Formal verification of the 5G EAP-TLS authentication protocol using Proverif

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Proverif

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  - Perfect cryptography assumption:
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- Based on applied π-calculus;

5G EAP-TLS protocol entities

- Home Network (HN):
  - Authentication Server Function (AUSF)
    - Certificate $CERT_{AUSF}$
  - Unified Data Management (UDM)
    - Authentication Credential Repository and Processing Function (ARPF)
    - Subscription Identifier De-concealing Function (SIDF)

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- User Equipment (UE):
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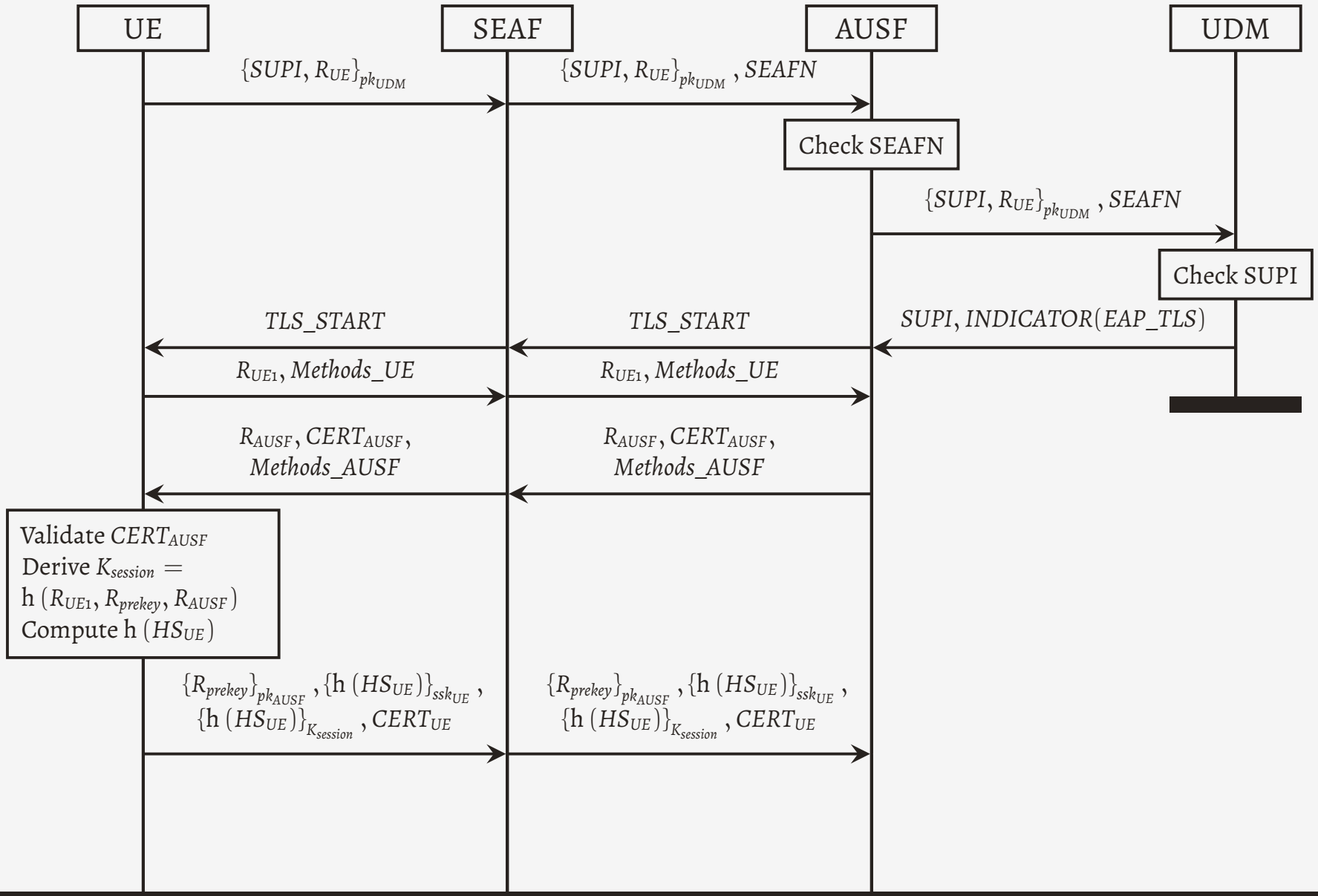
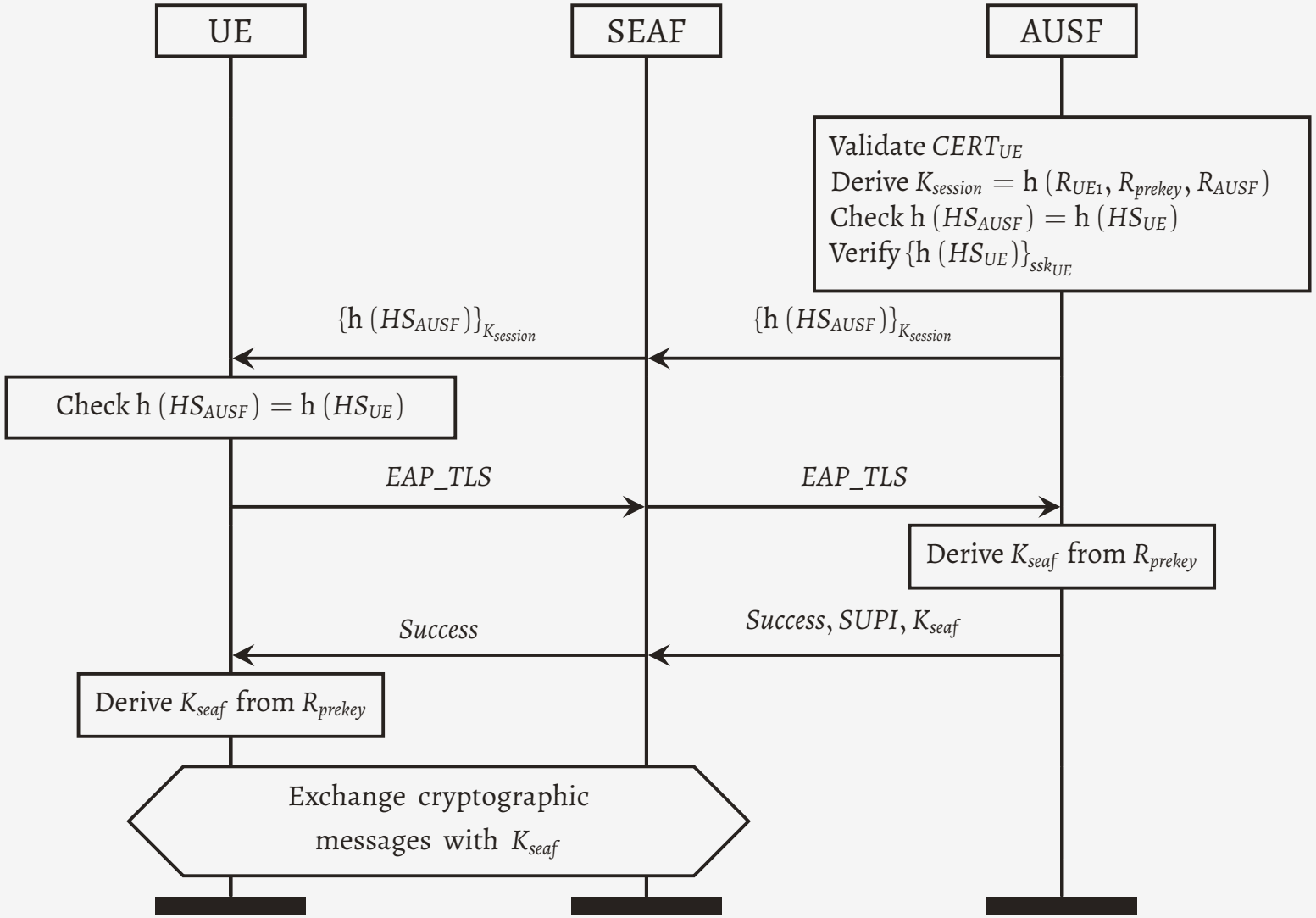
Assumptions:

