4G/LTE Security

Satyendra Gurjar

March 2013

LTE Network Architecture Overview

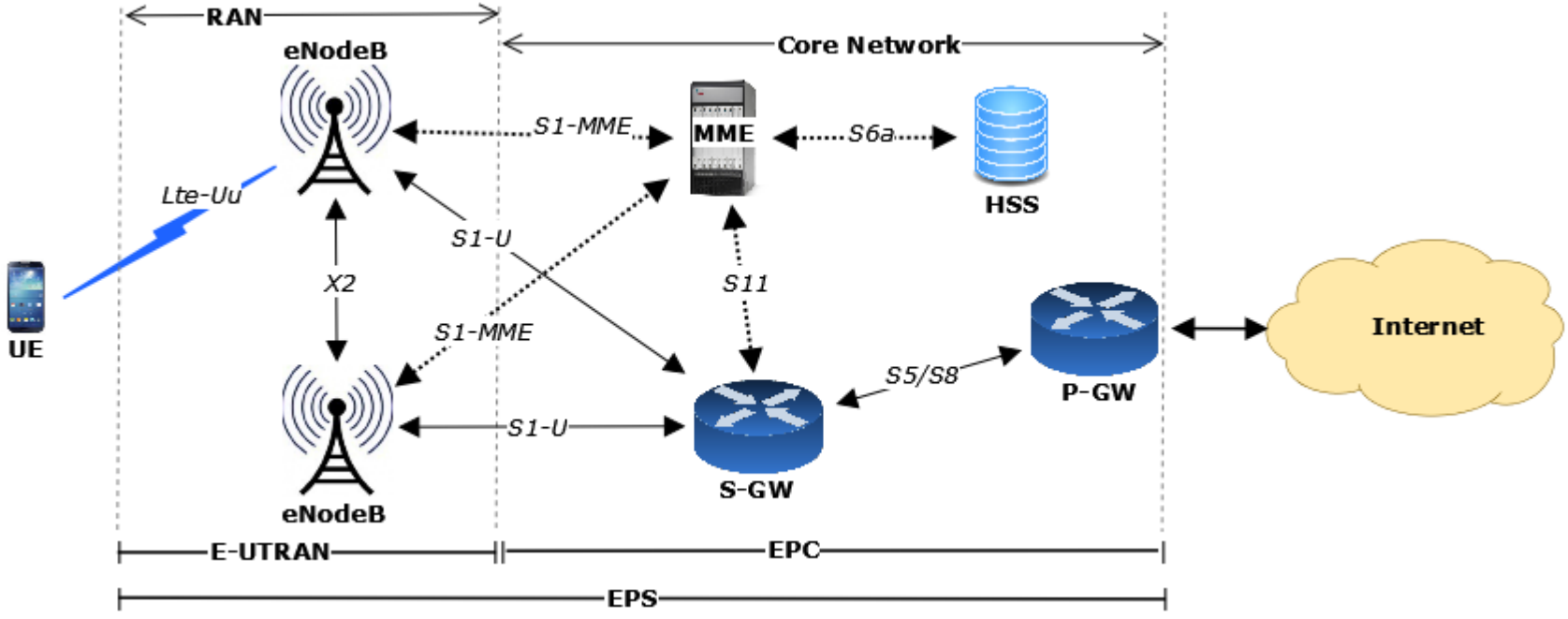


Figure: LTE Network Architecture

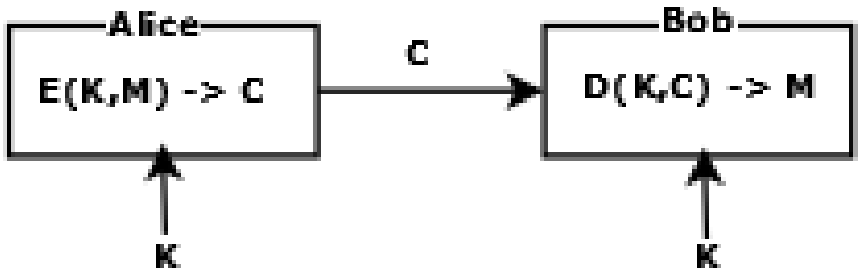
Cryptography Overview

- Symmetric Ciphers

Cryptography Overview

- Symmetric Ciphers
  - Protects **Confidentiality**

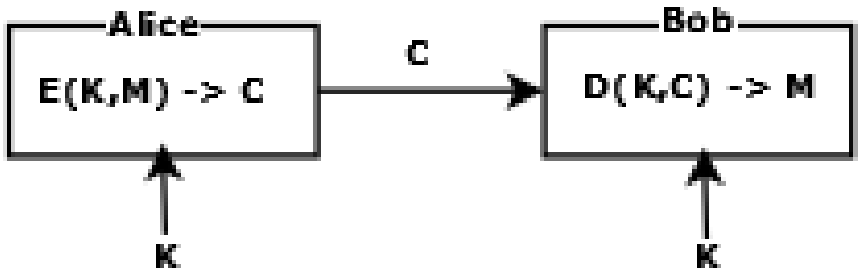
Sym Cipher (E,D,K)



