MME – FAAS

Cloud-Native Control for Mobile Networks

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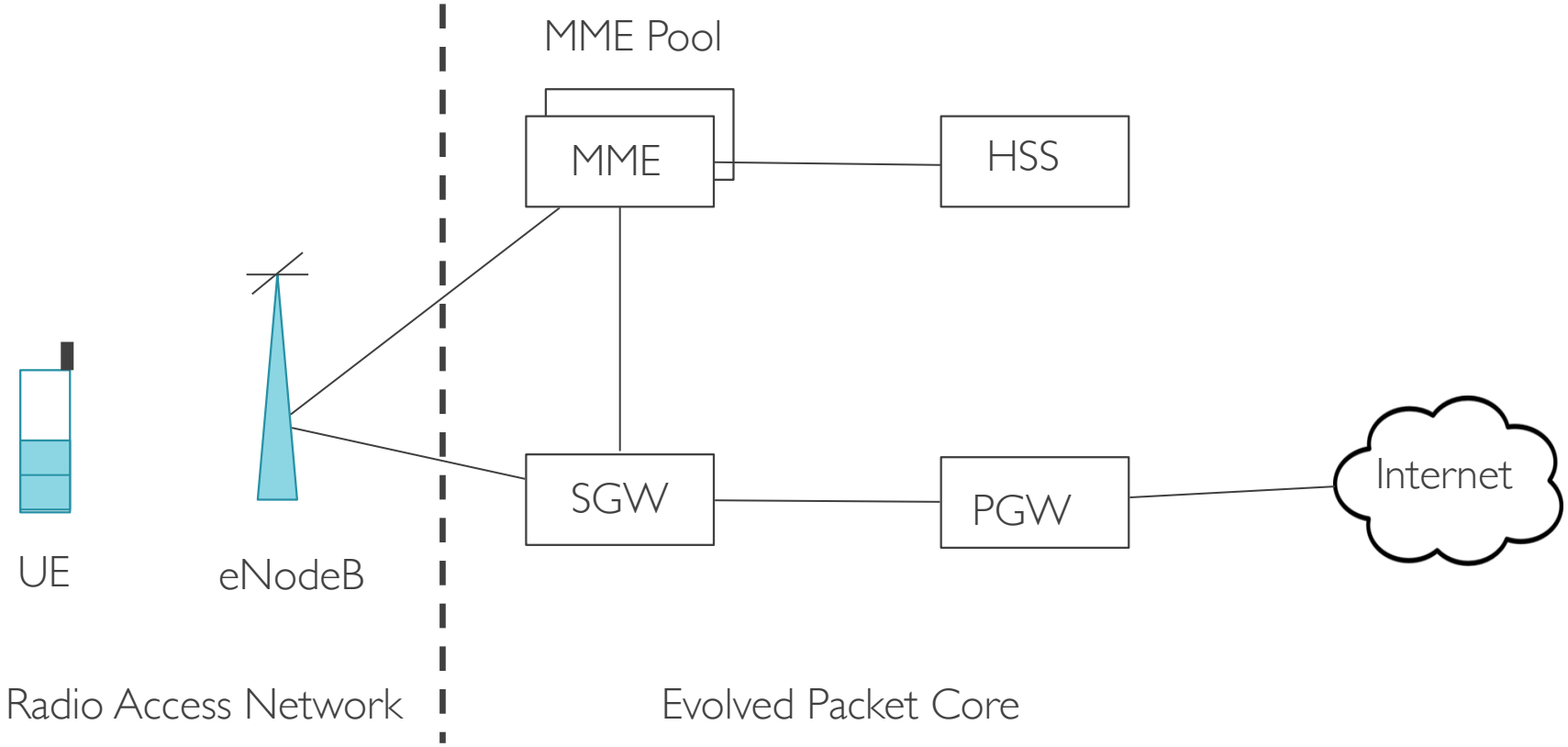
University of Utah

Nov 21, 2019

Introduction – Mobile network architecture



In the US, 400M Subscribers, 200K Cell towers, 50 MME Pool, 2.7M UE per MME

[https://www.statisticbrain.com/ cell-phone-tower-statistics/]
[https://en.wikipedia.org/wiki/List_of_United_States_wireless_ communications_service_providers]
[Mohammadkhan, A., Ramakrishnan, K. K., Rajan, A. S., and Maciocco, C. Considerations for Re-designing the Cellular Infrastructure Exploiting Software-based Networks. *2016, ICNP)]*

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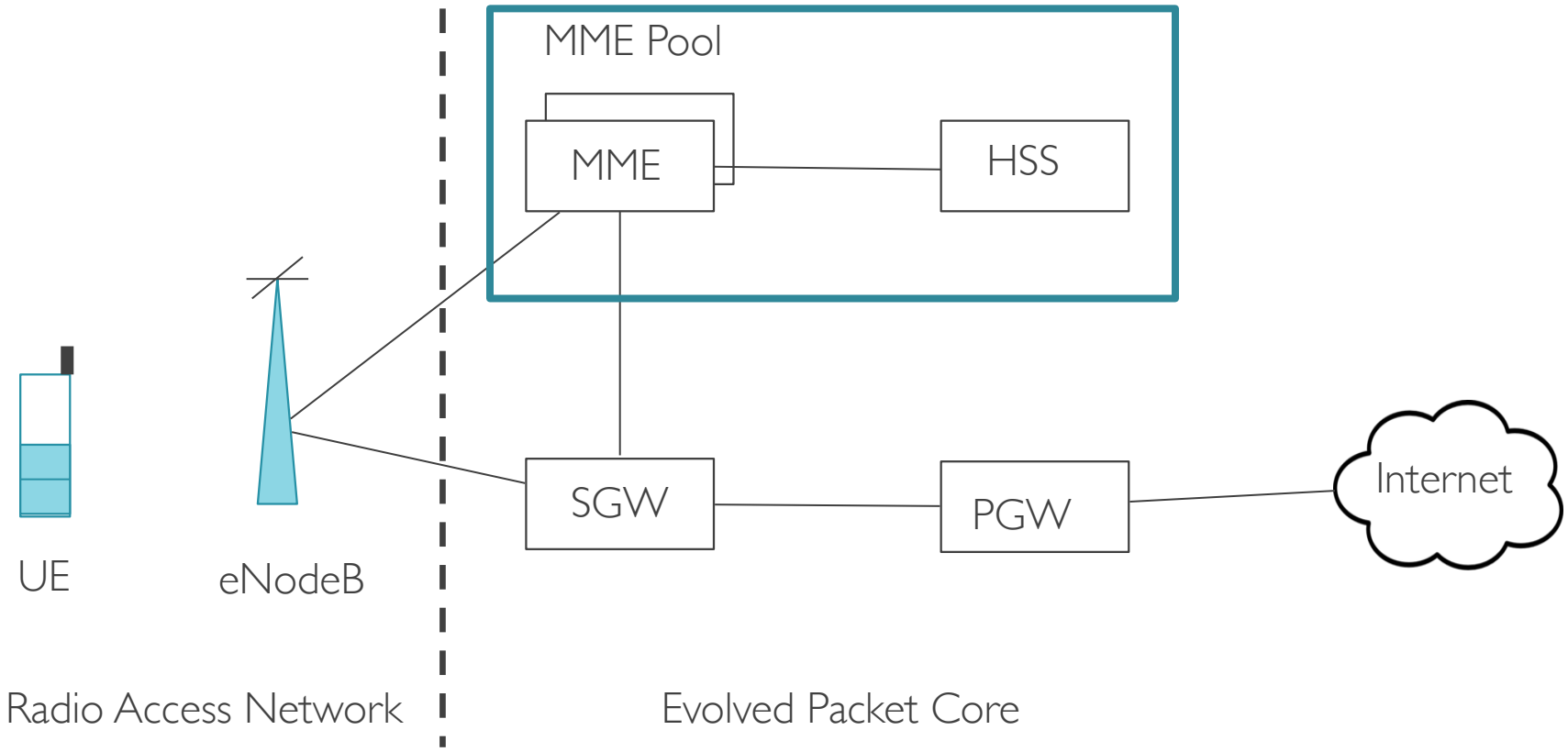

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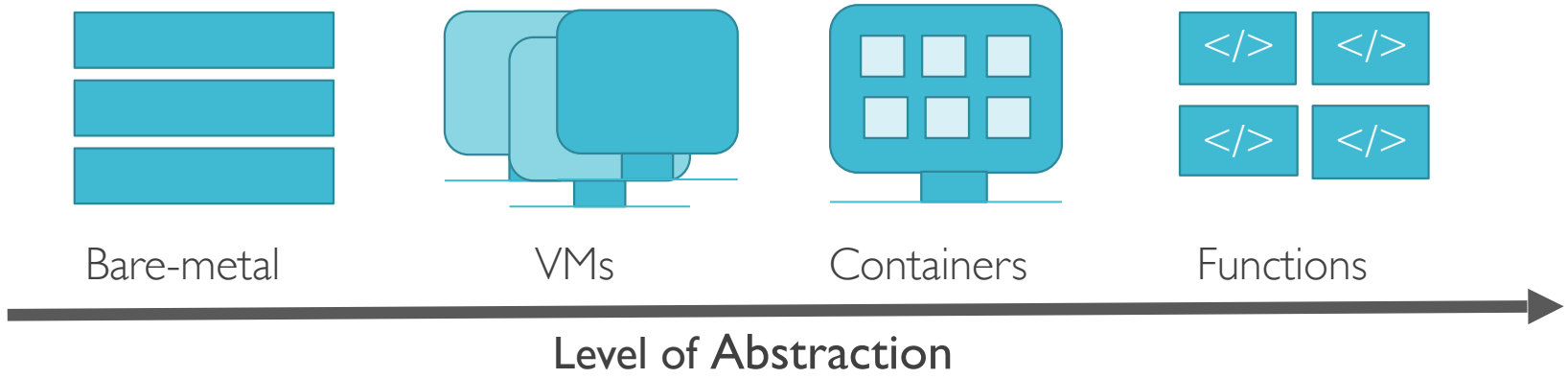
Introduction – Serverless & FaaS

- Managed Services
- Auto provisioning
- Function as a Service
- Platform to develop, run and manage functionality
- Event-driven functions

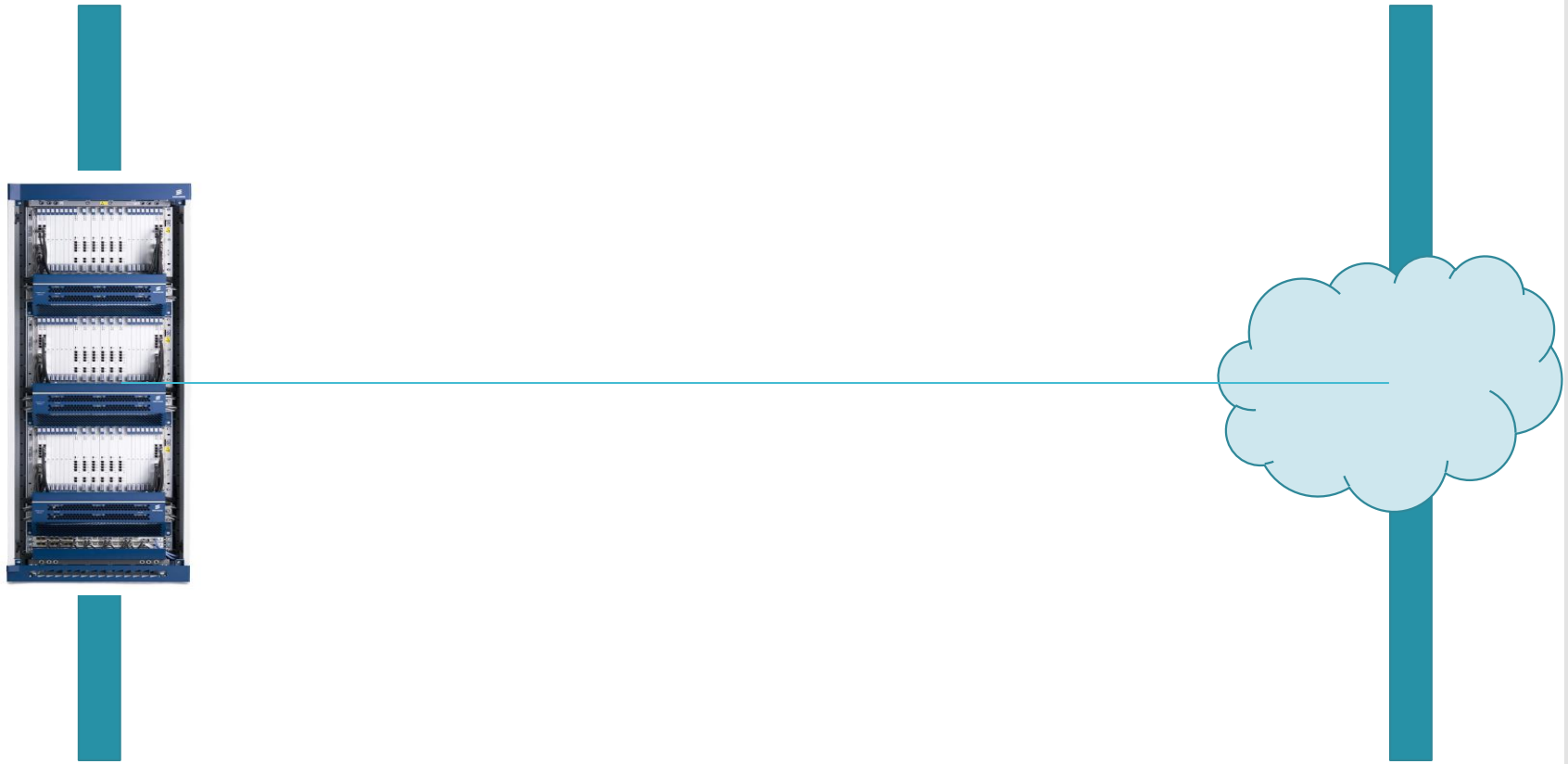


Mapping Mobile core to Serverless

Mobile Core Challenges	Serverless Feature
Purpose-built hardware	Software components
Over-provisioning	Dynamic allocation
Slow and costly capacity changes	Dynamic scaling
Monolithic Application	Independently scalable elements
Expensive	Pay-per-use

