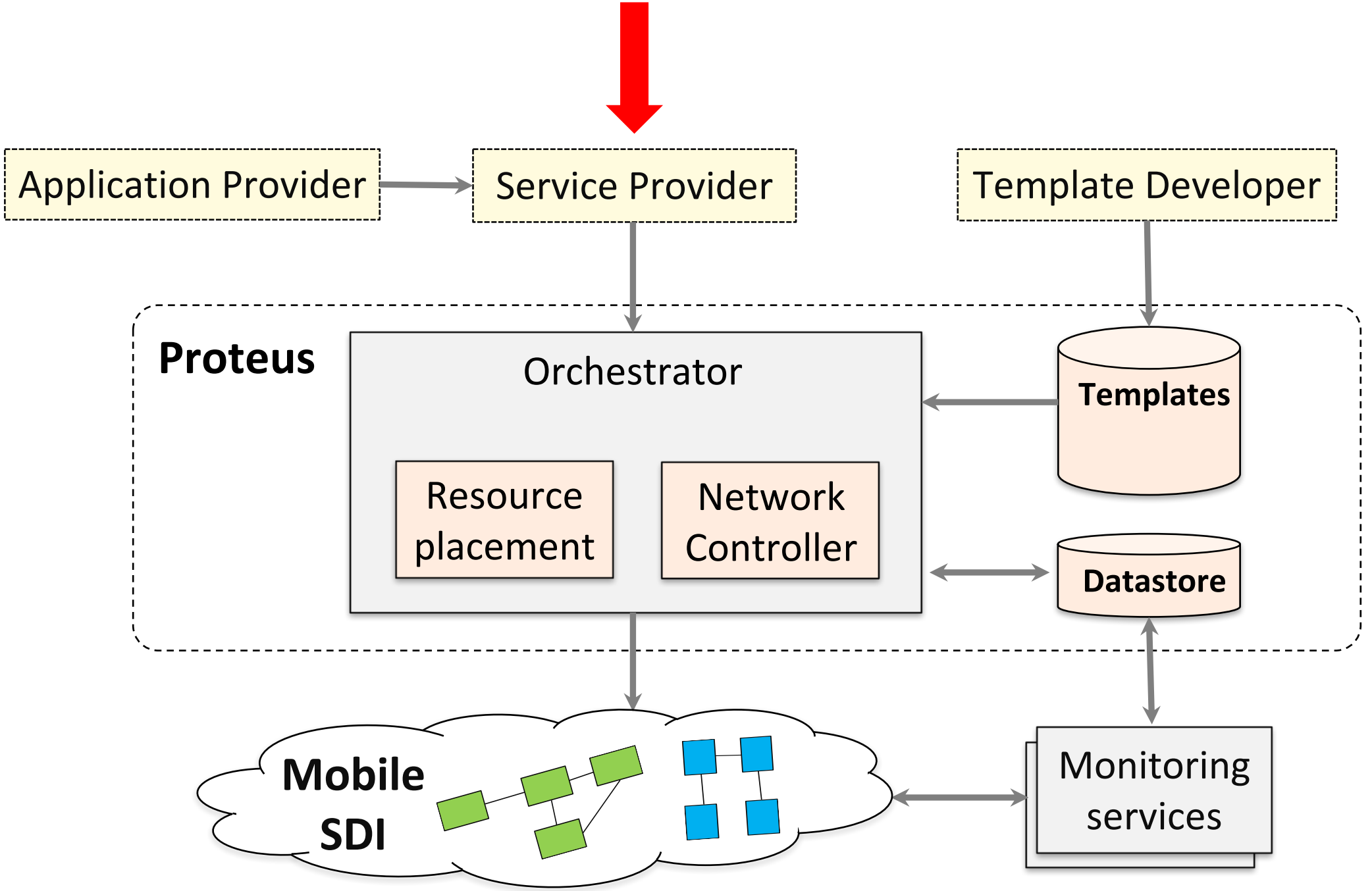
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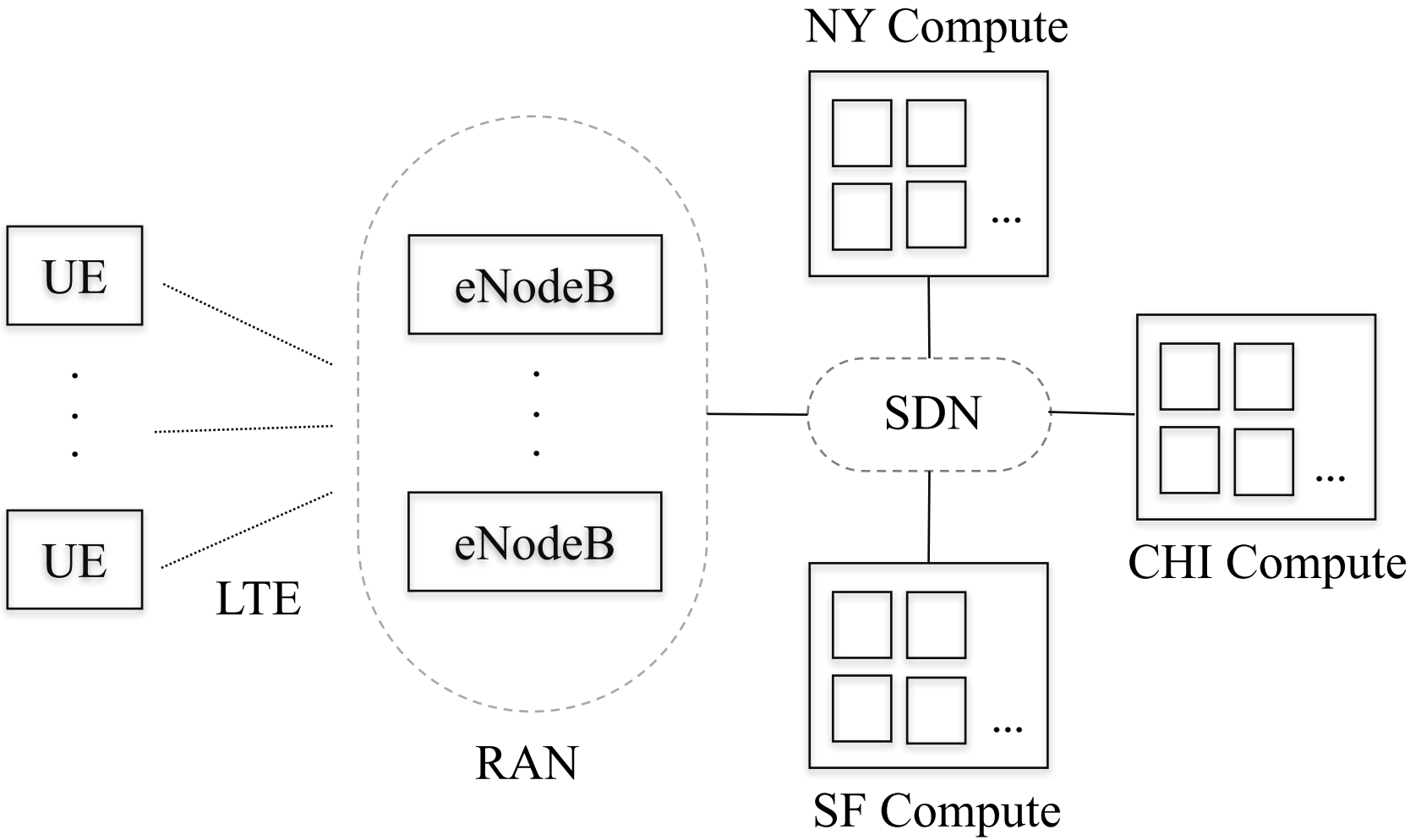
Evaluations



Topology in PhantomNet mobility testbed

Evaluations

Evaluations

- Service evolution and parallel instances