Cryptography Overview

- Symmetric Ciphers
  - Protects **Confidentiality**

Sym Cipher (E,D,K)

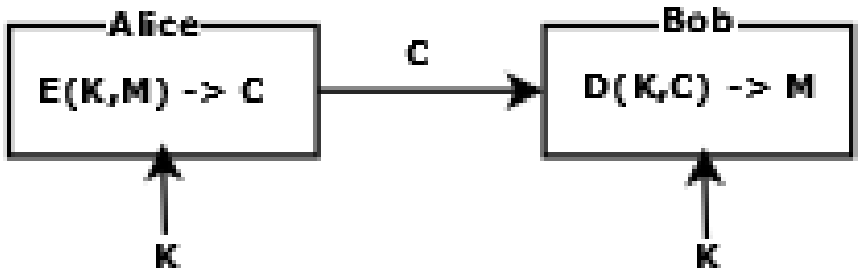


- Message Authentication Code (MAC)

Cryptography Overview

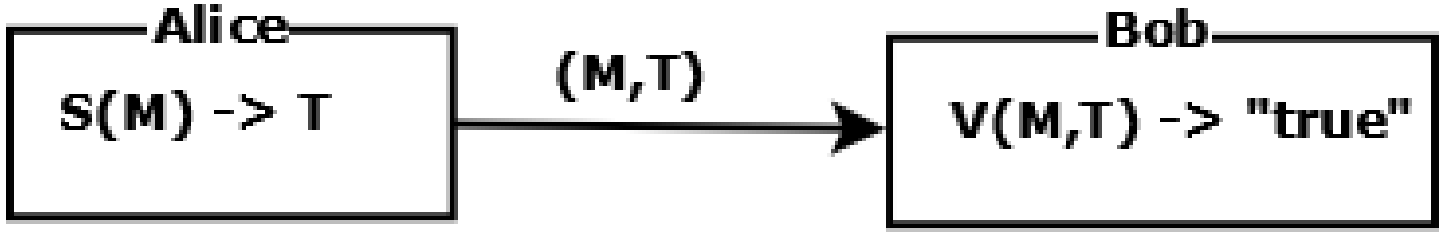
- Symmetric Ciphers
  - Protects **Confidentiality**

Sym Cipher (E,D,K)

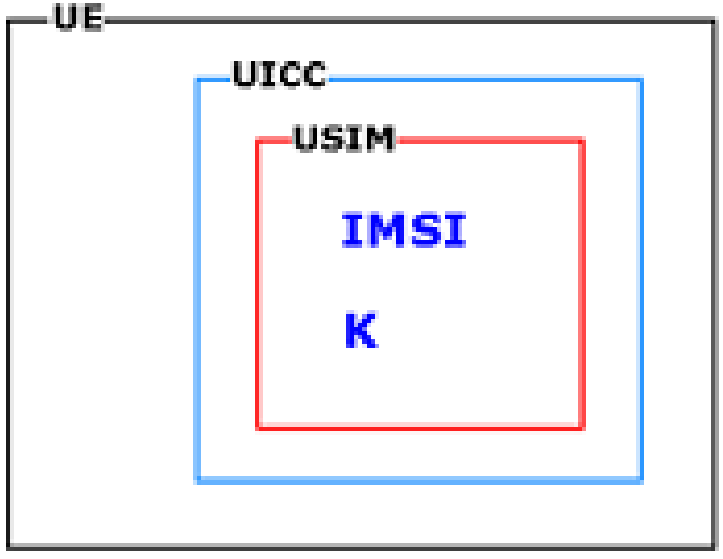


- Message Authentication Code (MAC)
  - Protects **Integrity**, no confidentiality.

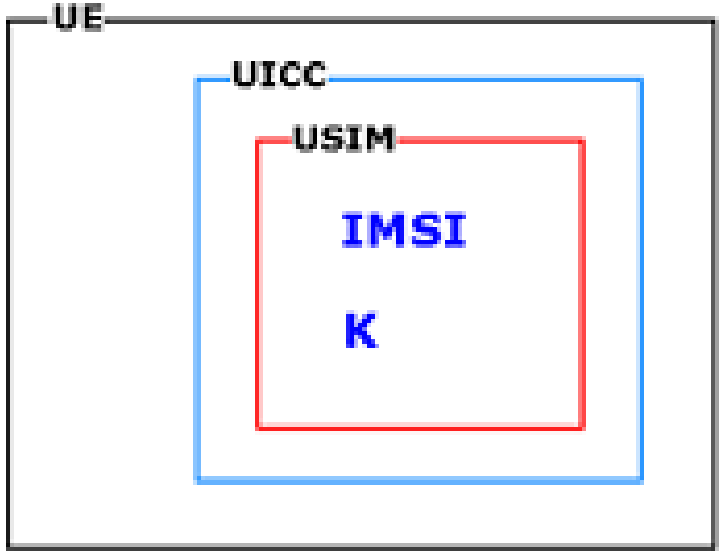
MAC (S,V,[K])