MME model using FaaS without 3GPP compliance

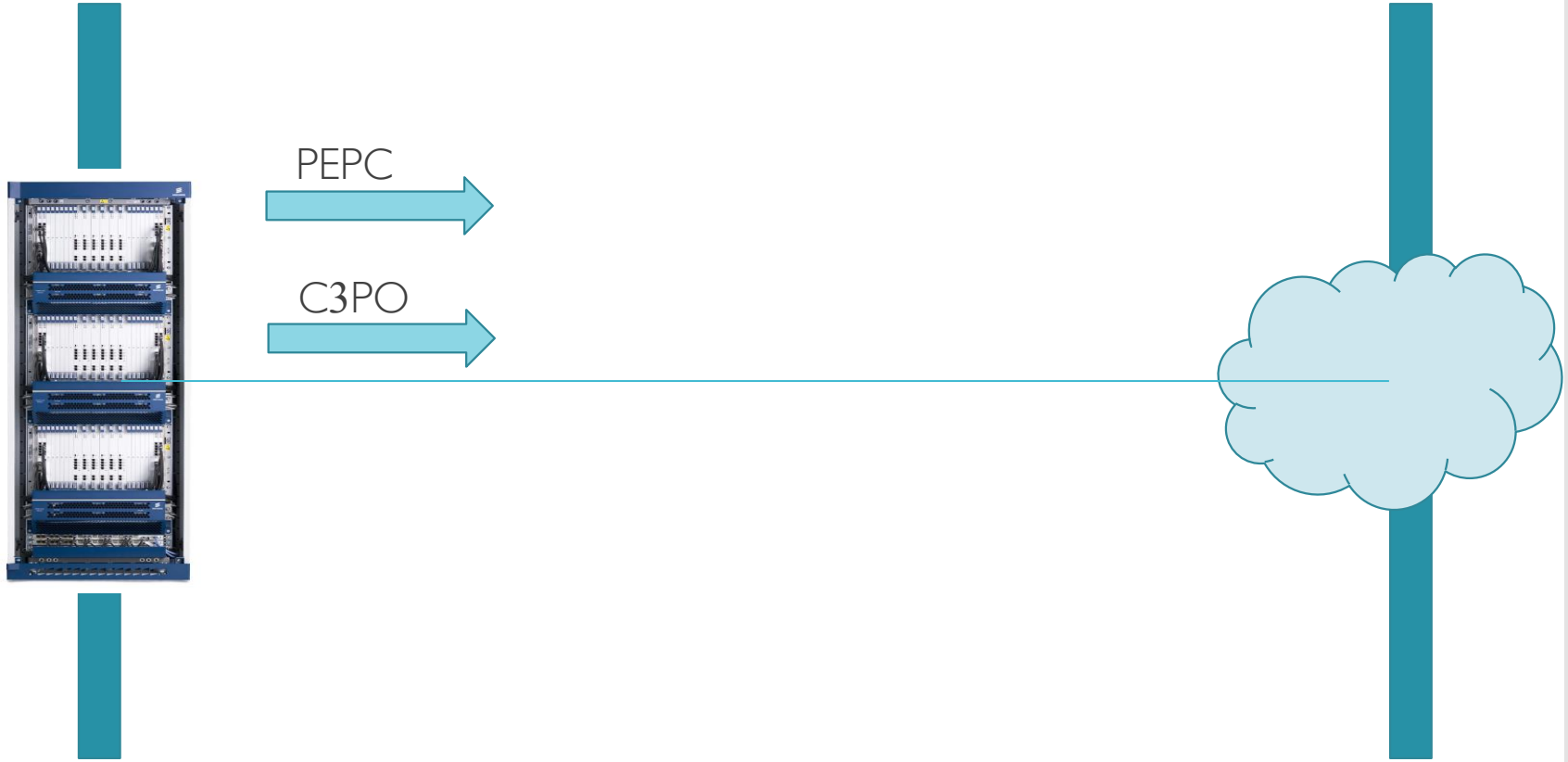
MME FaaS Approach



Monolithic

Cloud-Native

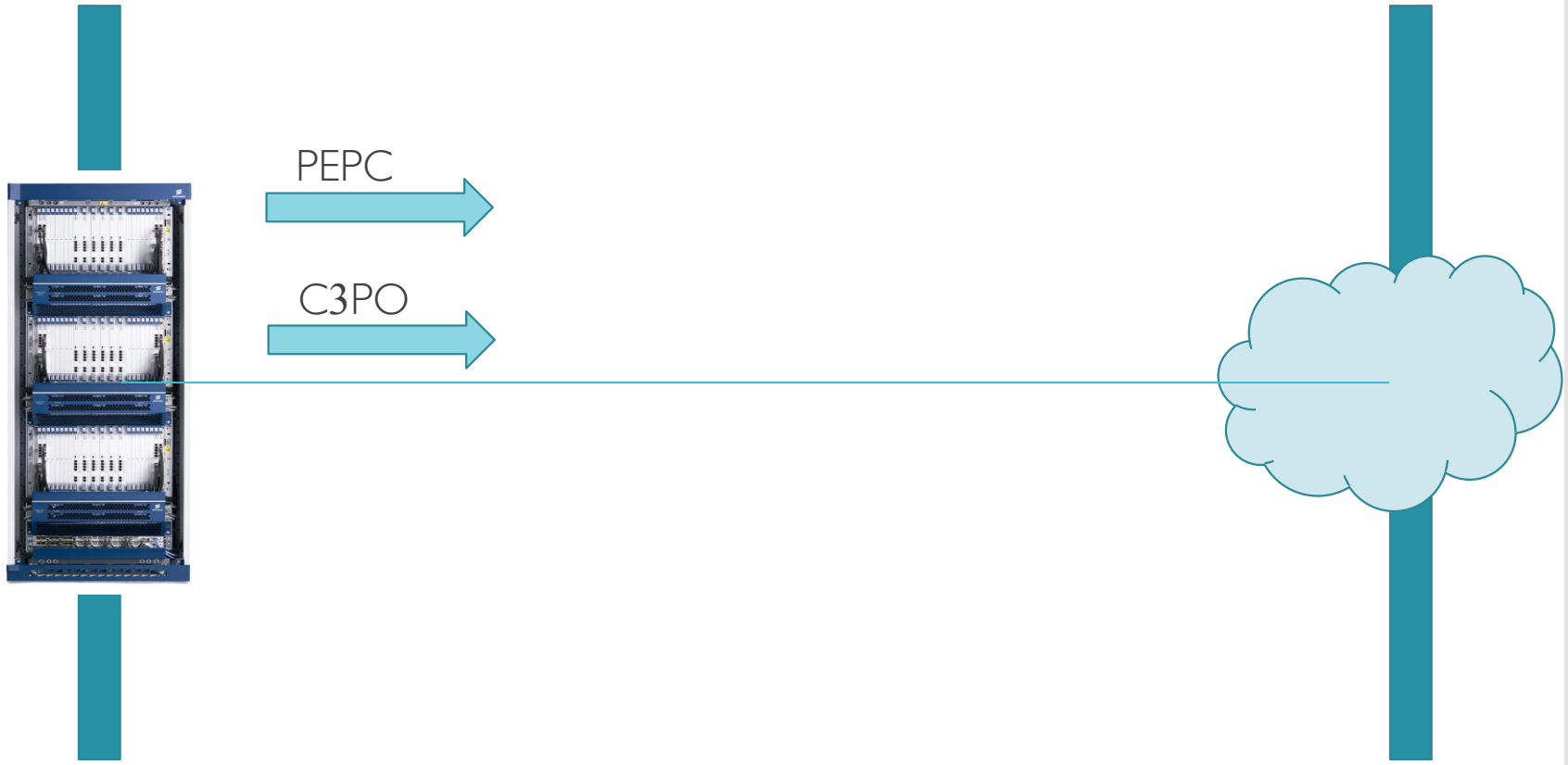
MME FaaS Approach



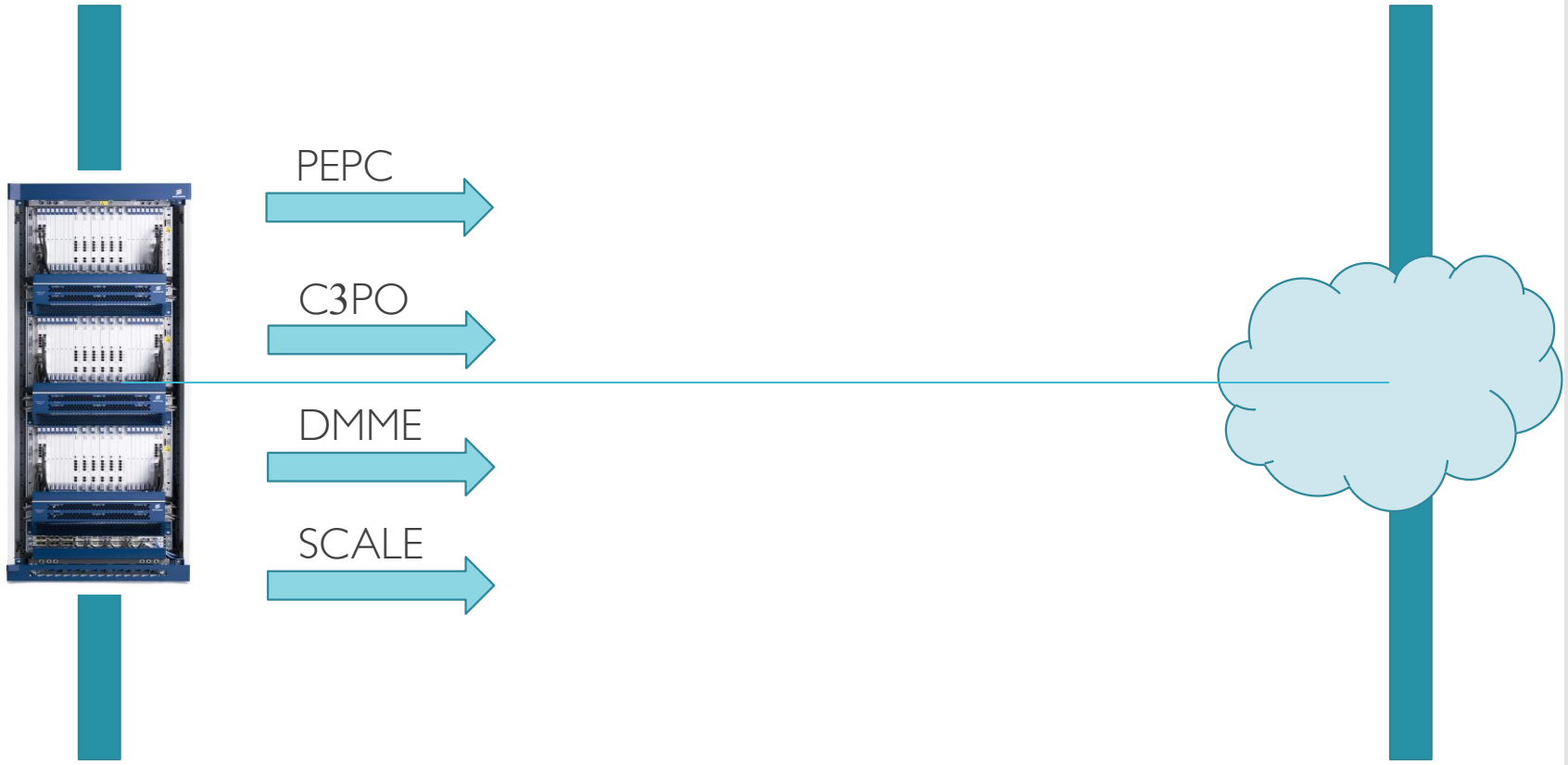
Monolithic **Cloud-Native**

[Qazi, Z. A., Walls, M., Panda, A., Sekar, V., Ratnasamy, S., Shenker, S SIGCOMM '17]
[Sprint, Intel Labs collaboration project]

MME FaaS Approach

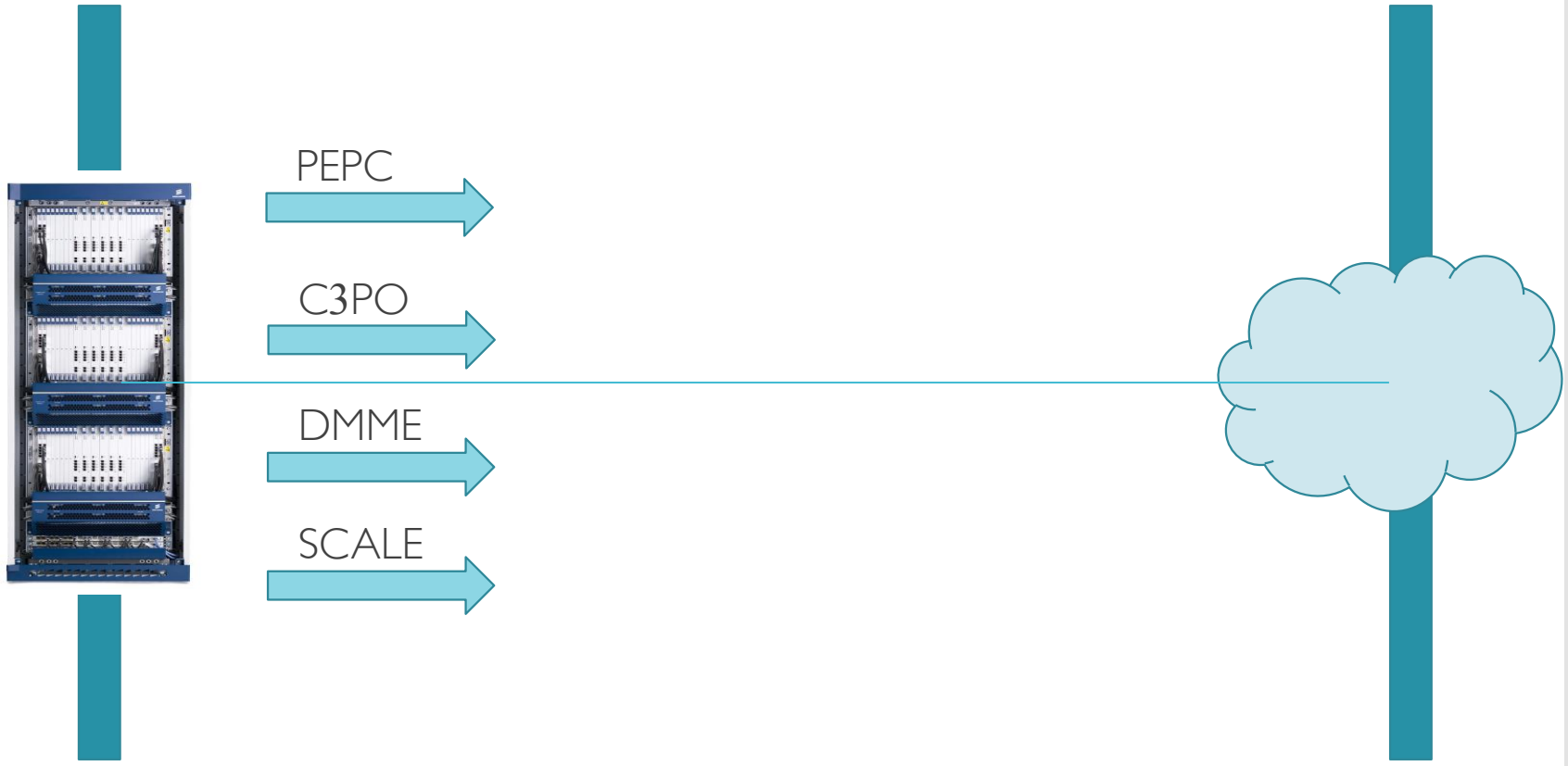


MME FaaS Approach



[An, X., Pianese, F., Widjaja, I., and Acer, U. G. Bell Labs Technical Journal 17]
[Banerjee, A., Mahindra, R., Sundaresan, K., Kasera, S., Van der Merwe, K., and Rangarajan, S CoNEXT '15]