  - LTE/EPC
  - EPC evolved with SMORE
  - EPC evolved with MobiScud
- Data-centric service management
  - Handling bursts of UE attachments
  - Migrating to a new location
- Scalability
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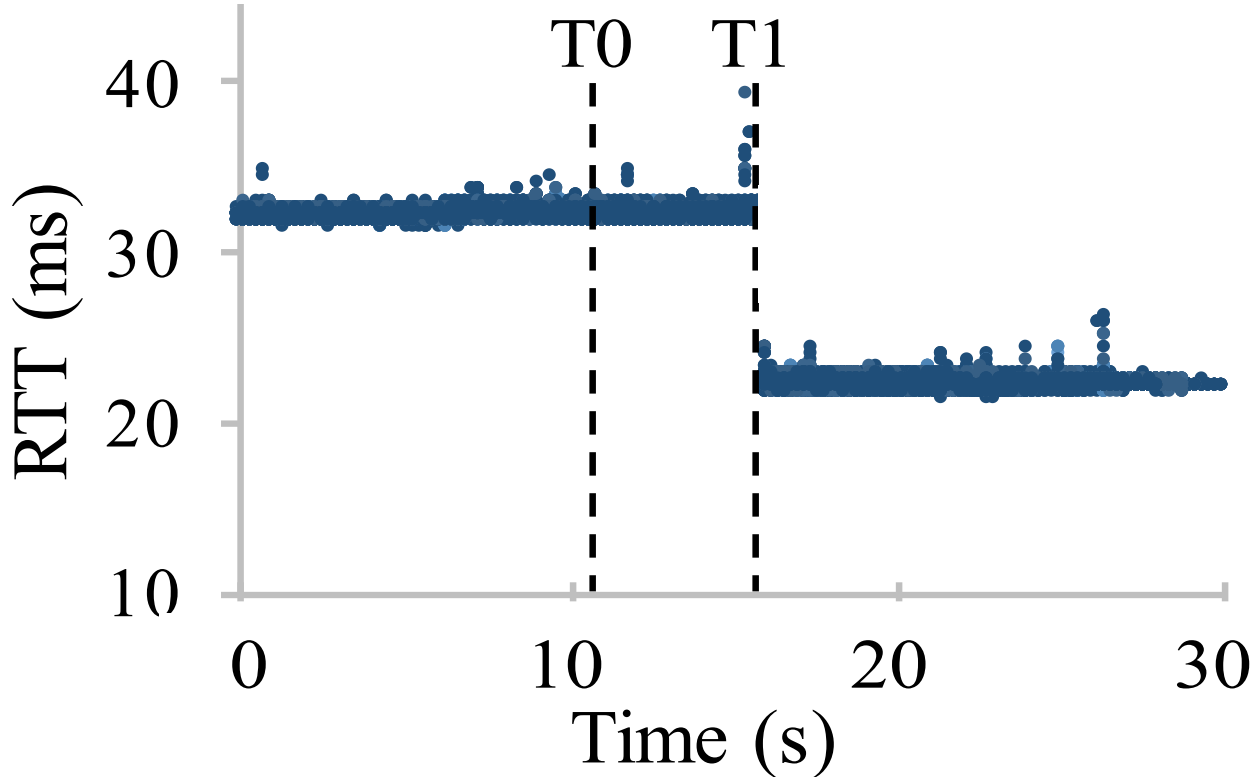