User Identity in 4G network

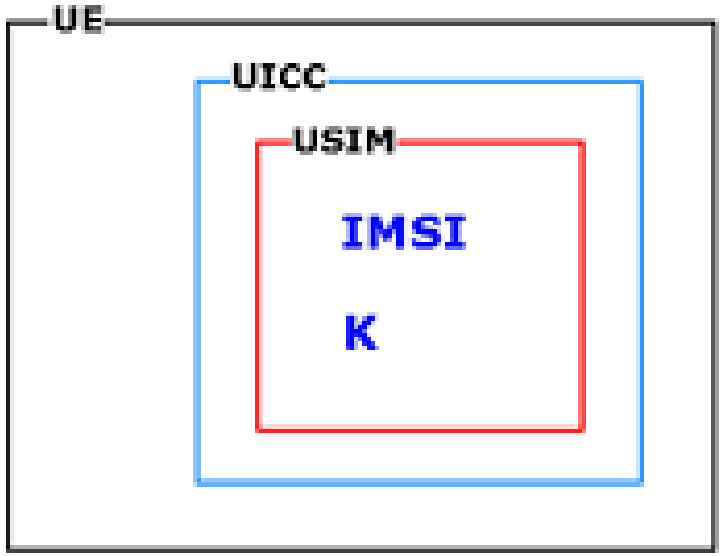


User Identity in 4G network



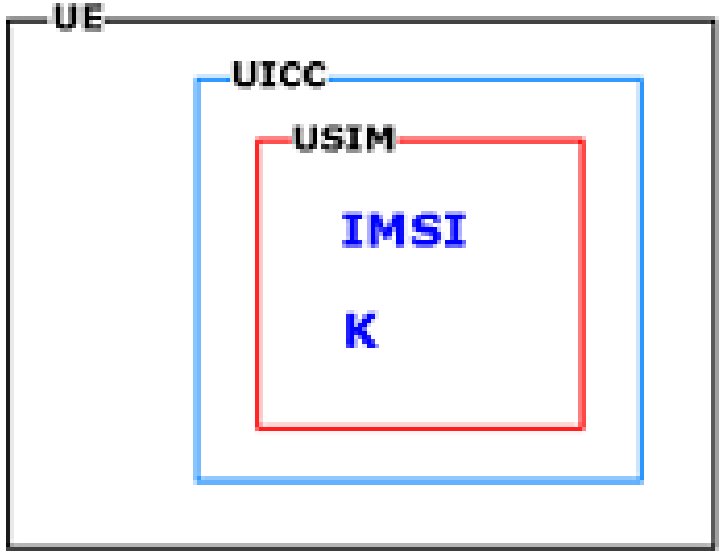
- Universal Integrated Circuit Card (UICC)

User Identity in 4G network

- 

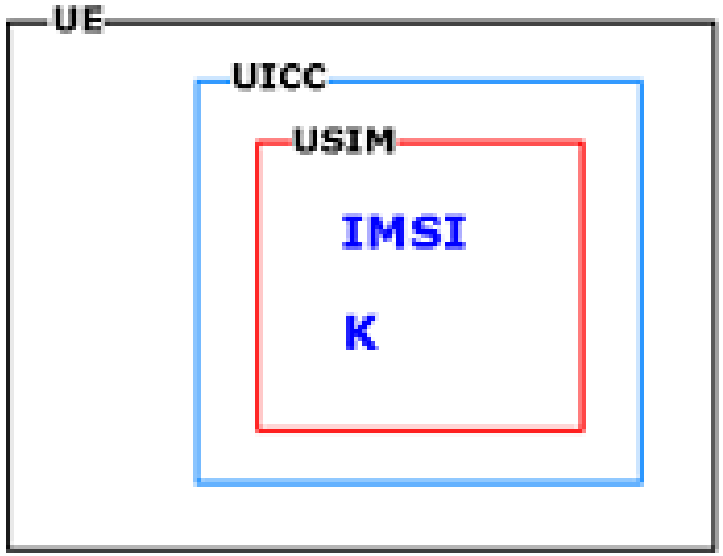
- Universal Integrated Circuit Card (UICC)
- USIM (Universal Subscriber identity module)