MME FaaS Approach



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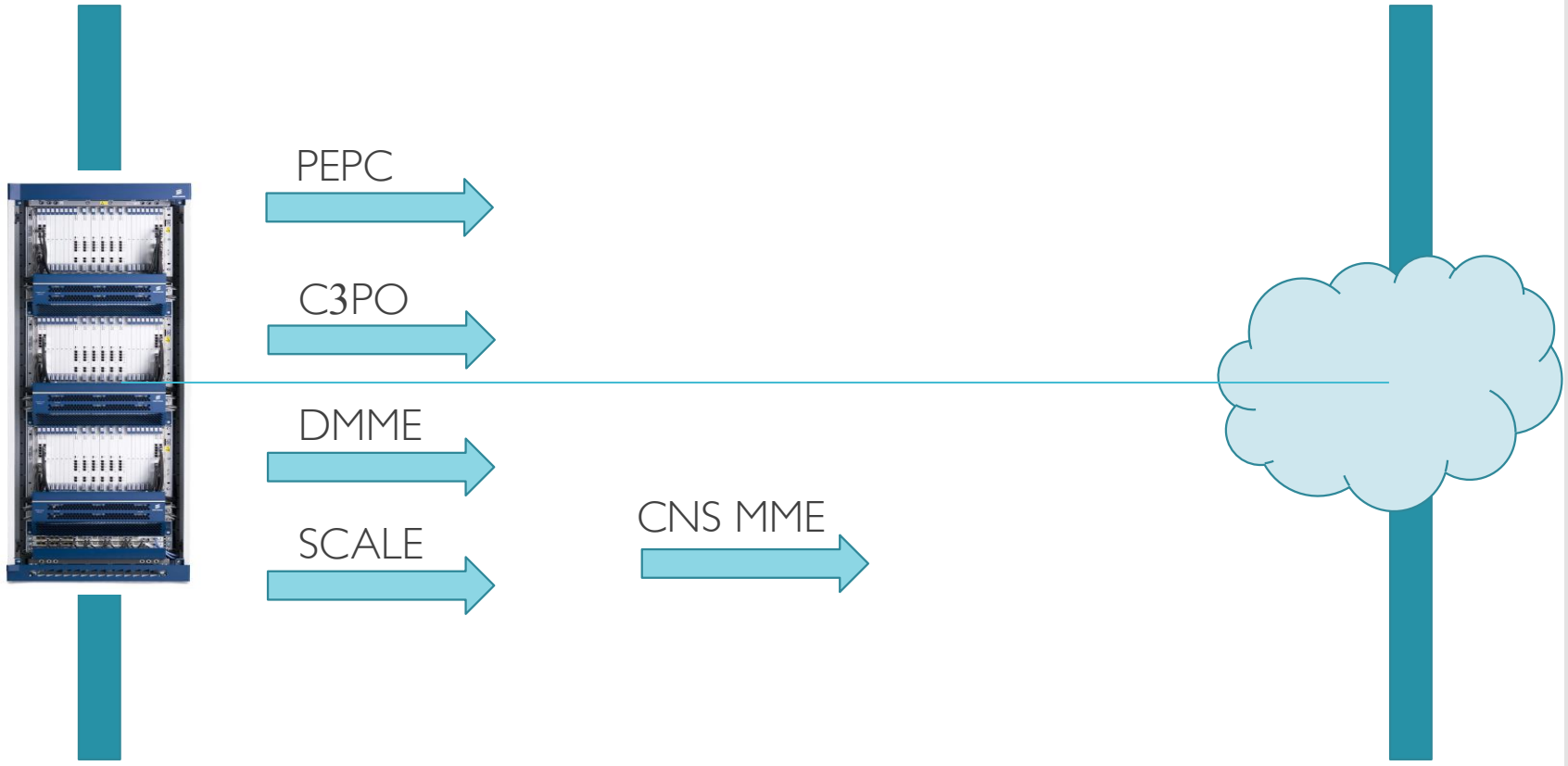
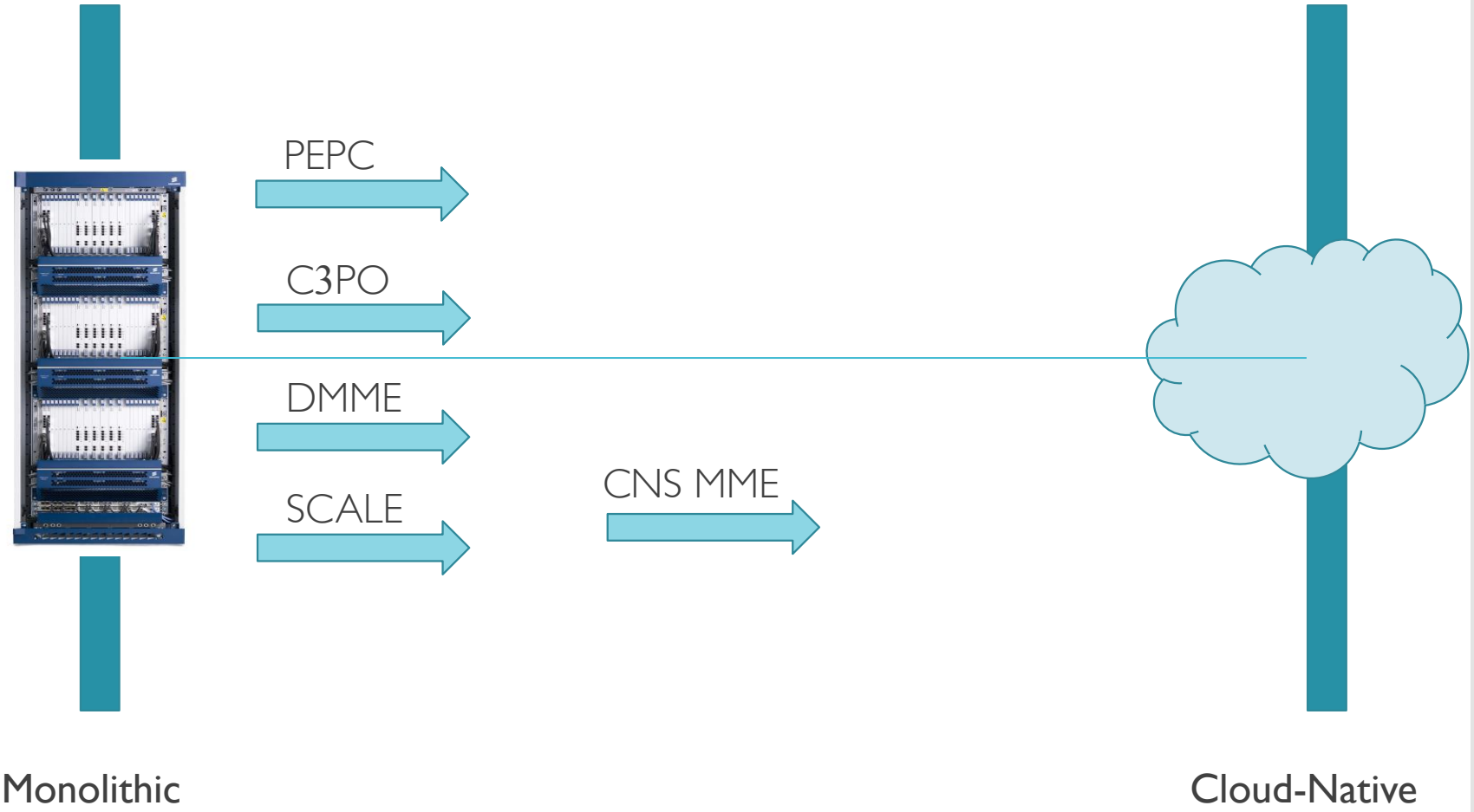


[Amogh, P. C., Veeramachaneni, G., Rangisetti, A. K., Tamma, B. R., and Franklin, A. A. 2017 IEEE 28th PIMRC]

MME FaaS Approach



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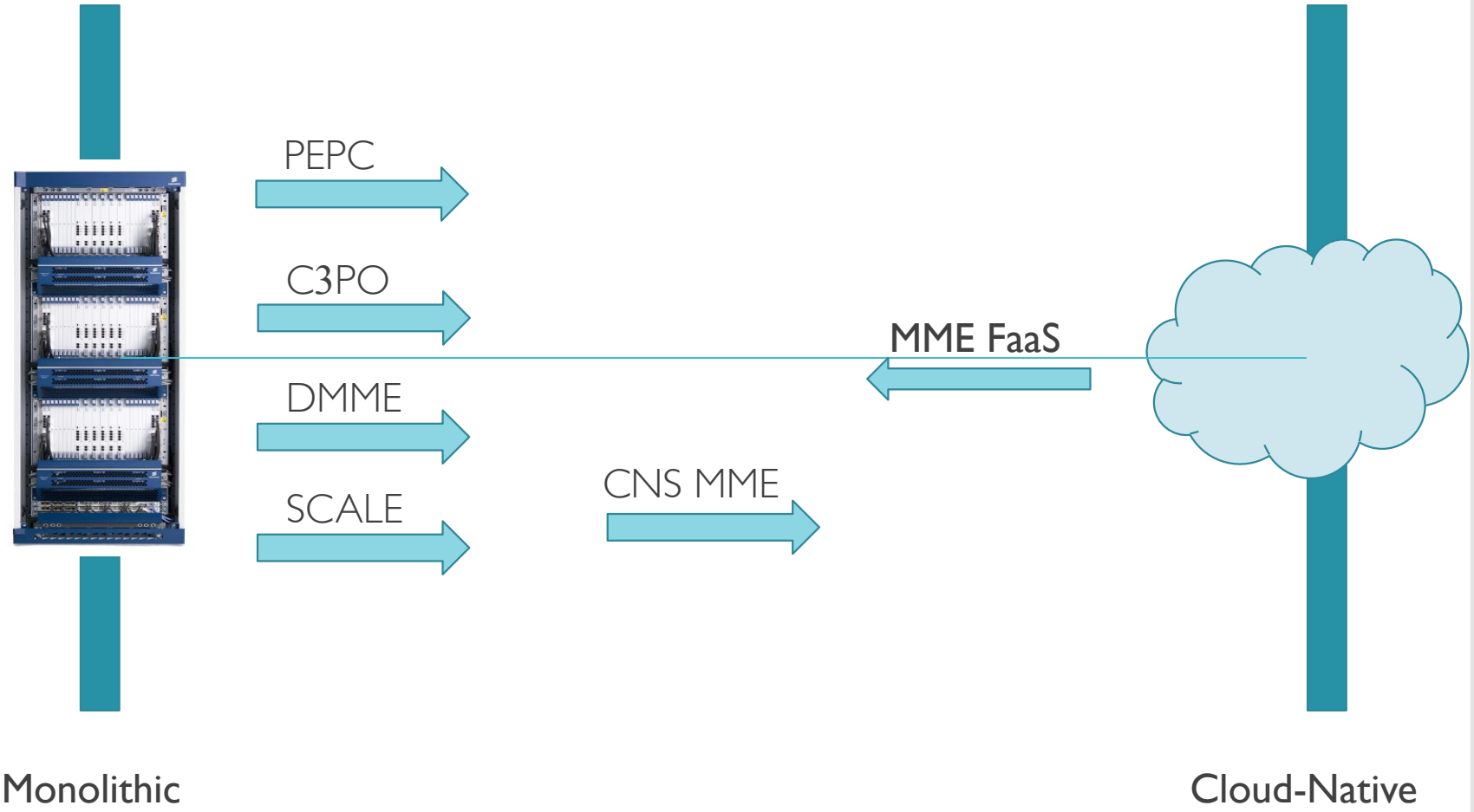
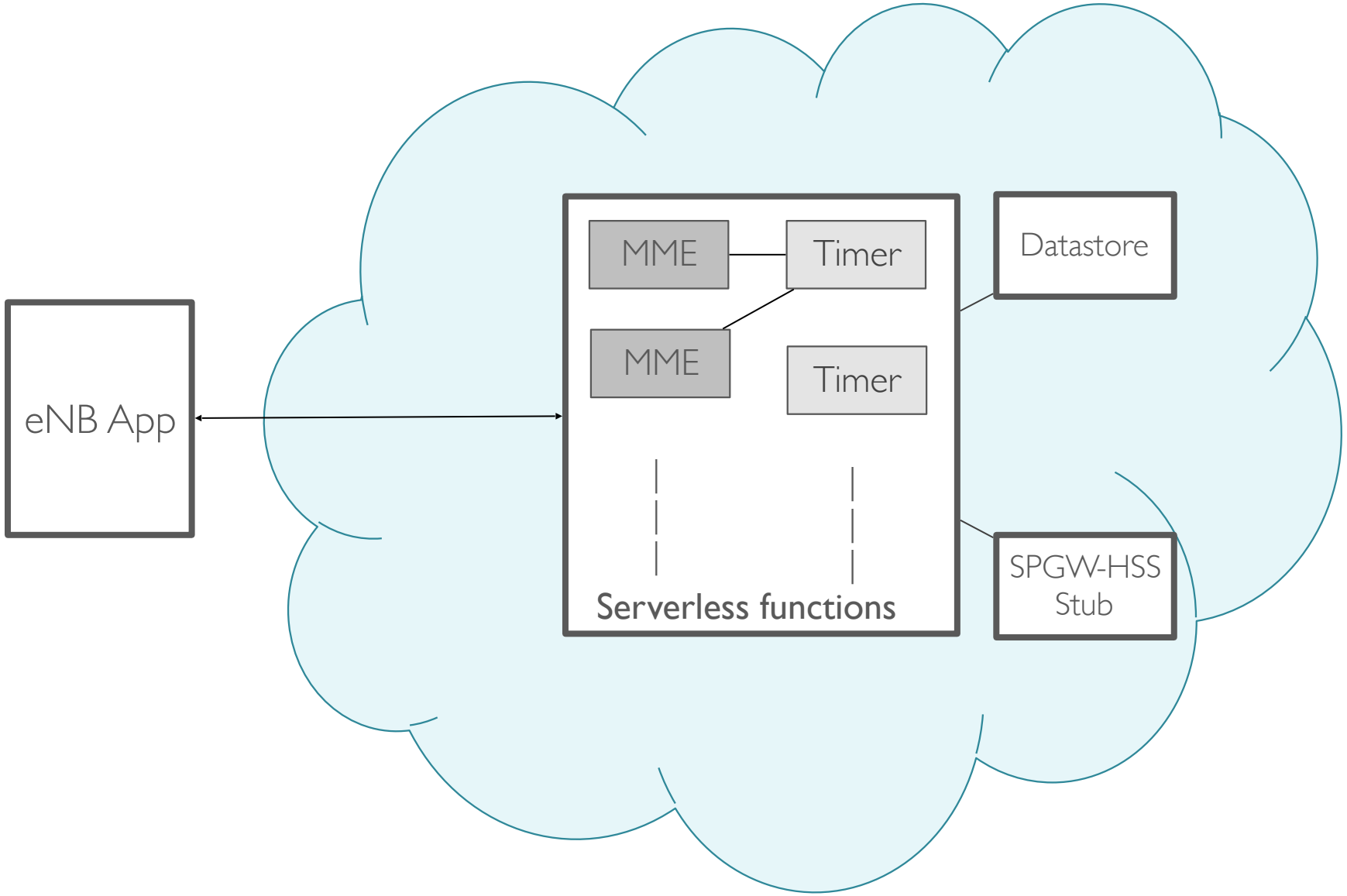