- T1: PGW migration ends



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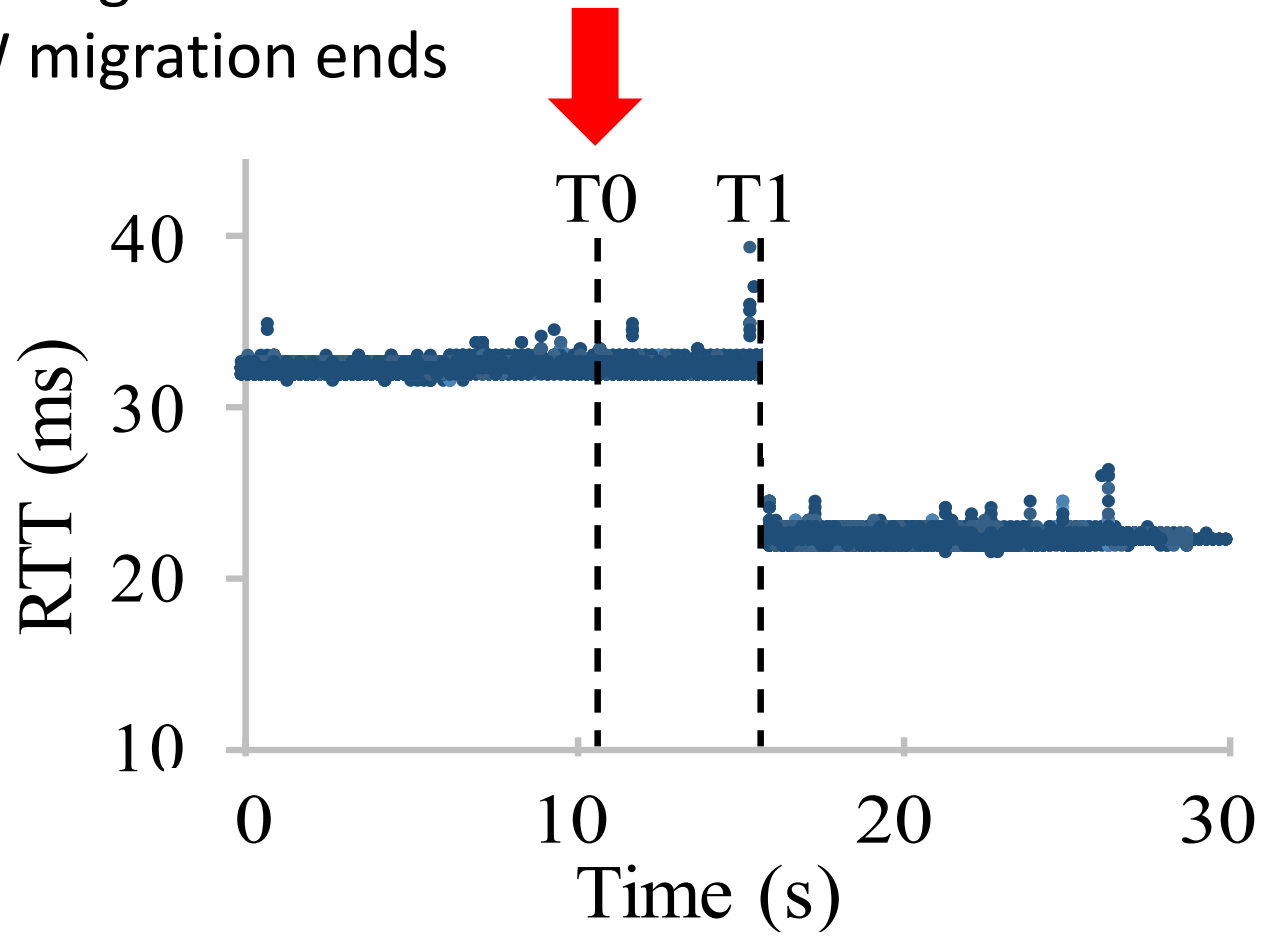

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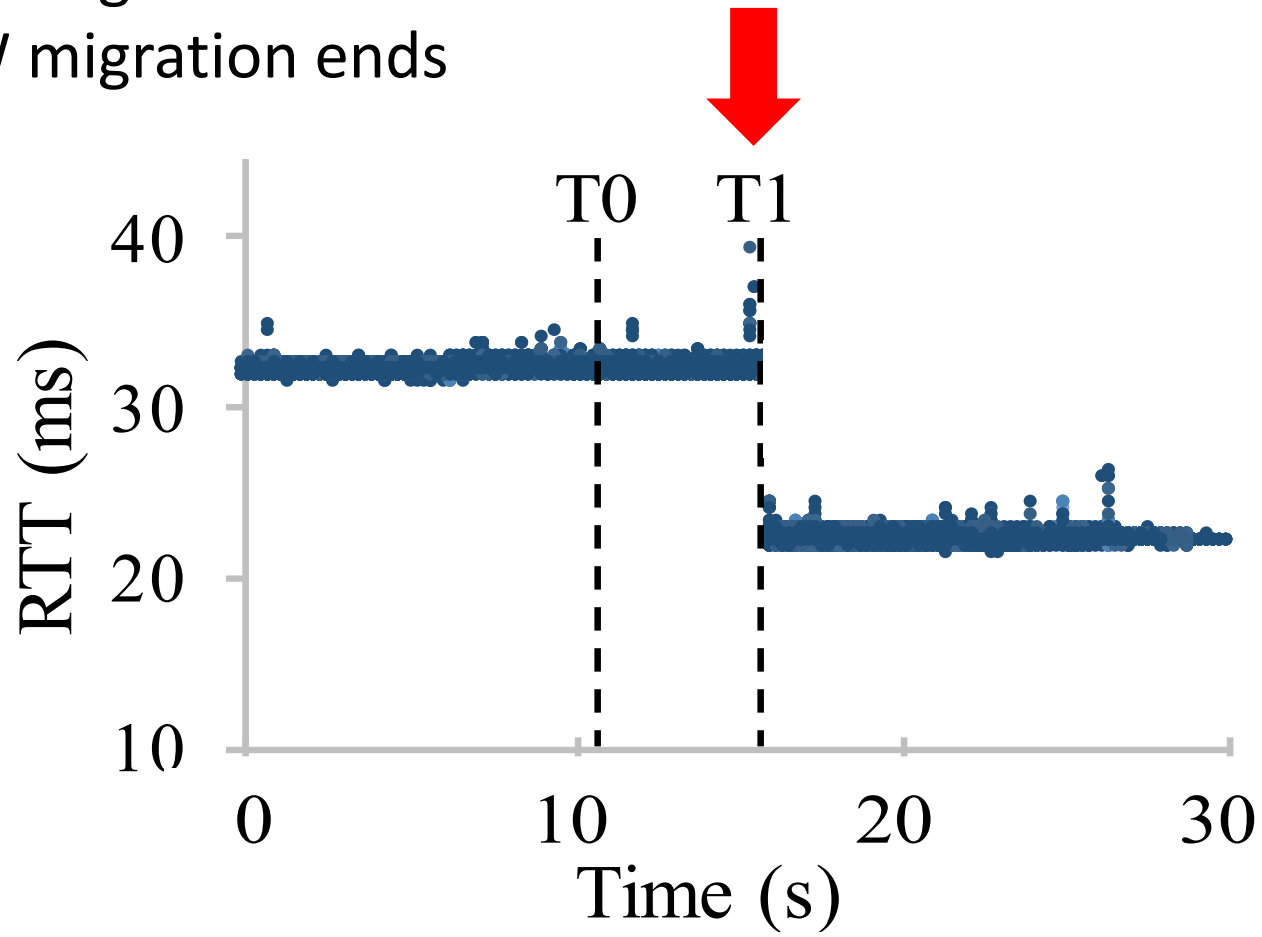
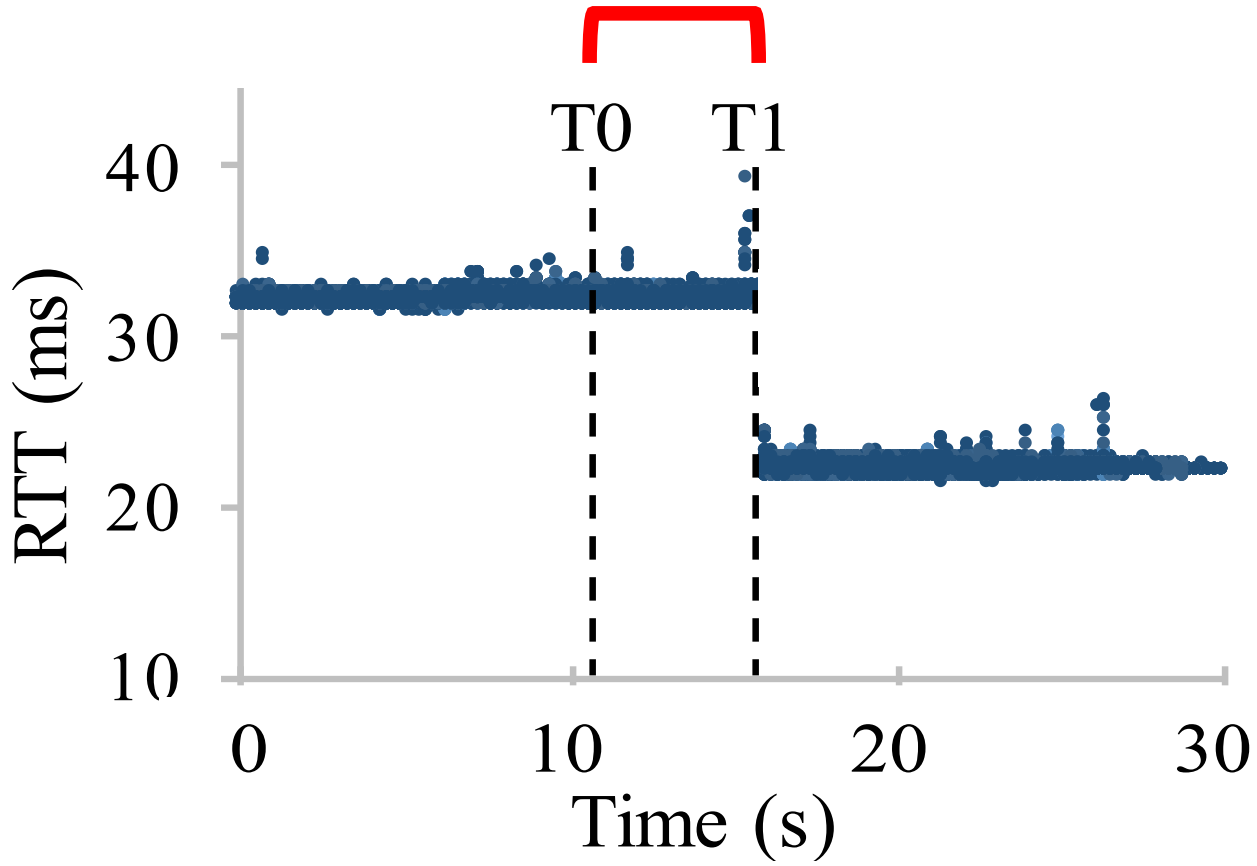