User Identity in 4G network

- 

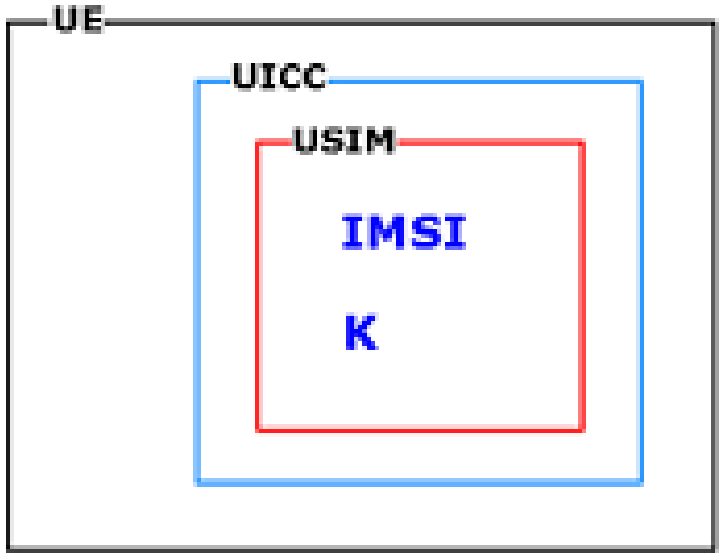
- Universal Integrated Circuit Card (UICC)
- USIM (Universal Subscriber identity module)
- User's permanent identity

User Identity in 4G network

- 

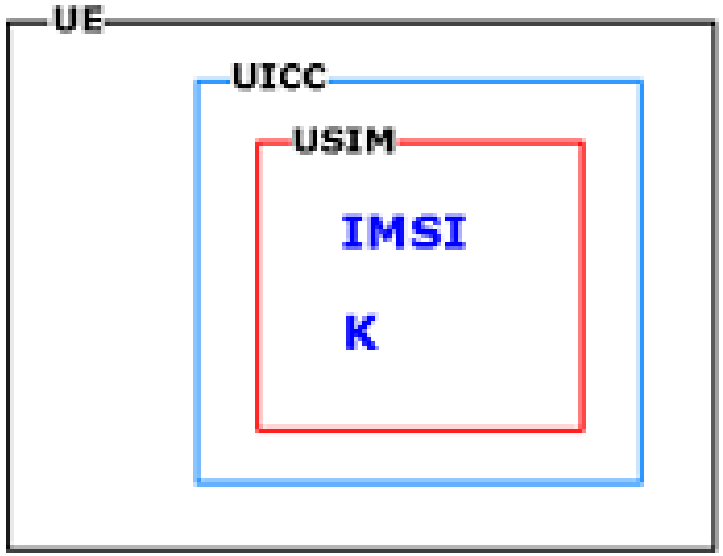
- Universal Integrated Circuit Card (UICC)
- USIM (Universal Subscriber identity module)
- User's permanent identity
  - International Mobile Subscriber Identity (IMSI)

User Identity in 4G network



- Universal Integrated Circuit Card (UICC)
- USIM (Universal Subscriber identity module)
- User's permanent identity
  - International Mobile Subscriber Identity (IMSI)
- User's shared secret

User Identity in 4G network



- Universal Integrated Circuit Card (UICC)
- USIM (Universal Subscriber identity module)
- User's permanent identity
  - International Mobile Subscriber Identity (IMSI)
- User's shared secret
  - Permanent key, K

Authentication and key agreement (AKA)