Details

Components


eNB App
MME
Timer
MME
Timer
Datastore
SPGW-HSS
Stub
Serverless functions

Design Principles – Attach Procedure

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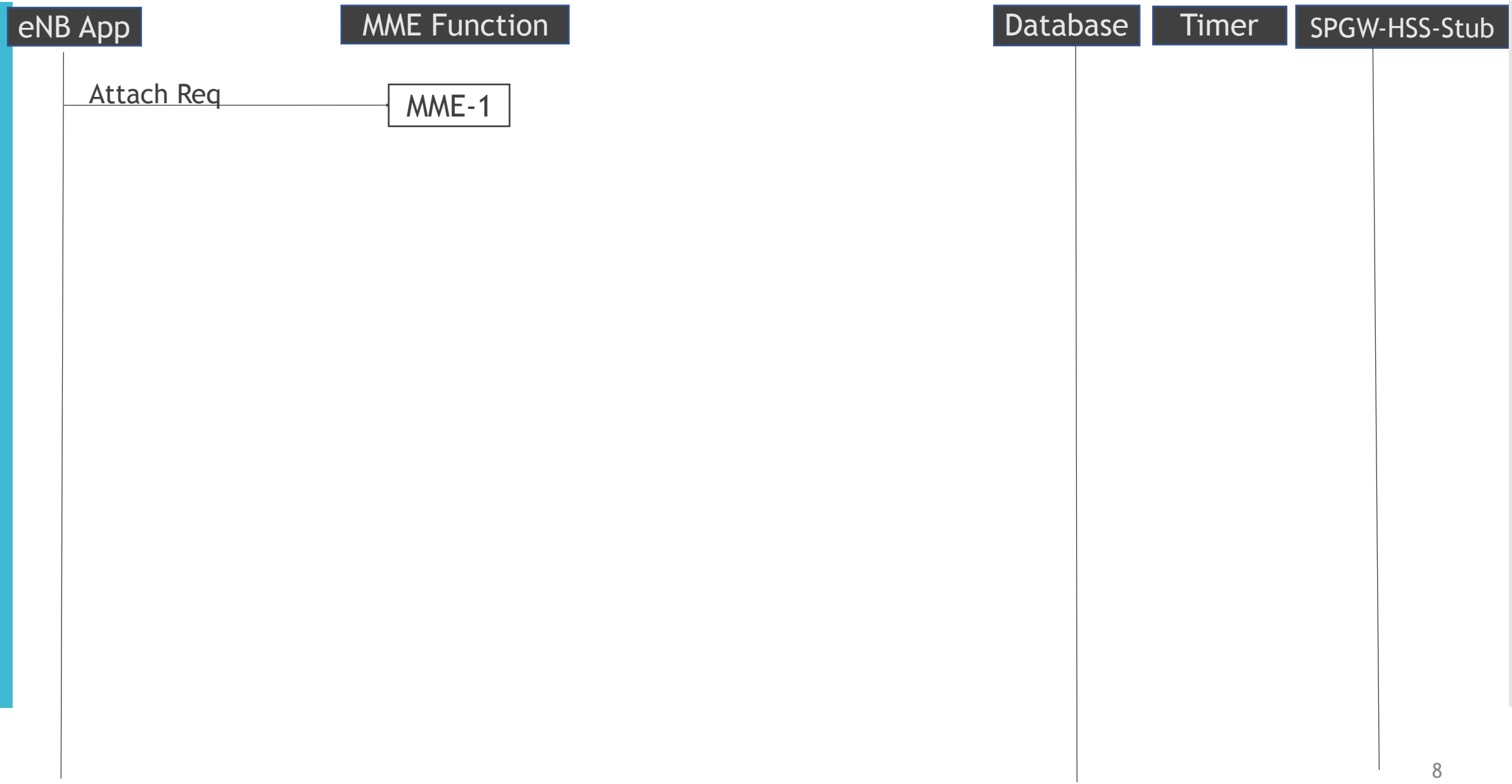

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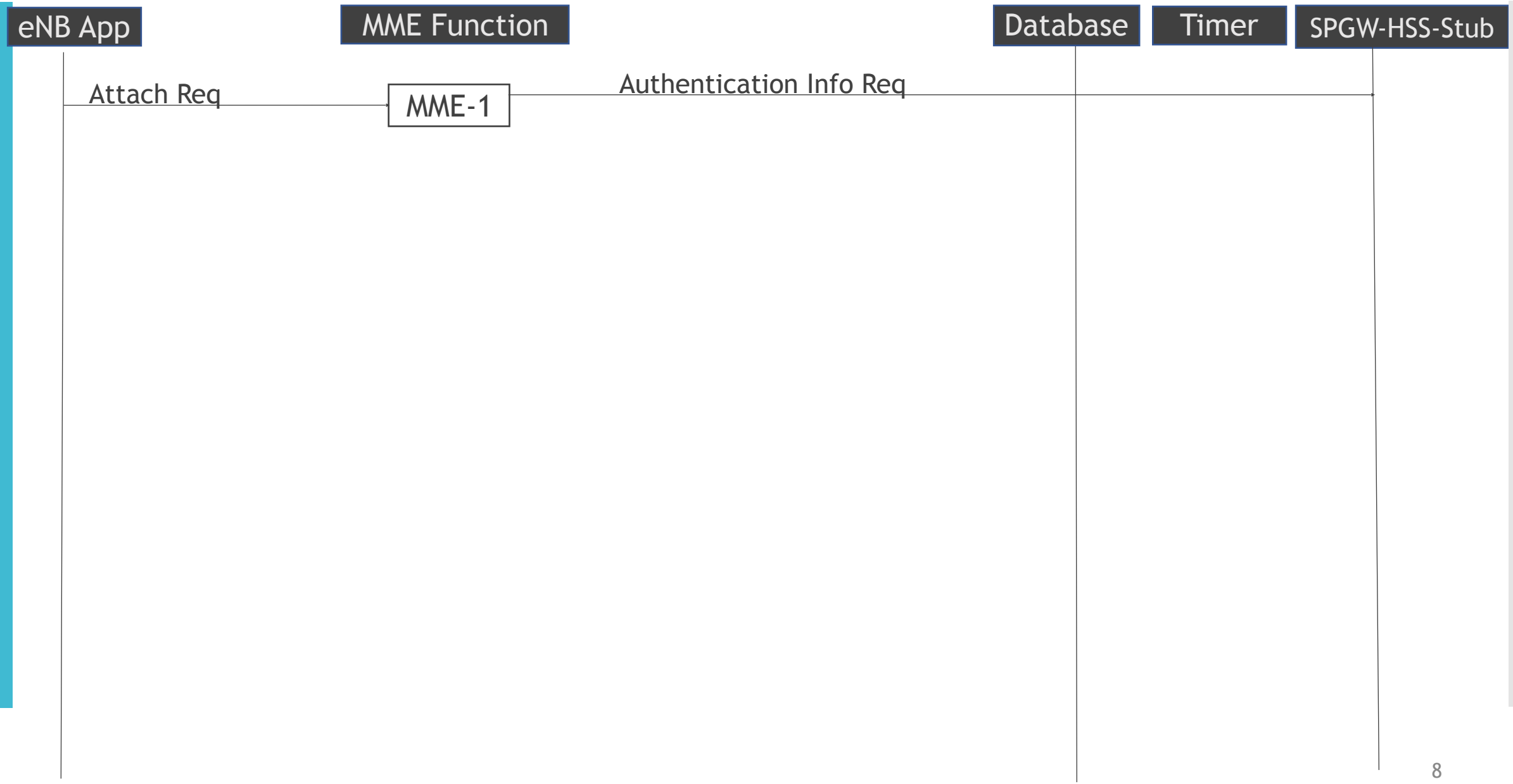

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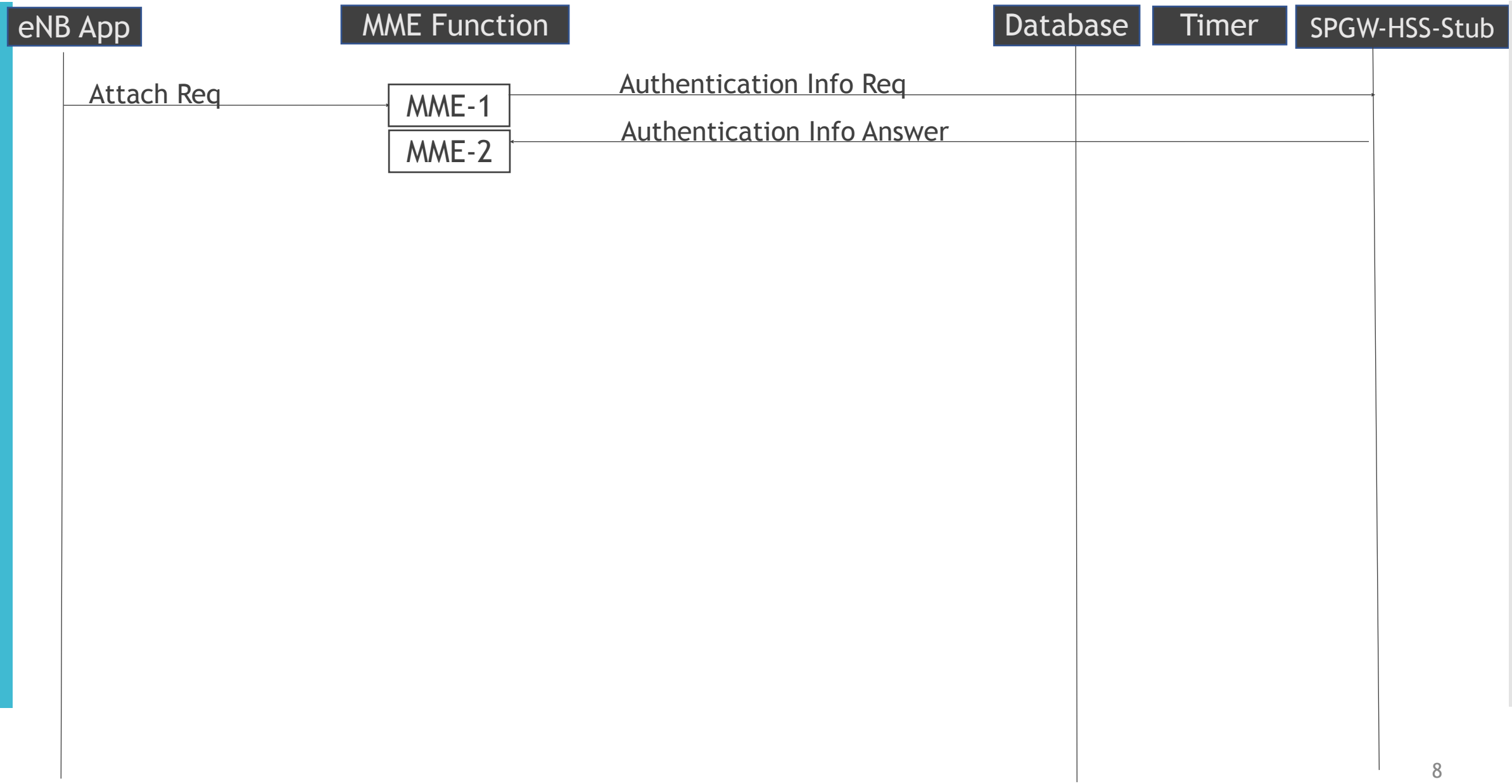

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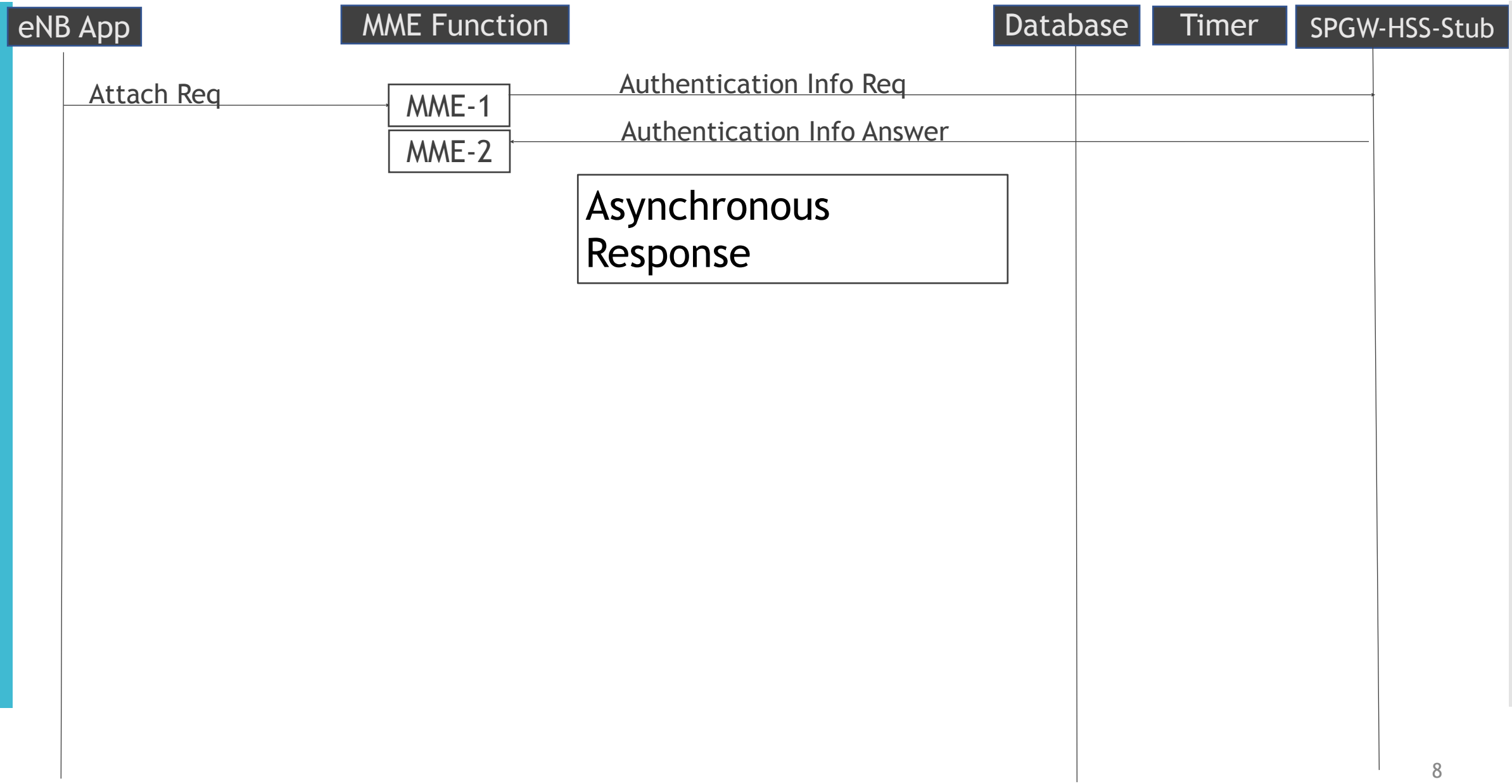