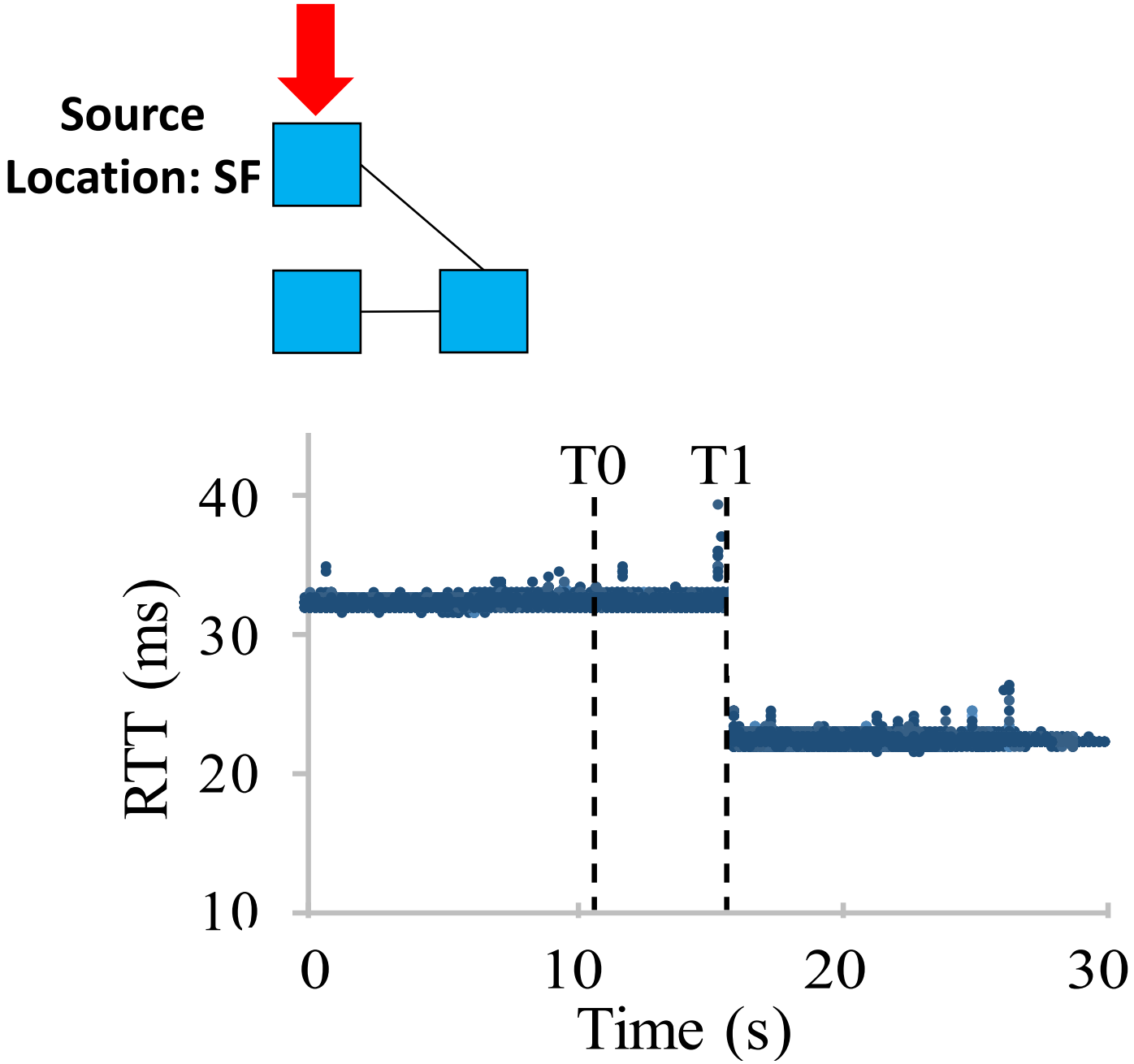
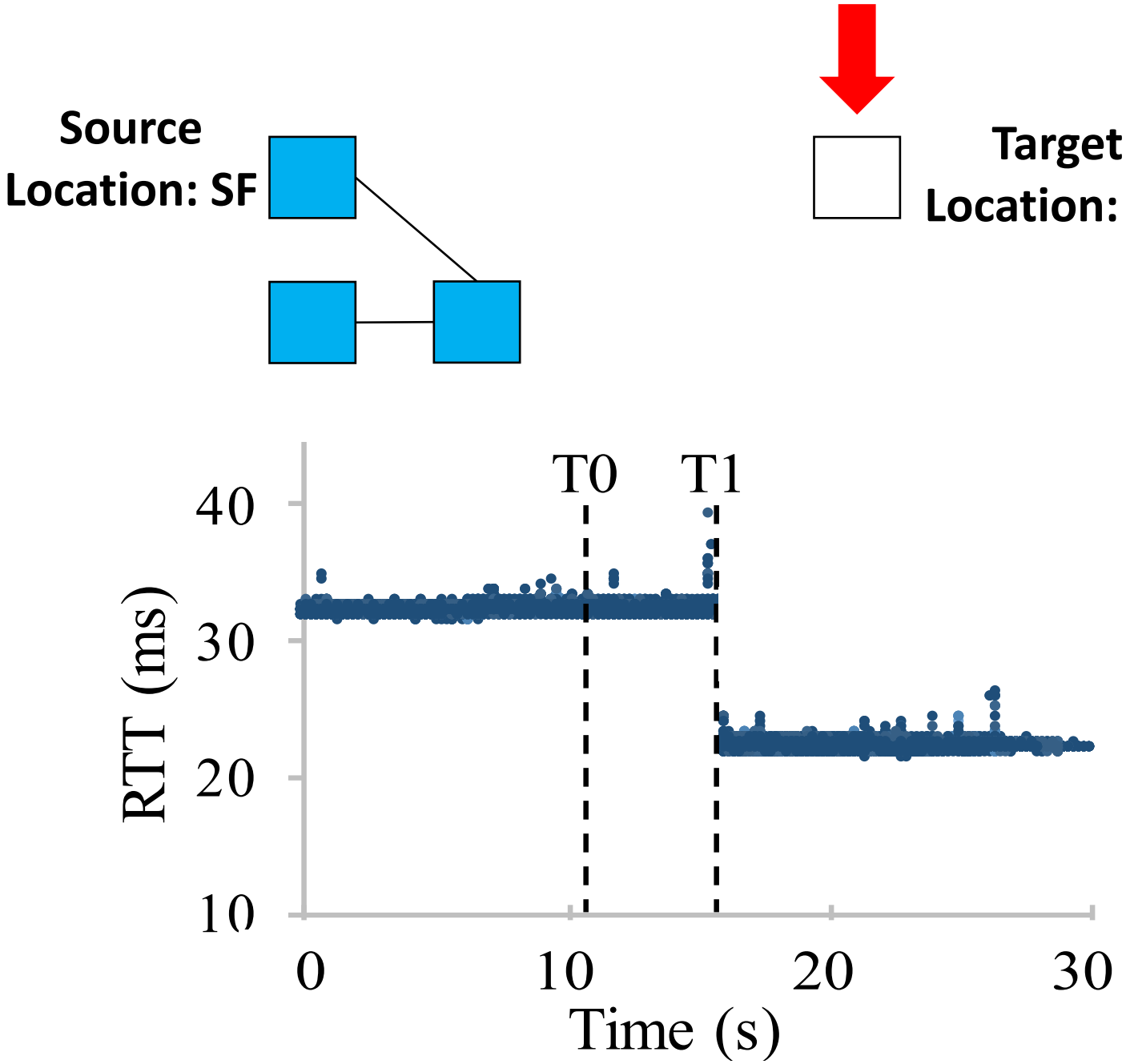
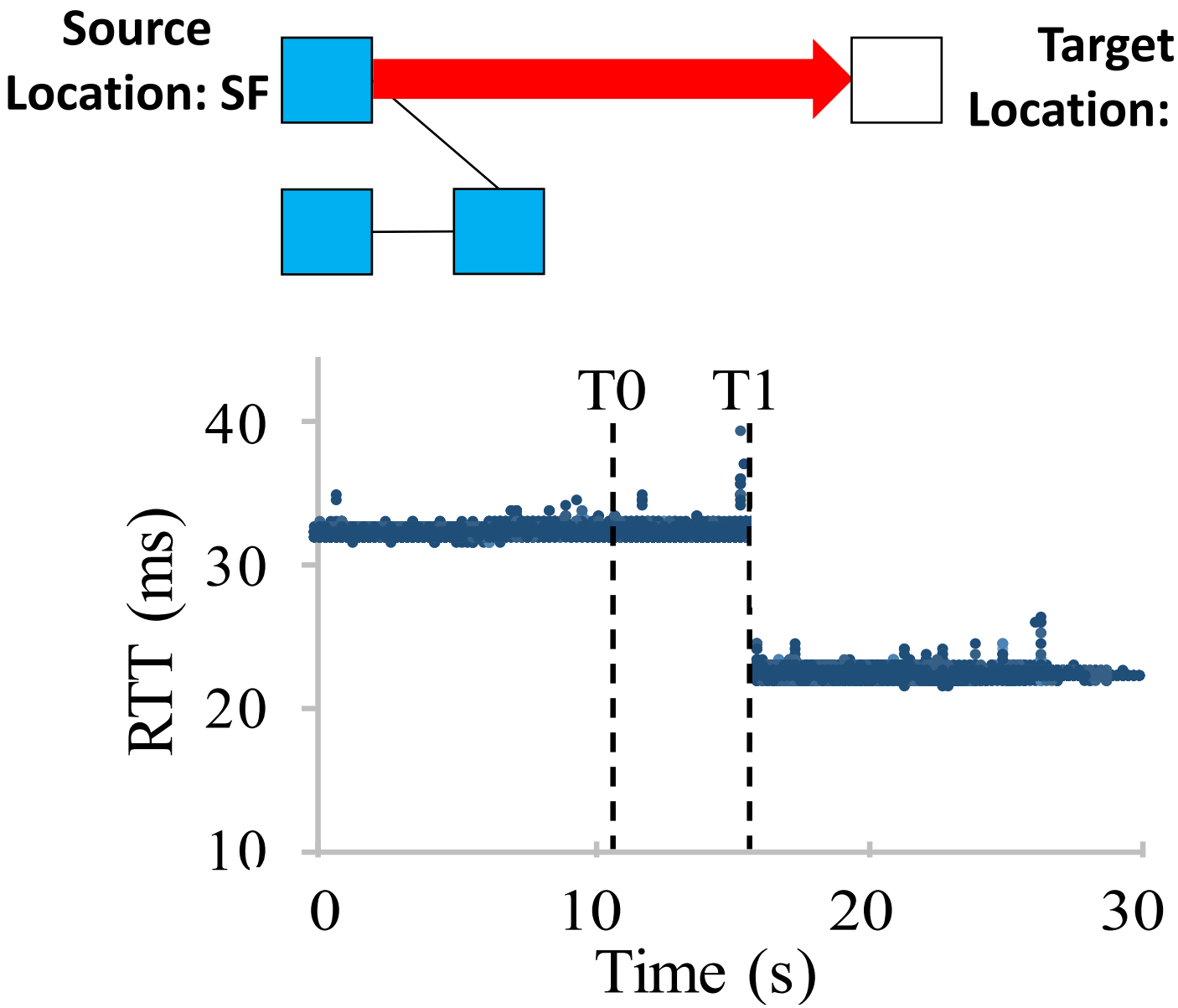



T0
T1
40
30
20
10
RTT (ms)
0
10
20
30
Time (s)


Source
Location: SF
T0
T1
40
30
20
10
RTT (ms)
0
10
20
30
Time (s)


Source