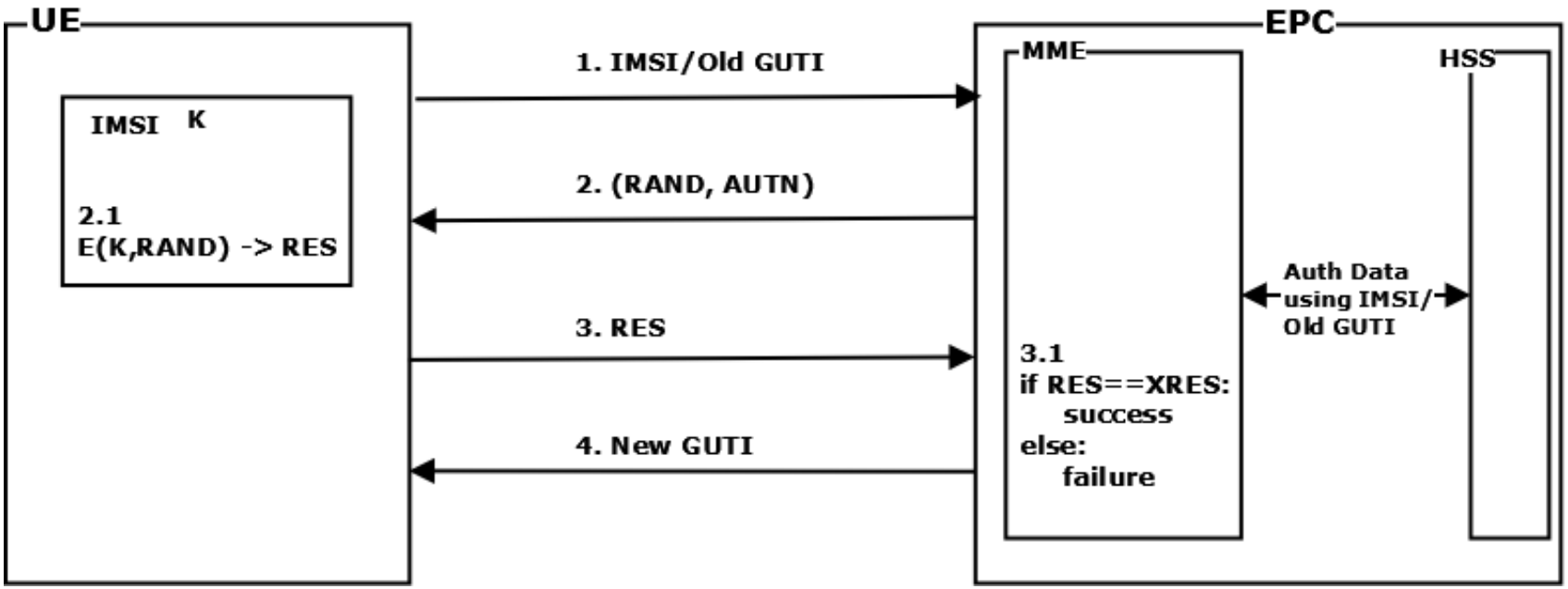


Figure: Authentication and key agreement

Authentication and key agreement (AKA)

- UE connectivity is established in following steps:
  1. System acquisition & RRC connection establishment
  2. Intial Attach
  3. Authentication
  4. NAS security establishment
  5. AS security establishment
  6. PDN connectivity and IP address allocation