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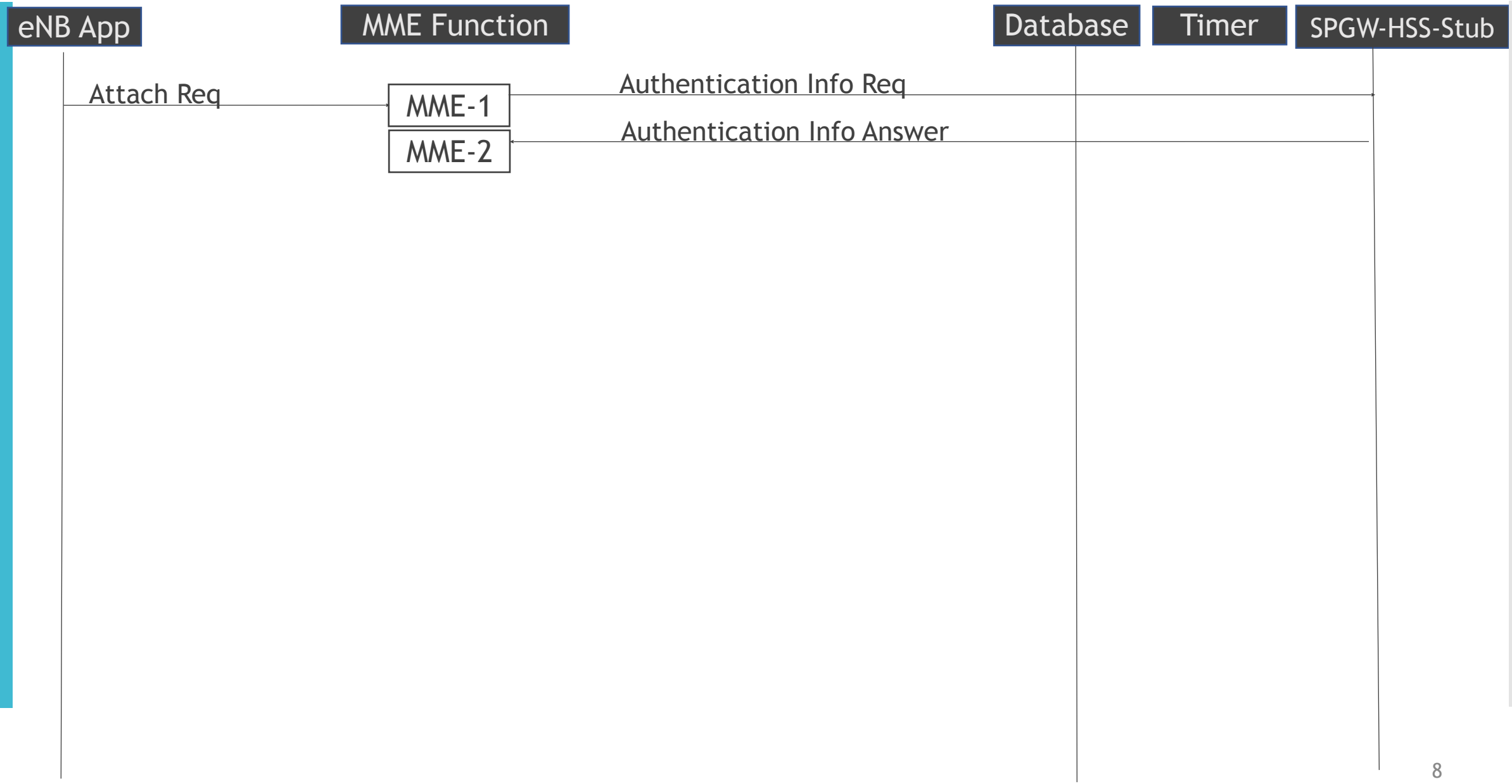

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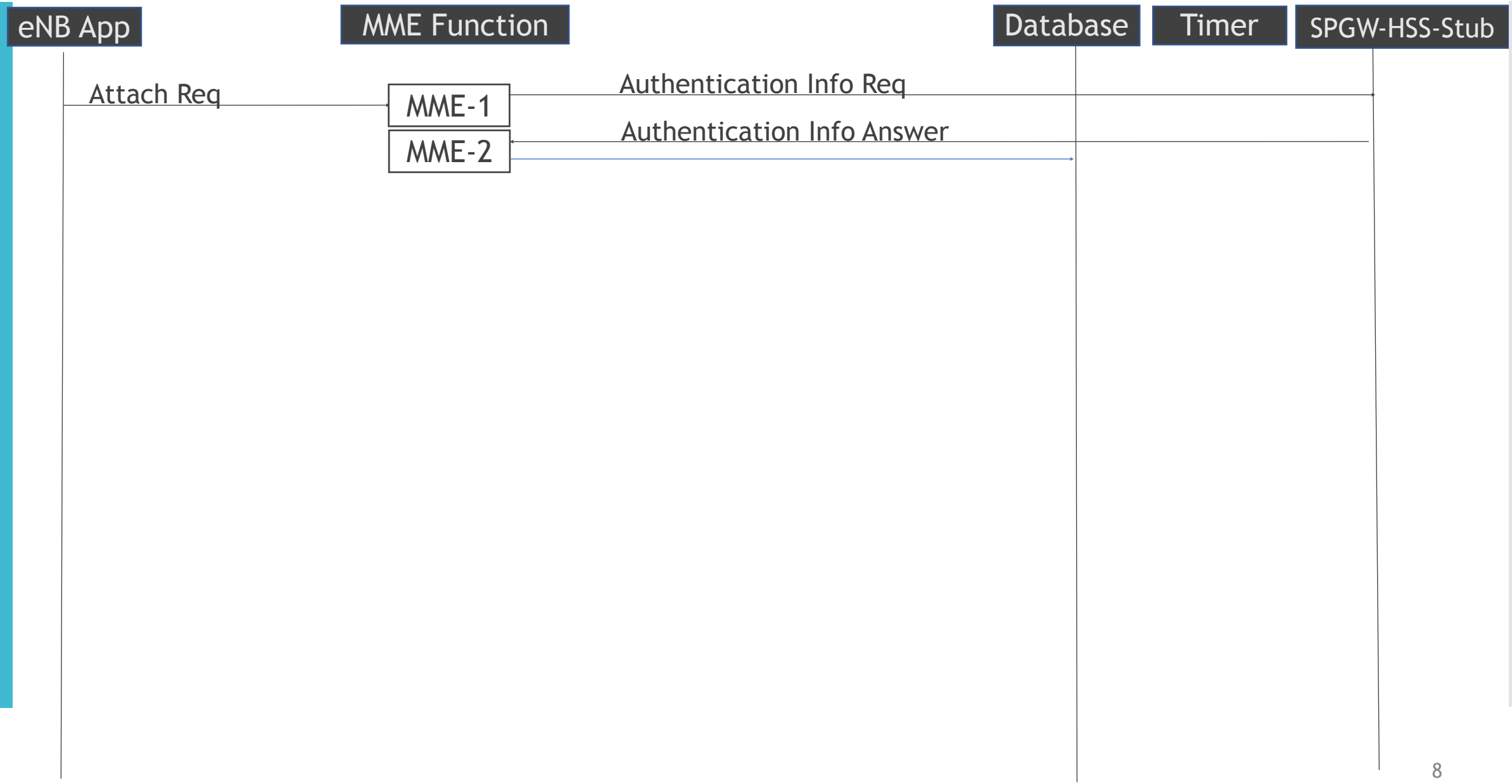

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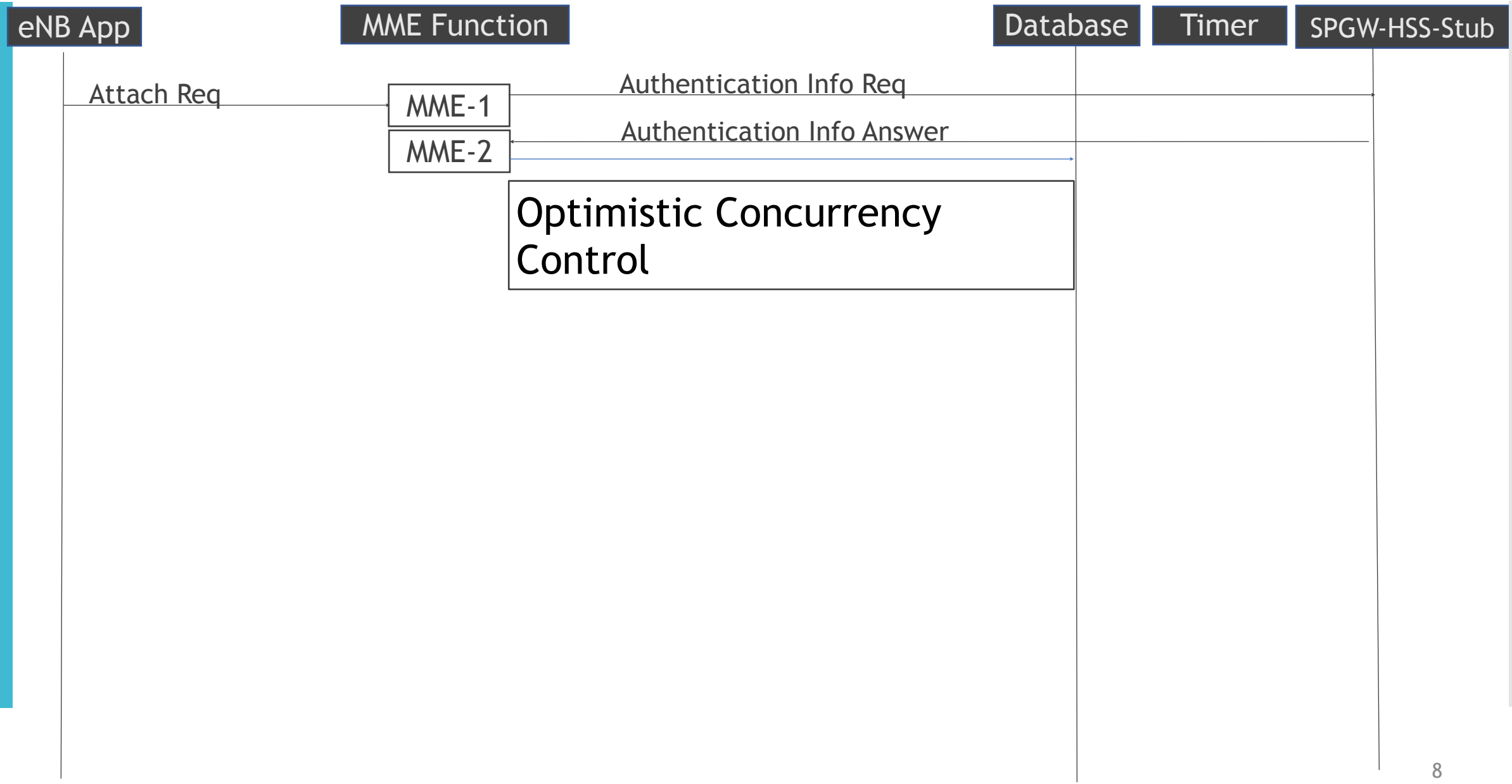

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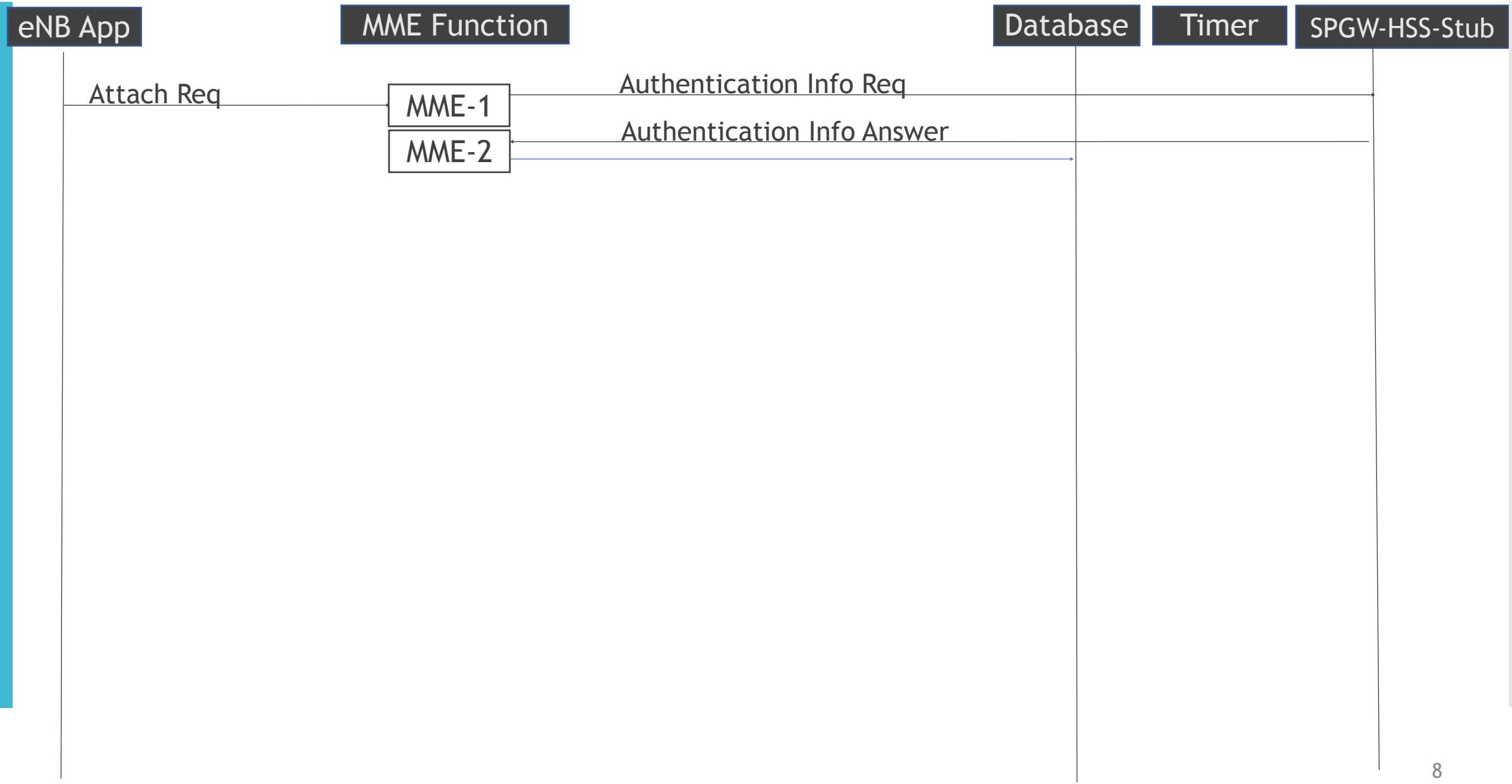

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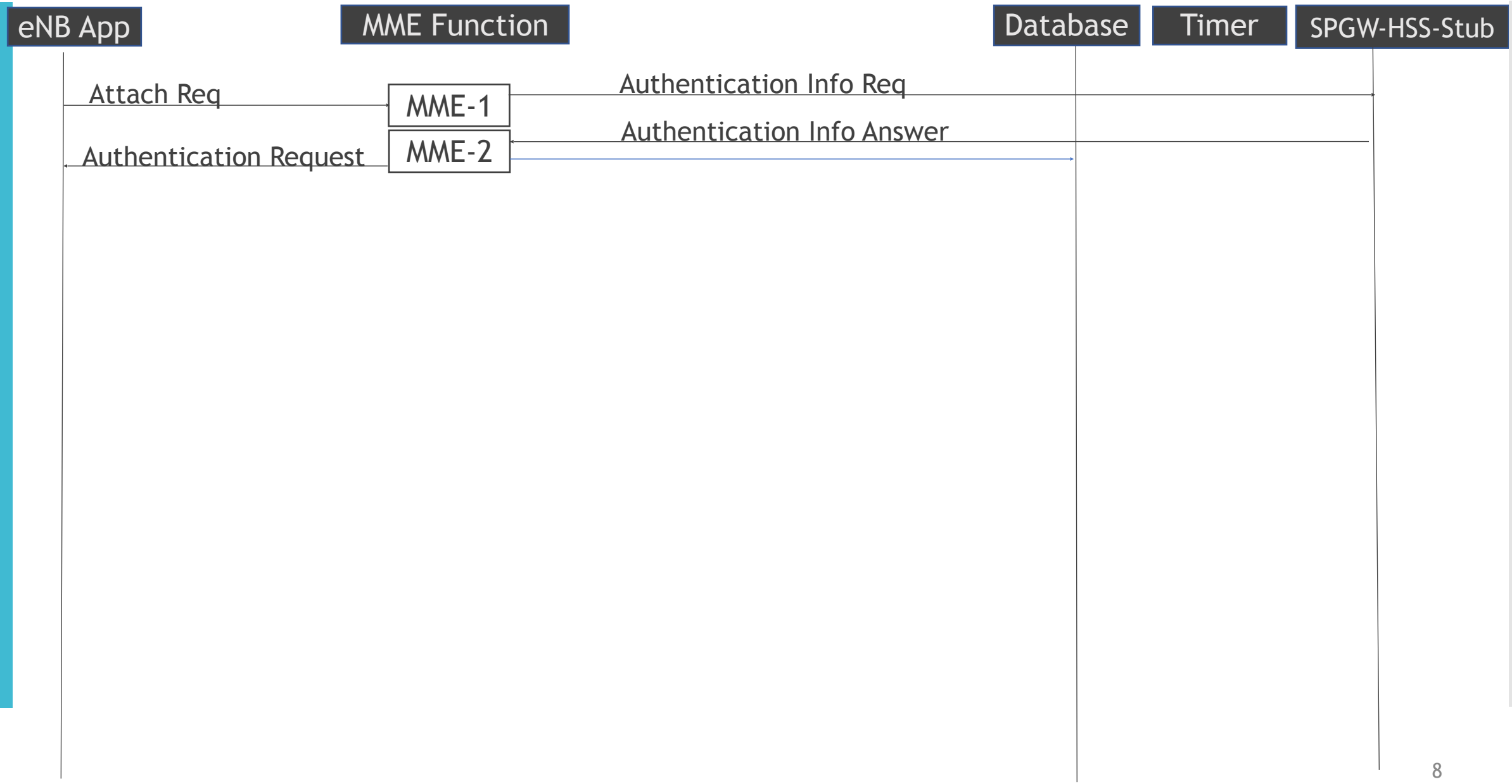