Location: SF
Target
Location: NY
T0
T1
40
30
20
10
RTT (ms)
0
10
20
30
Time (s)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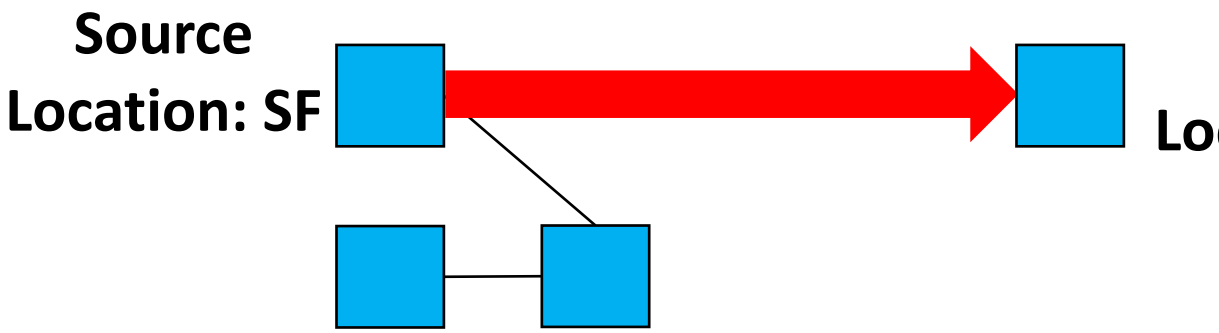
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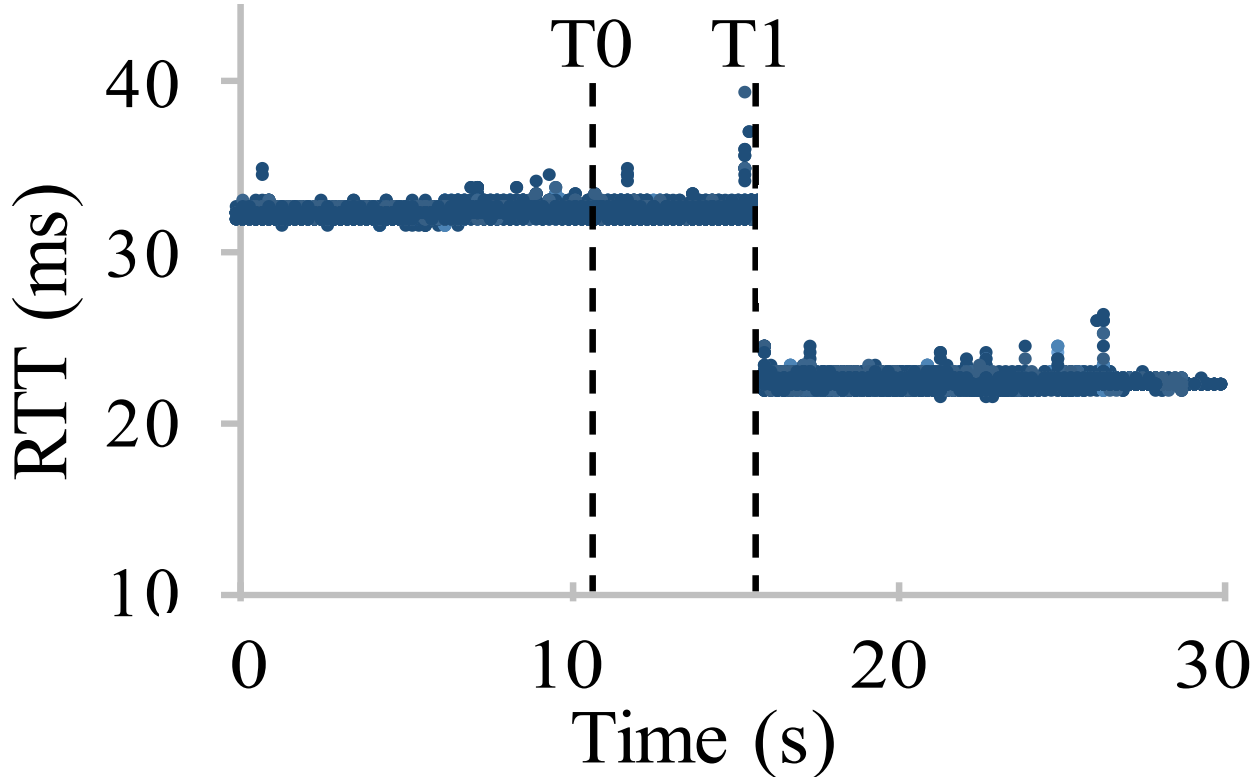