Authentication and NAS security establishment

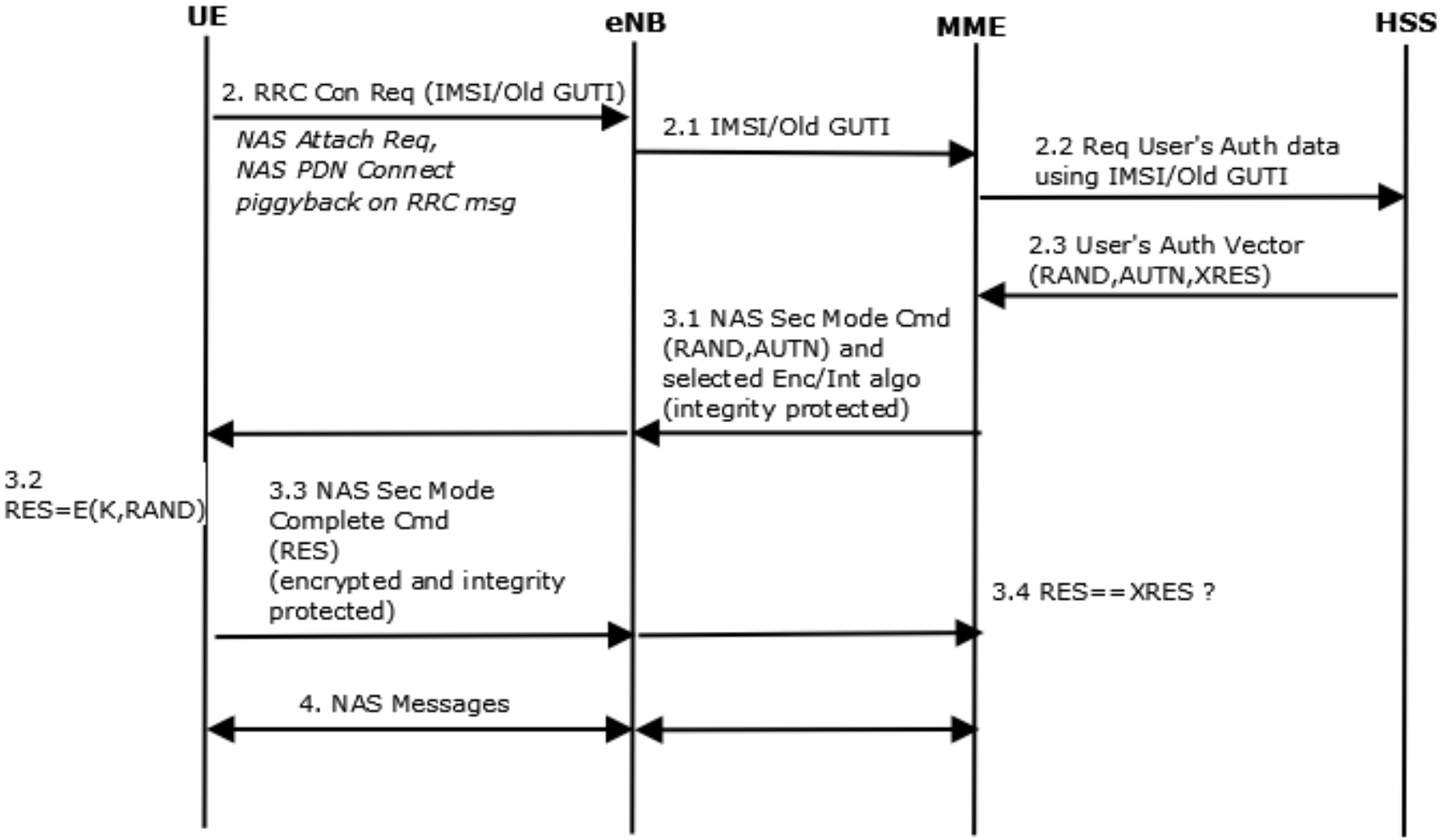
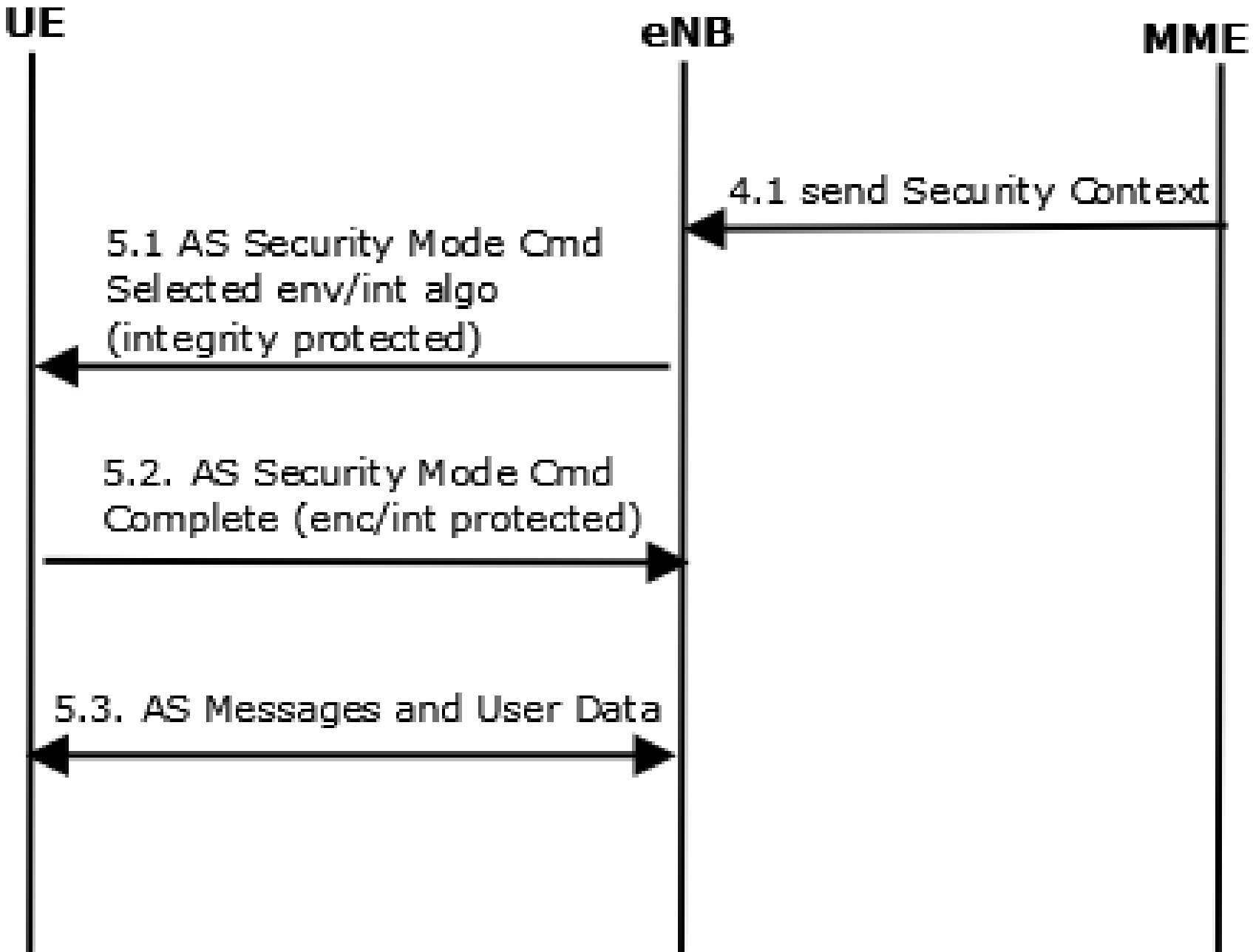