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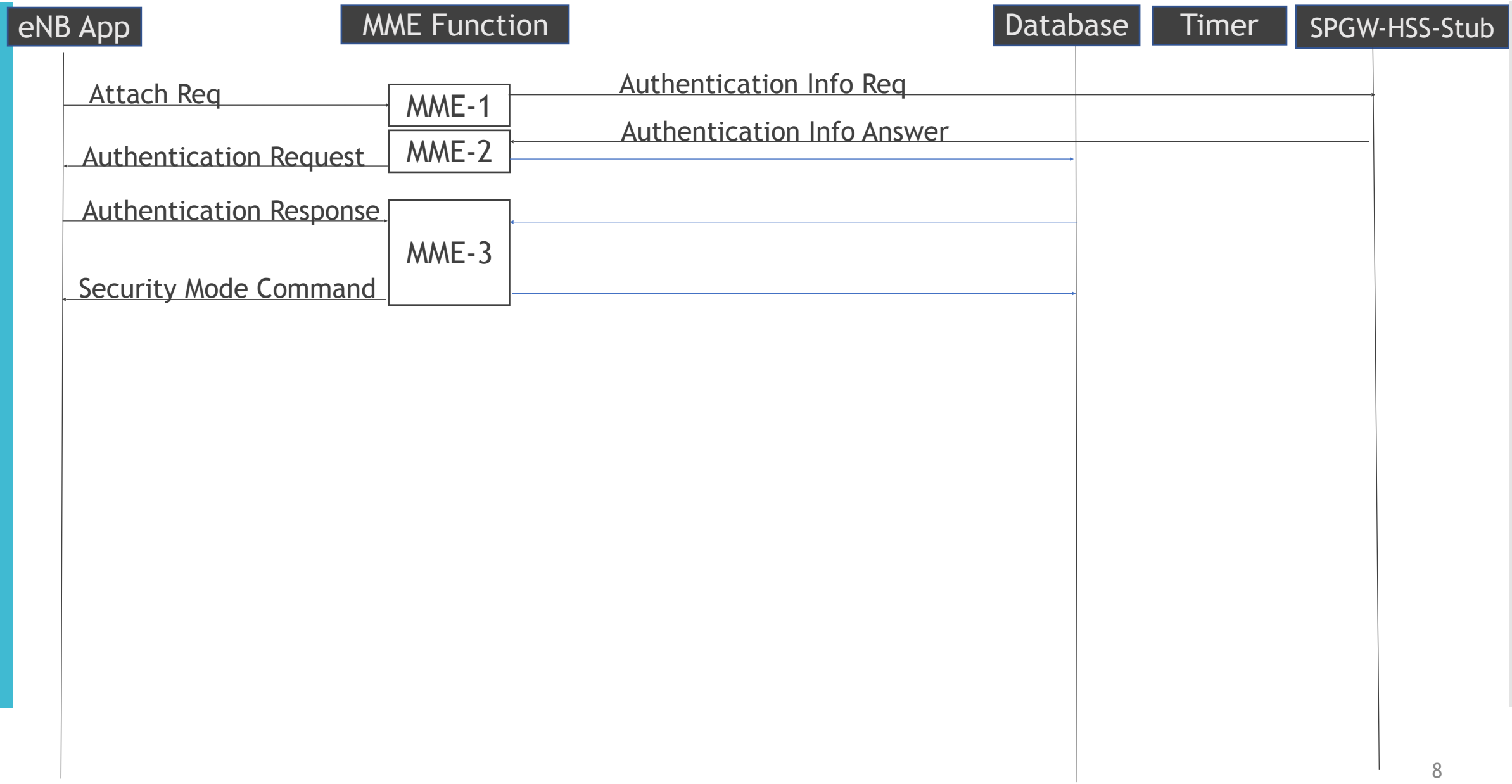

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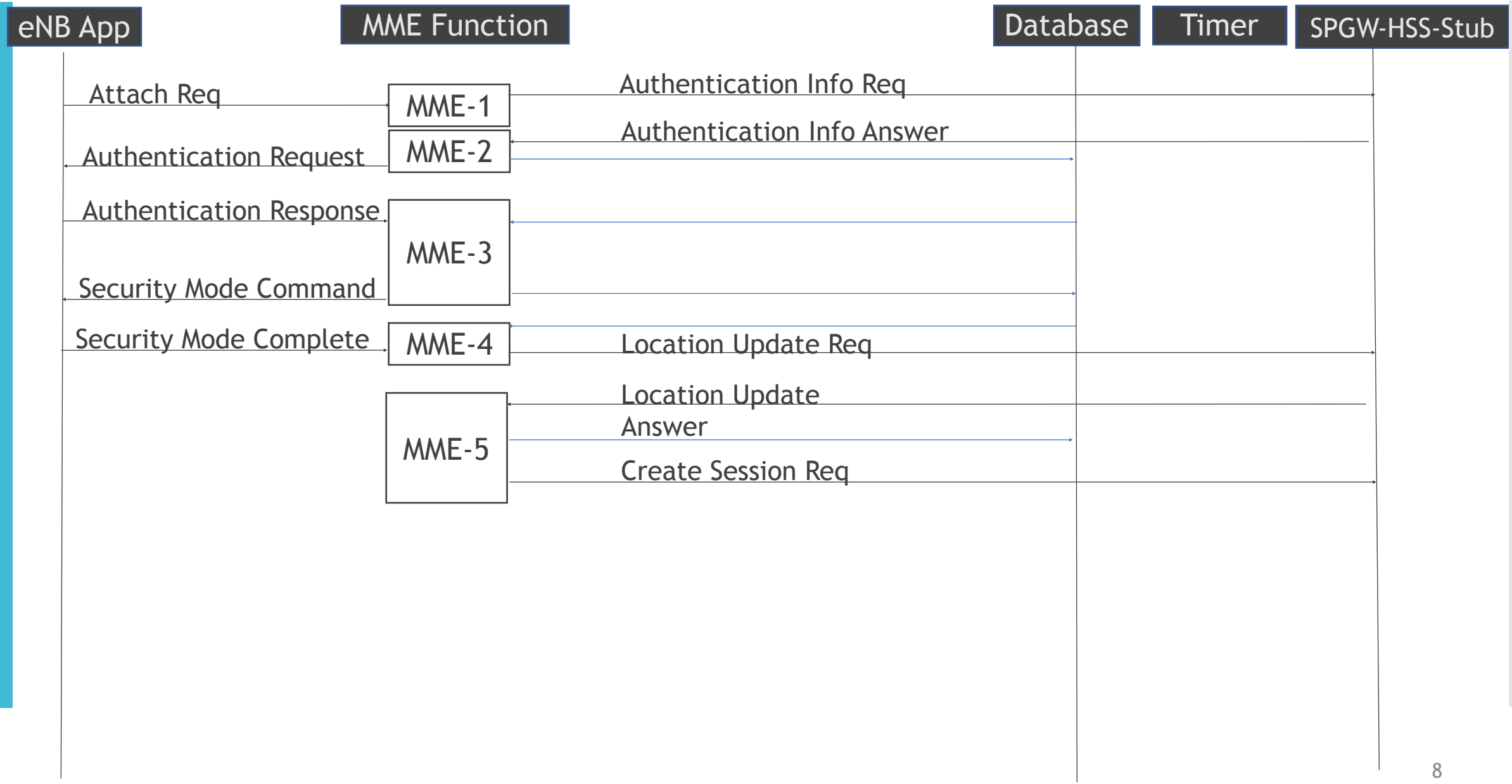

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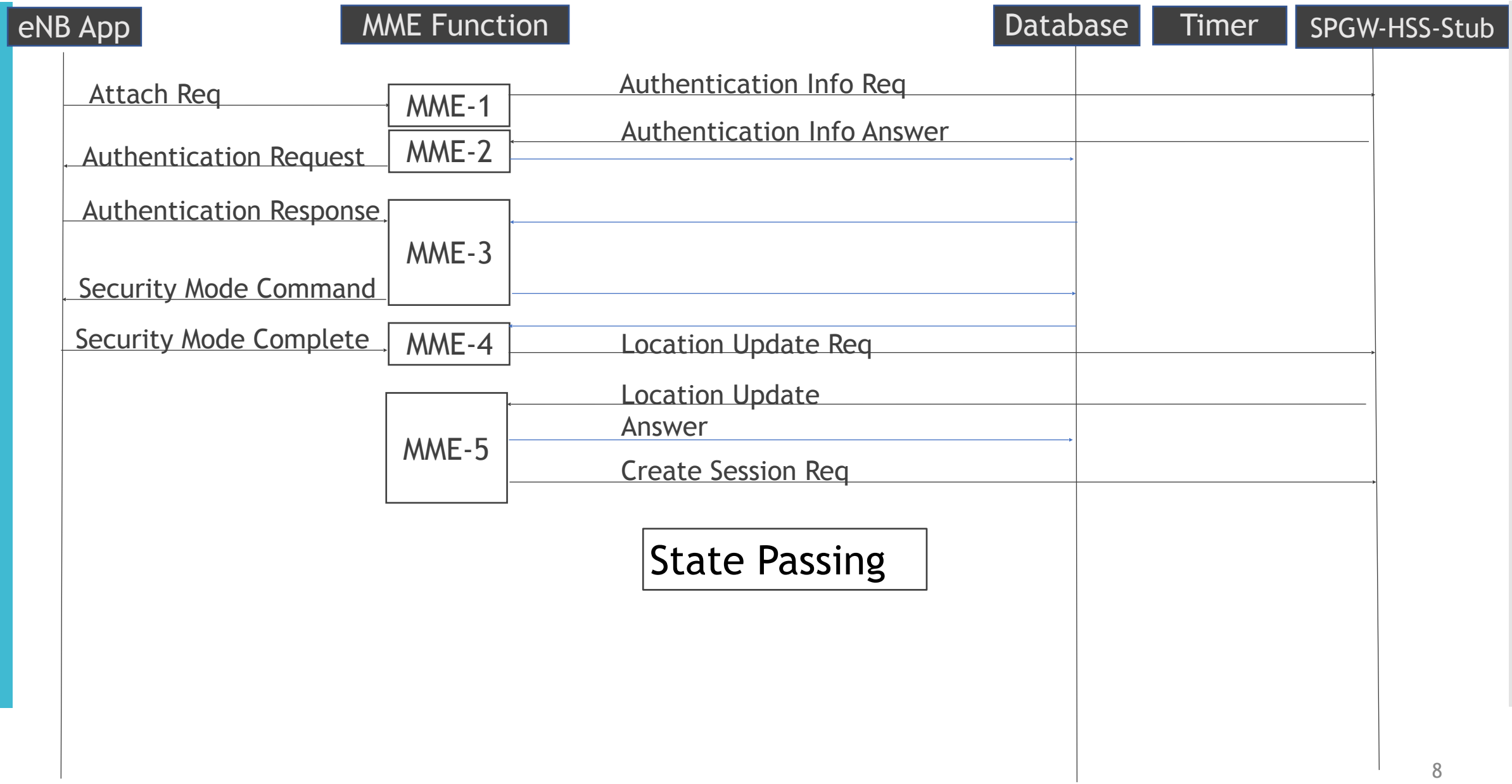

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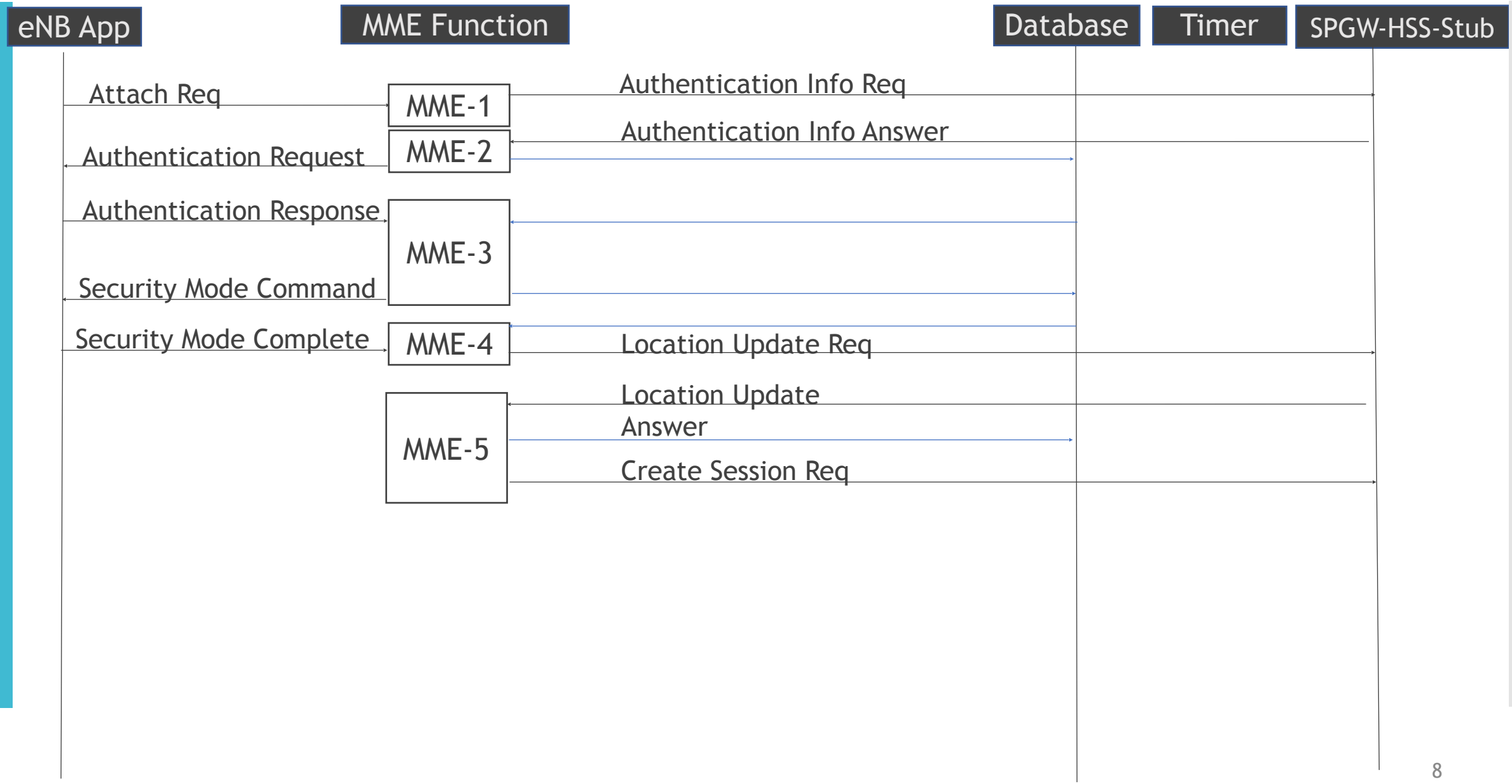