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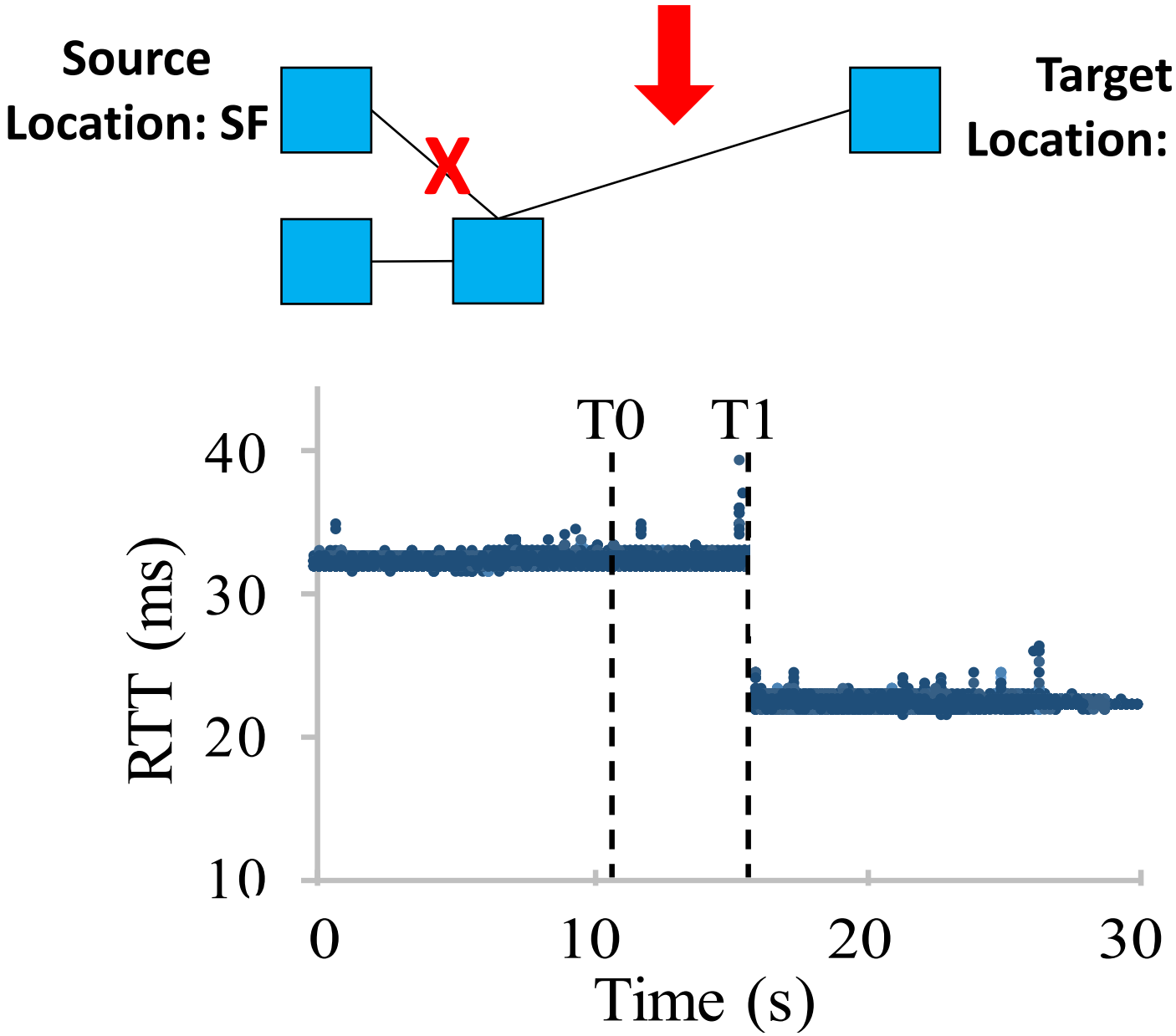
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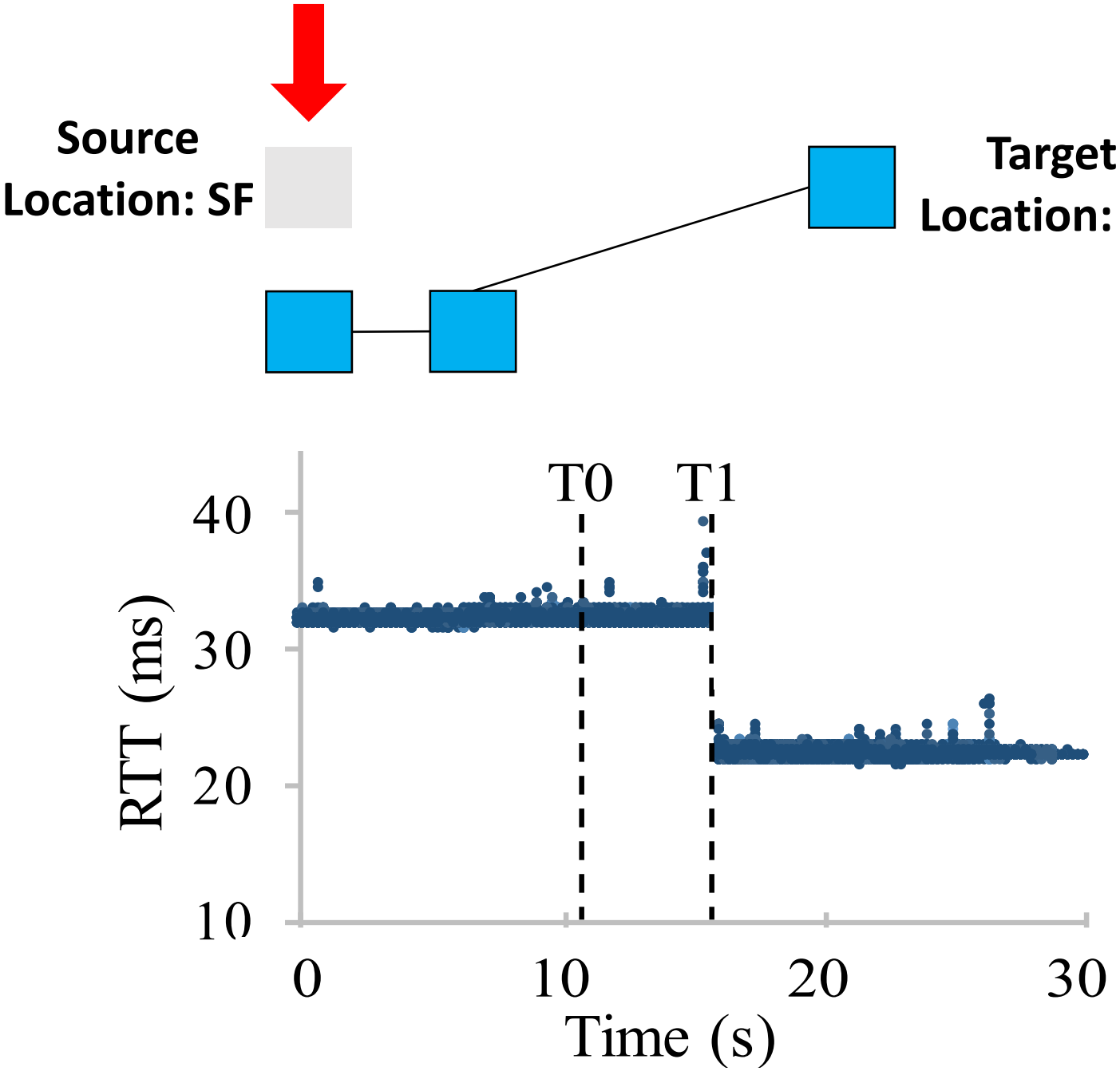
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Target
Location: NY
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T1
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30
20
10
RTT (ms)
0
10
20
30
Time (s)

Conclusion

- Problem
  - Mobile network service deployment and evolution very slow
  - Future mobile networks will be unable to meet app demands without being more evolvable
- Our solution
  - Trend towards mobile software-defined infrastructure (SDI)
  - Proteus, a control platform that allows safe and rapid service creation and evolution in a mobile SDI

Questions?