Figure: Authentication and NAS security establishment

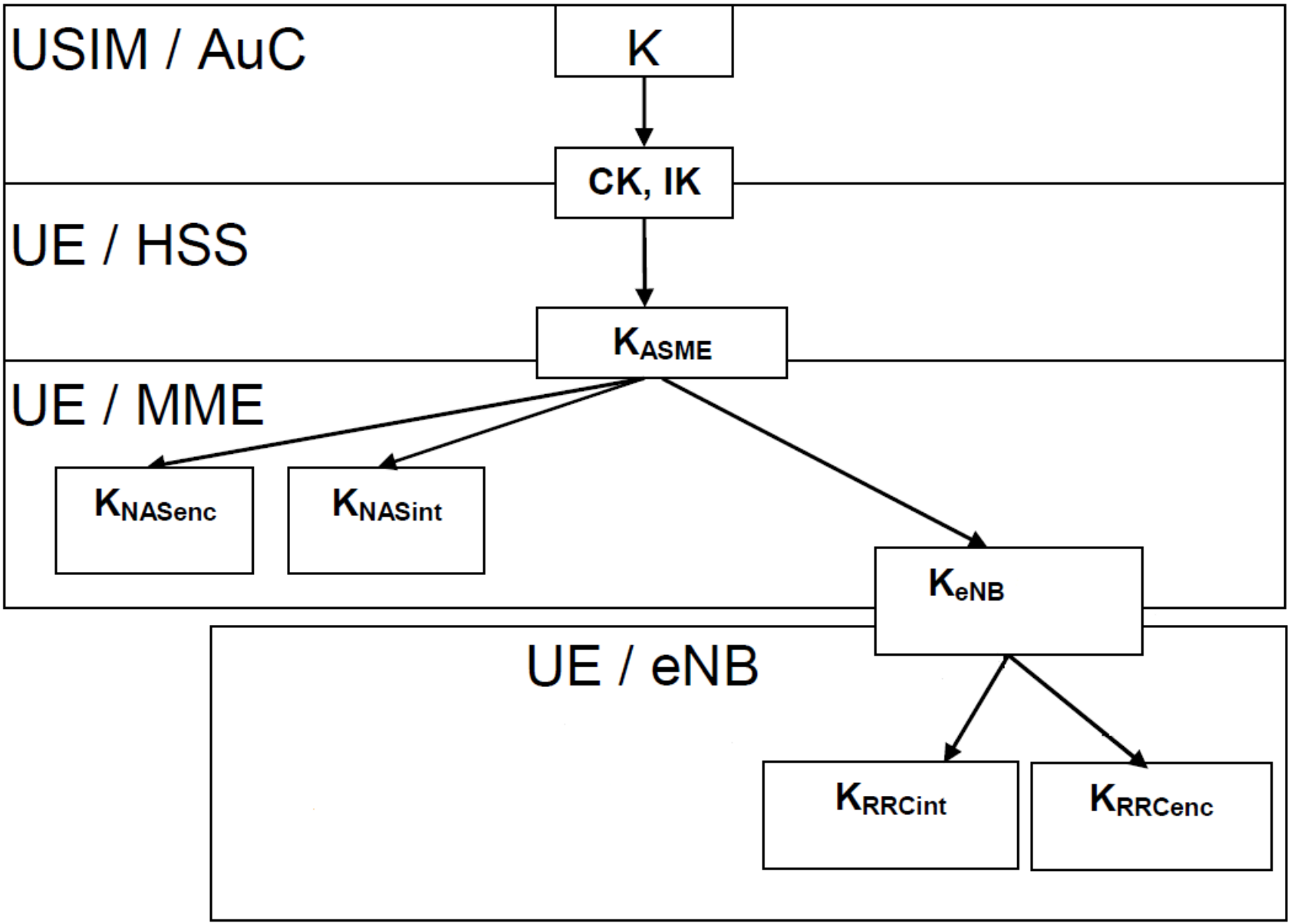
AS security establishment



PDN connectivity and IP address allocation

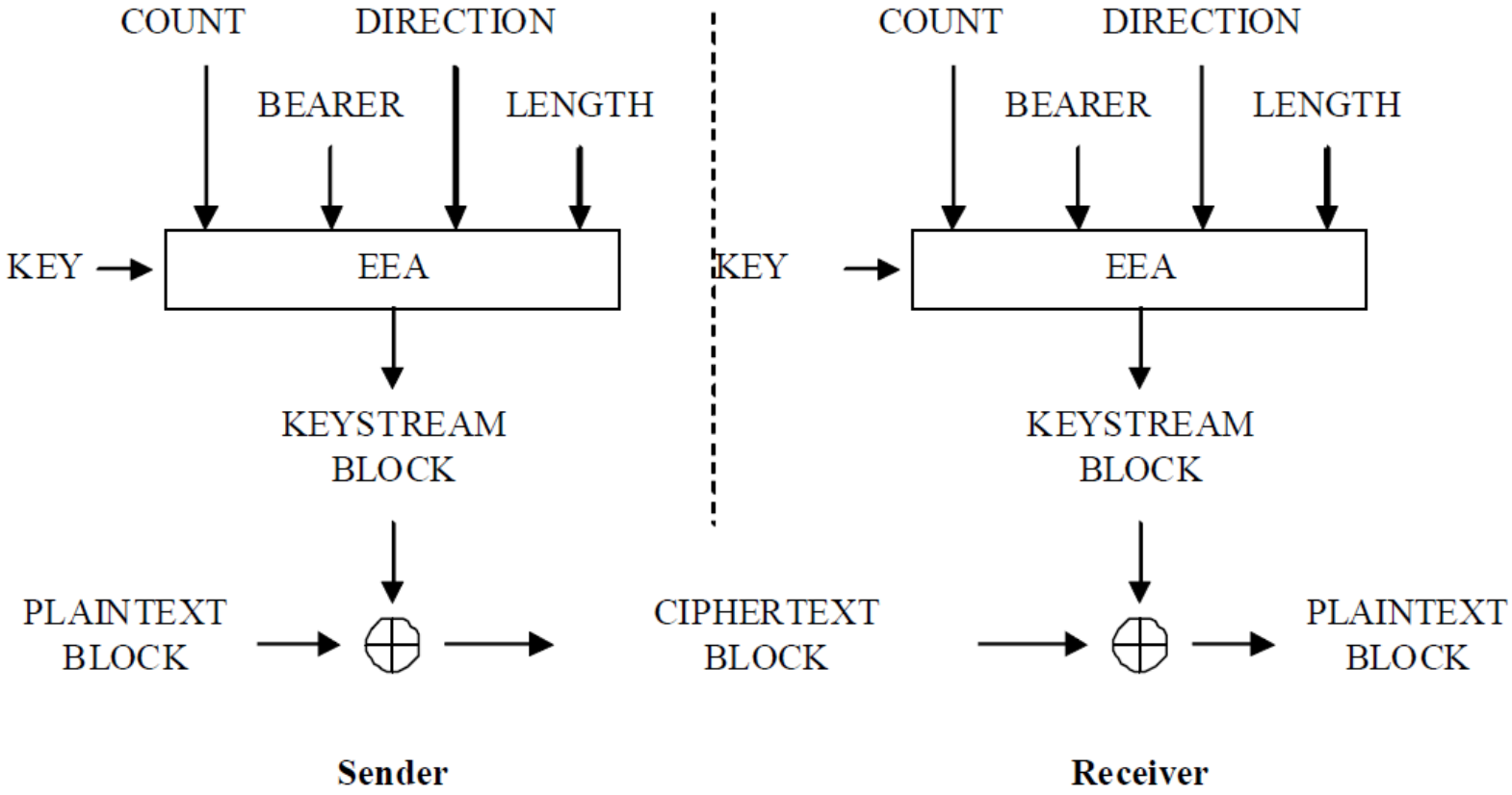
- When the RRC connection was setup, the UE had piggybacked two NAS messages. The second of those messages, the PDN Connectivity Request, caused the MME to establish a default bearer for user traffic between the UE and a P-GW after authentication was completed.