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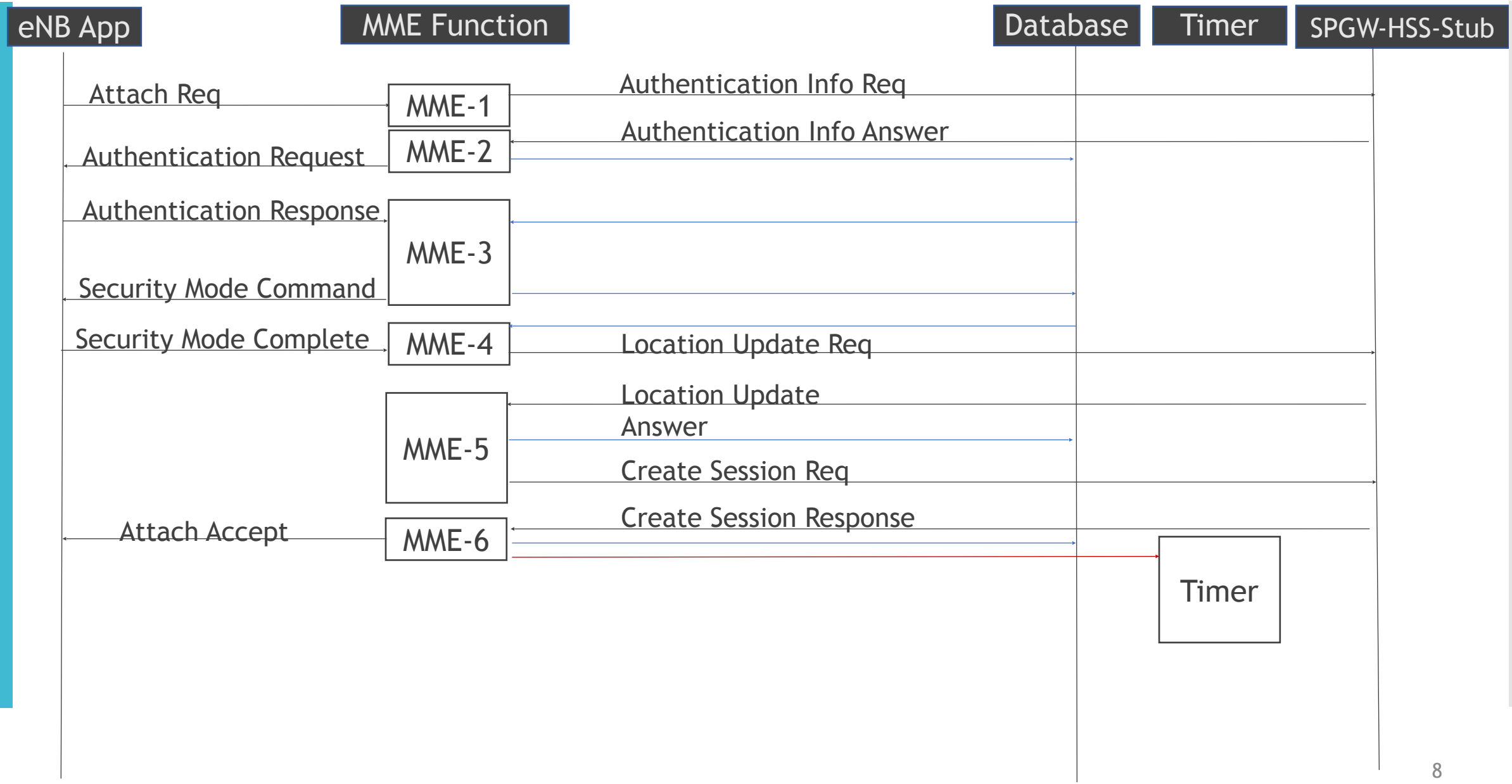

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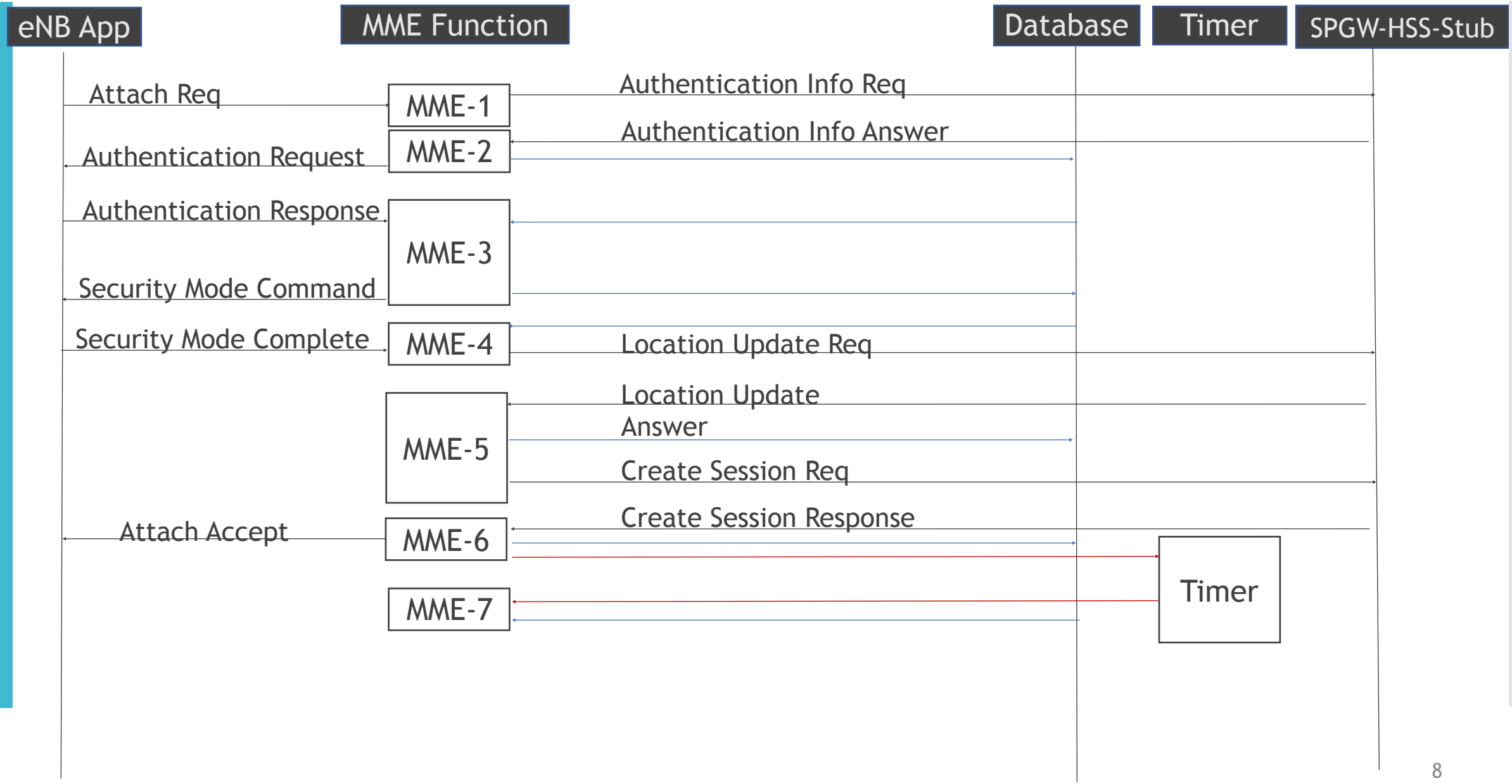

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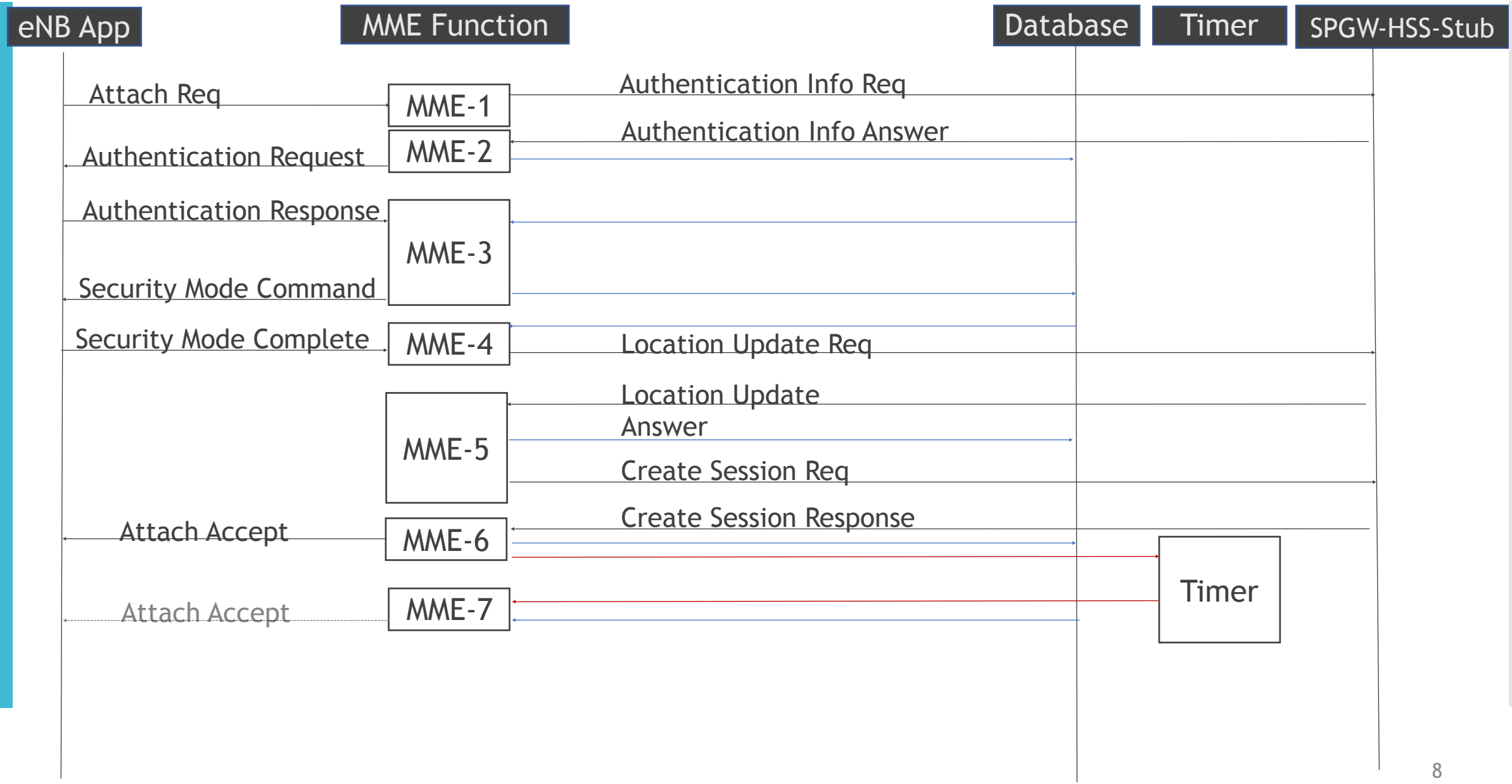

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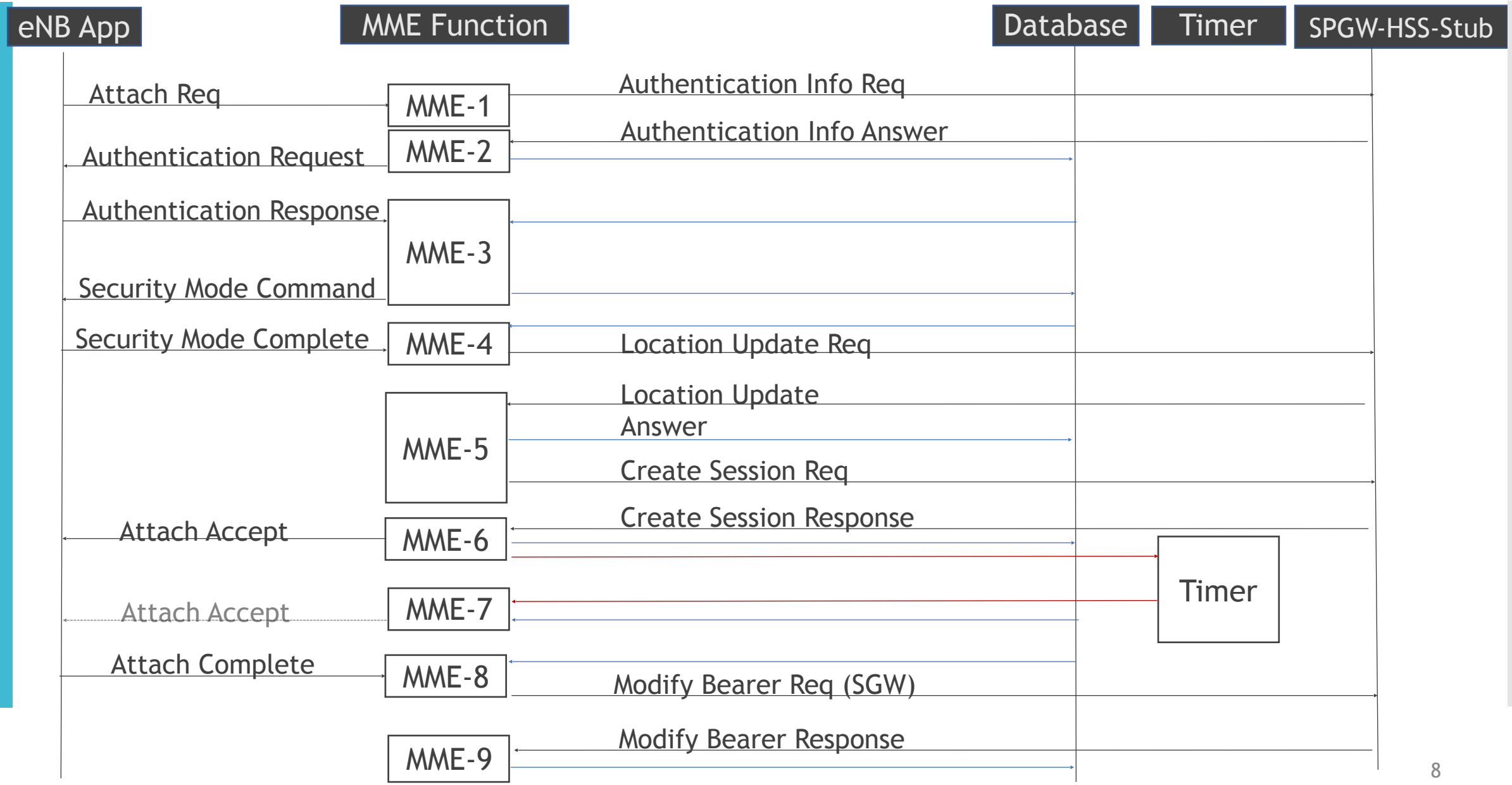
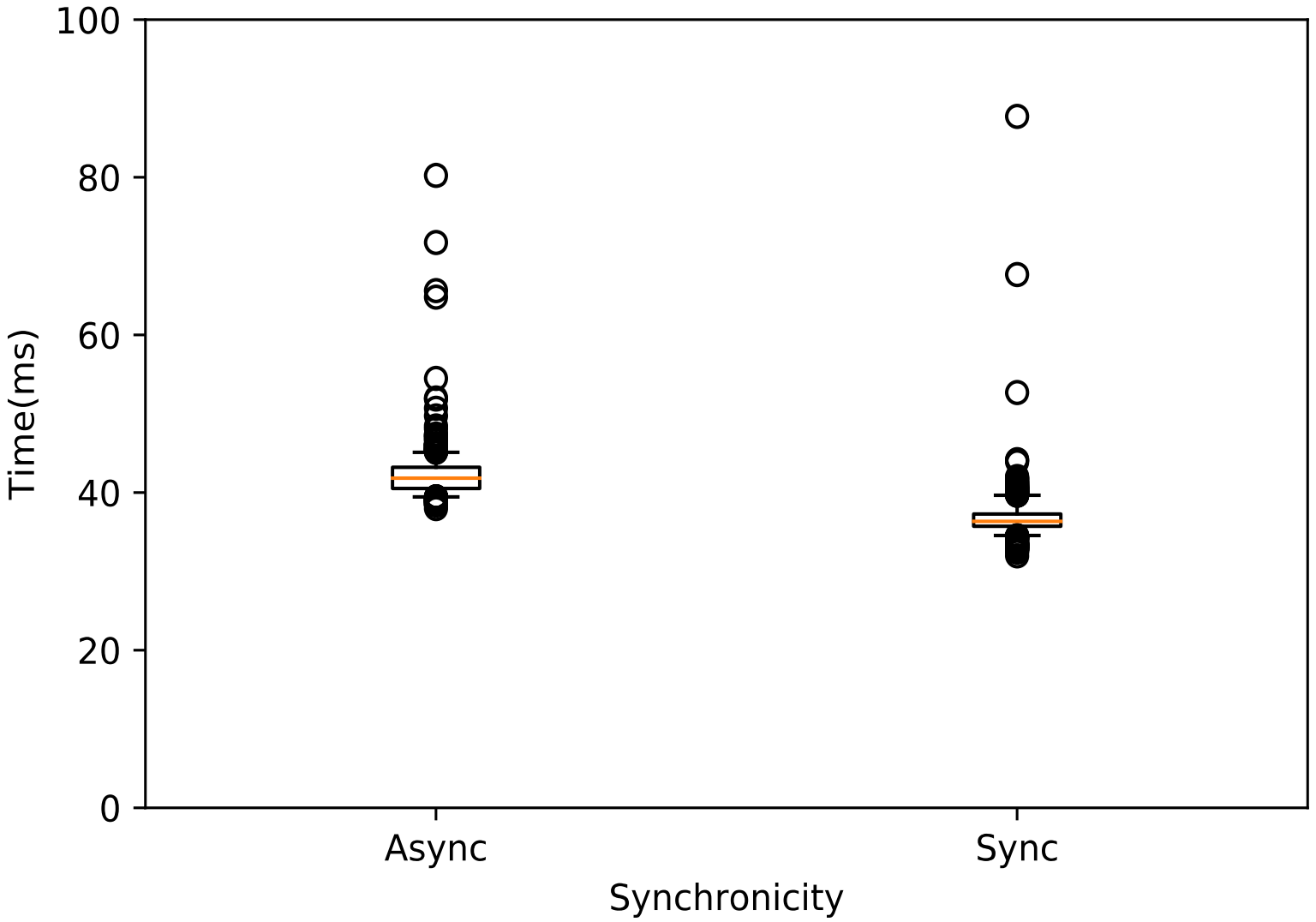


Design Principles

- Asynchronous responses
- Optimistic Concurrency Control
- State passing
- State Separation
- 3GPP timers

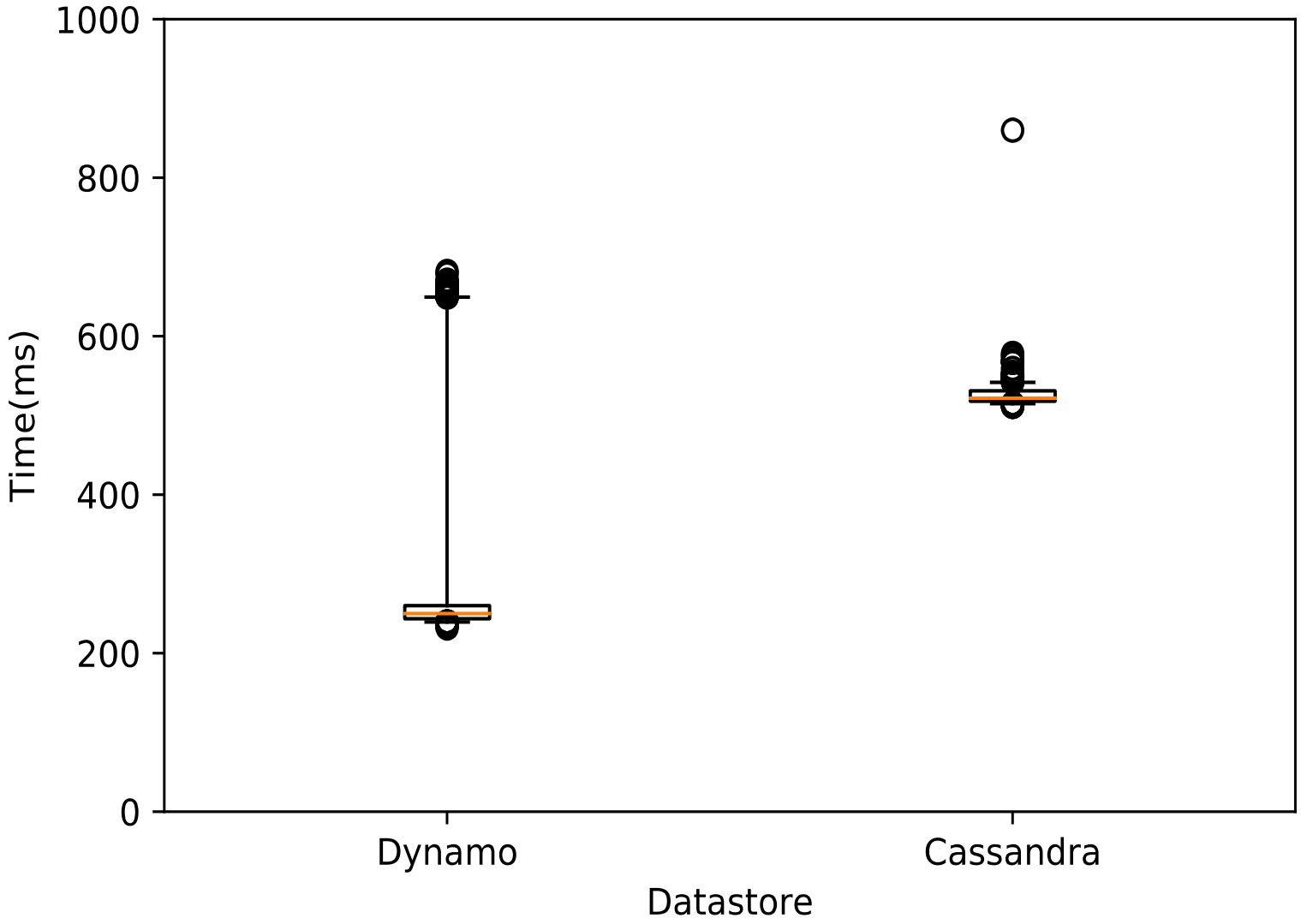
Evaluation

Evaluation – MME OpenFaaS



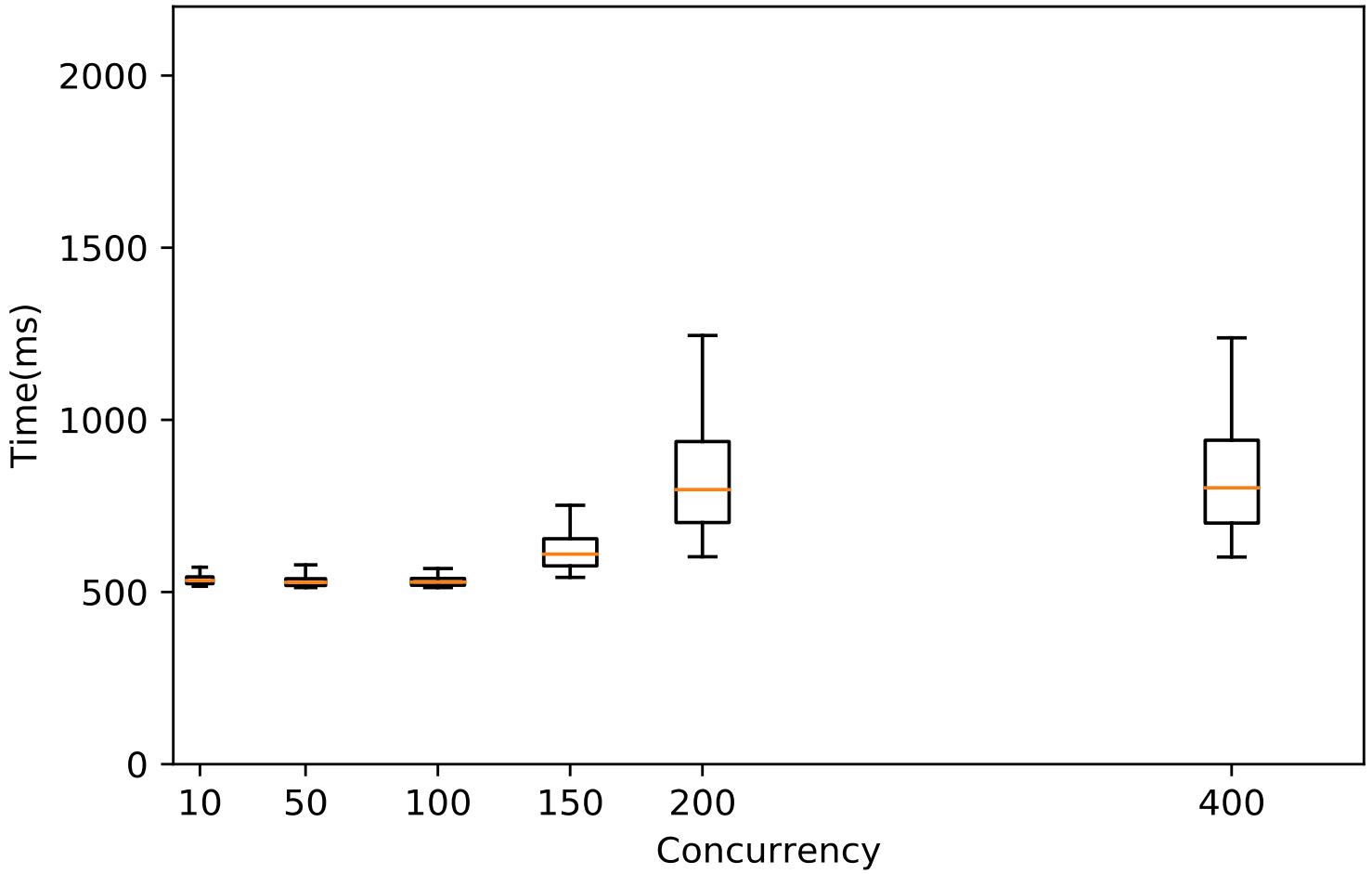
3GPP timer – UE side – Attach sent : Attach Accept – 15s

Evaluation – MME AWS Lambda



OpenEPC – 450ms OpenAirInterface – 1800ms

Evaluation – Concurrency



Cassandra DB

Evaluation – Why Cost?

- Functionality broken into measurable pieces
- Modelling of all interactions
- Cost can be predicted
- No way to compare with real deployments

Evaluation – Cost : 1 Attach

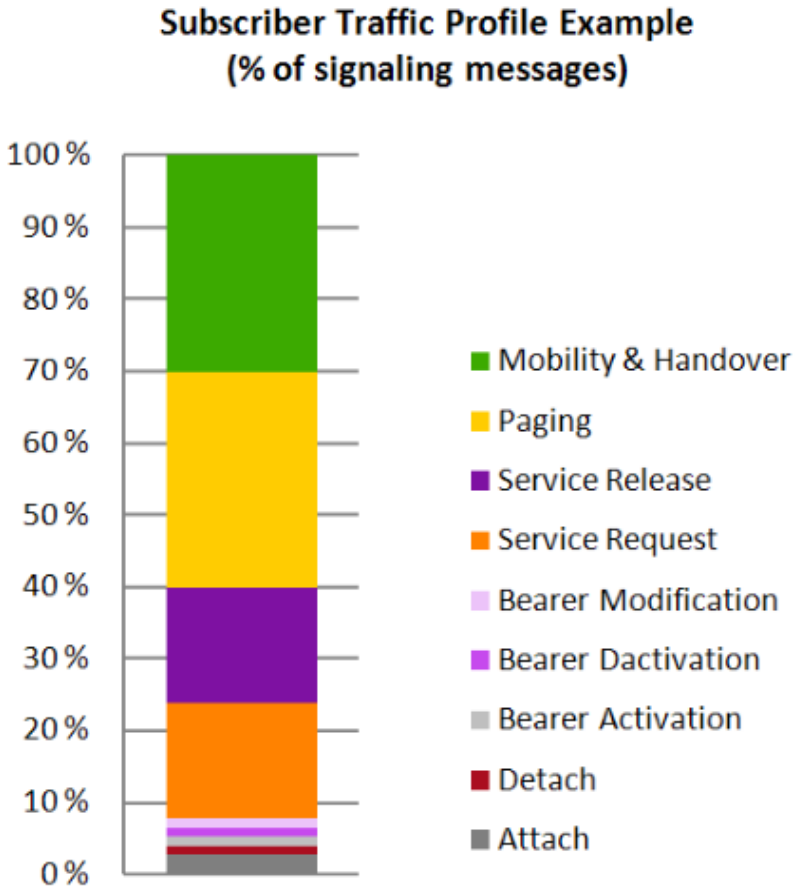
Based upon AWS Pricing

Cost element	Price per Attach	Percentage
Requests	0.0002 cents	4.5
Duration	0.0002 cents	4.5
API Gateway	0.0035 cents	75
DynamoDB Read	0.000100 cents	2.5
DynamoDB Write	0.000625 cents	13.5

0.00465 cents per Attach, **$46.50** for **1M** Attaches

Evaluation – Cost : Example distribution

- We estimated cost for each of the procedure (details not discussed here)
- **1M events costs $12.5**
- 111.6M transactions per busy hour for 1M subscribers
- **Busy hour traffic for 1M subscribers costs $1400**



Example Source: Nokia Seimens. Signaling is growing 50% faster than data traffic. https://docplayer.net/ 6278117-Signaling-is-growing-50-faster-than-data-traffic.html.

Future Work

Future work

- Compliance – 4G or 5G
- Cost – API Gateway
- Cold start delay
- High availability

Q&A

Serverless for MME

Low latency

Cost