- As part of the bearer establishment in the EPC, the P-GW allocated an IP address for the UE. The IP address is delivered to the UE in the NAS Activate Default EPS Bearer Context Request message.

EPS key hierarchy



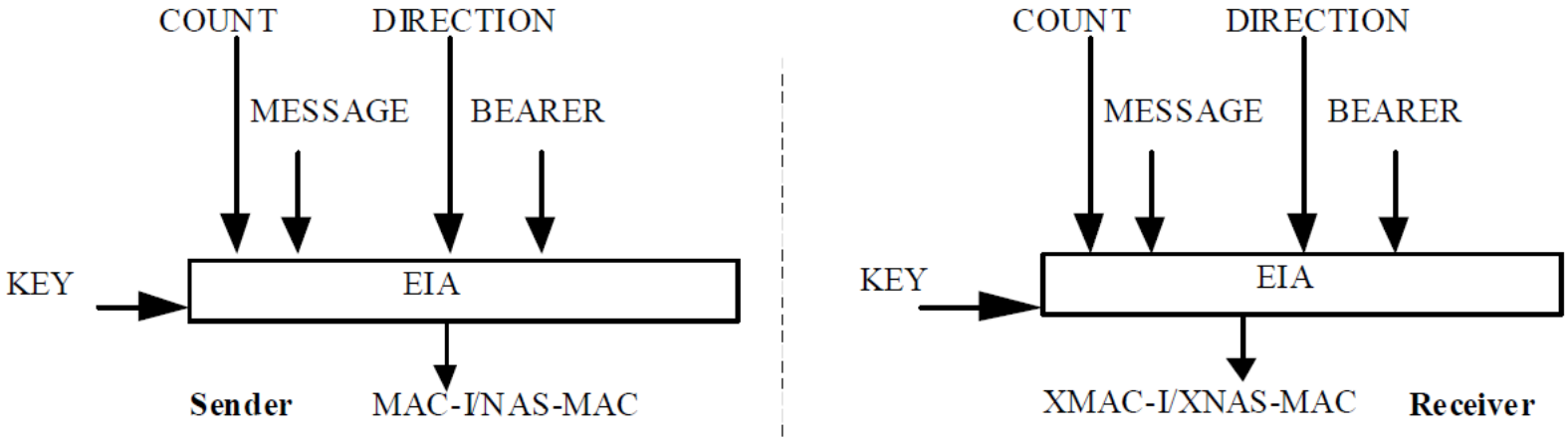
Algorithms for ciphering and integrity protection

- Ciphering Algorithms



EPS key hierarchy

- Integrity Algorithms



Questions/Comments