- HN $\leftrightarrow$ SN communications are secure

5G EAP-TLS protocol execution I



5G EAP-TLS protocol execution II



Required security properties

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- **Authentication properties**:
  - A1. Both the home network and the subscriber should agree on the identity of each other after successful termination
  - A2. Both the home network and the subscriber should agree on the pre-master key R_{prekey} after successful termination

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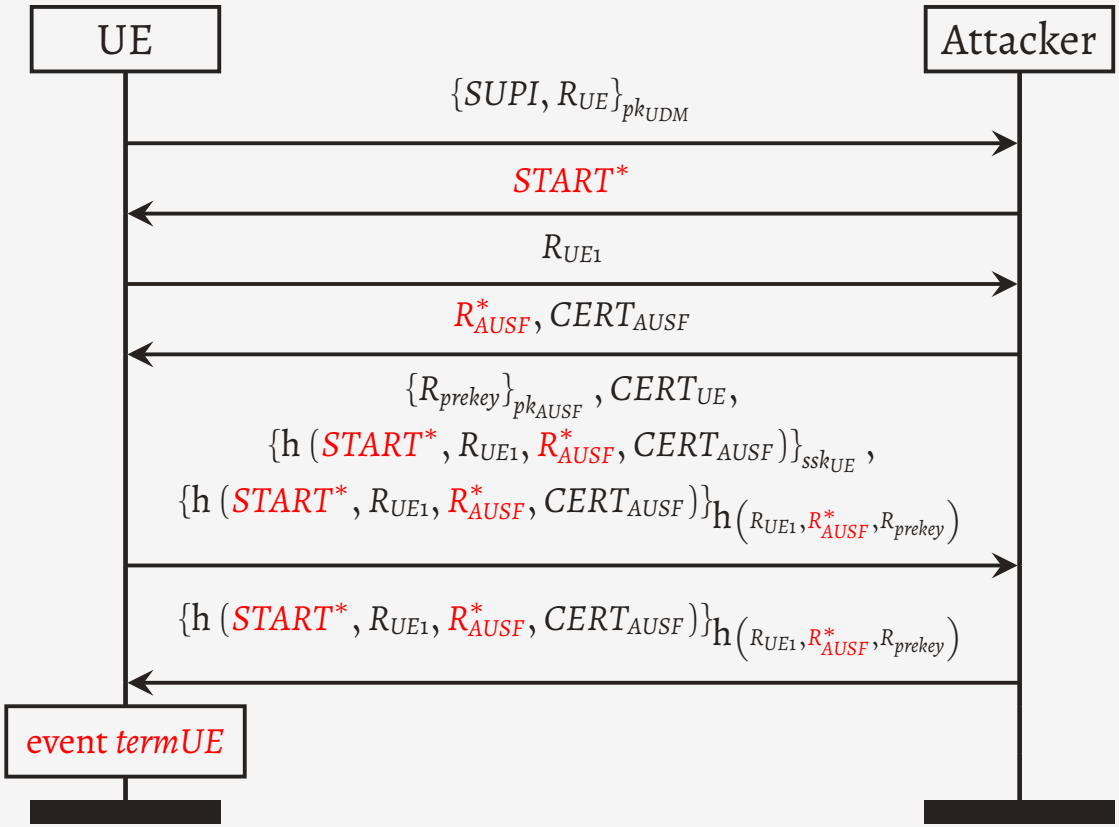
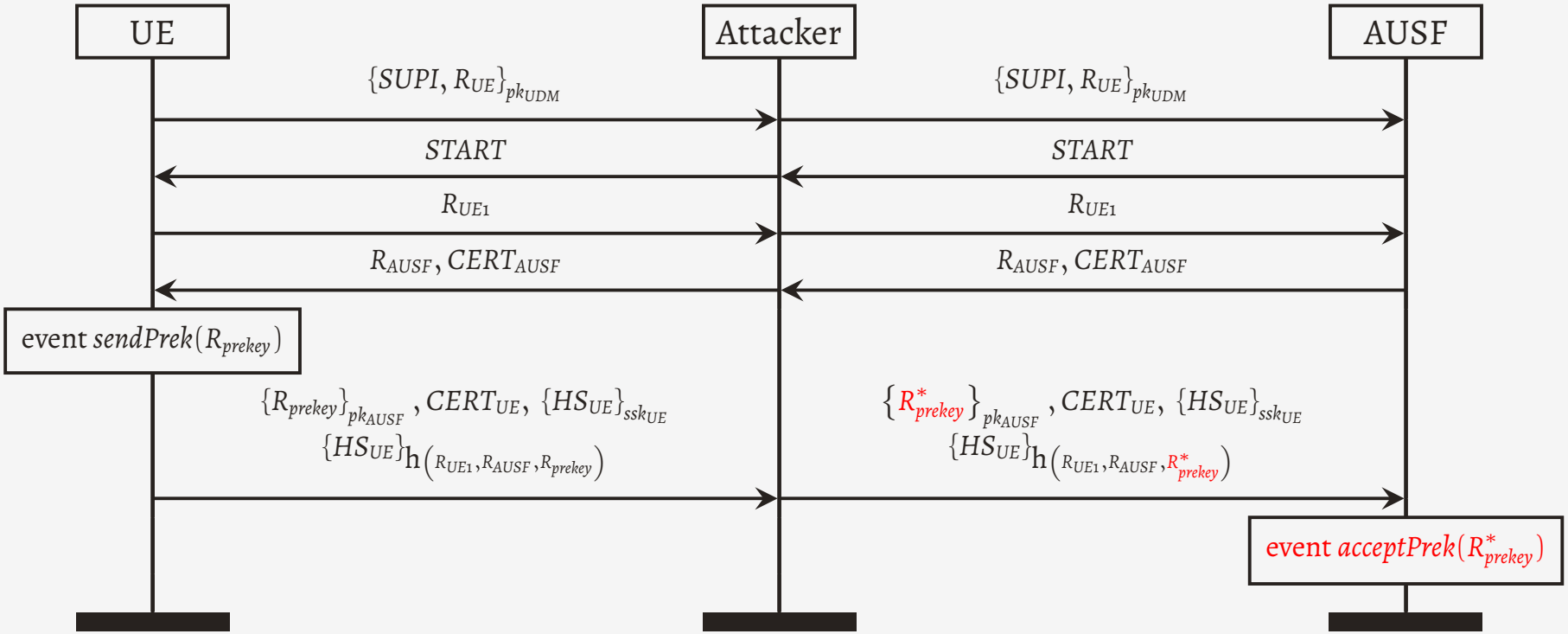
- **Authentication properties**:
  - A1. Both the home network and the subscriber should agree on the identity of each other after successful termination
  - A2. Both the home network and the subscriber should agree on the pre-master key R_{prekey} after successful termination
- **Secrecy properties**:
  - S1. The attacker cannot obtain the identity *SUPI* of an honest subscriber
  - S2. The attacker cannot obtain the pre-master key R_{prekey} of an honest subscriber
  - S3. The attacker cannot obtain the session key $K_{session}$ of an honest subscriber

It's ***DEMO*** time!!

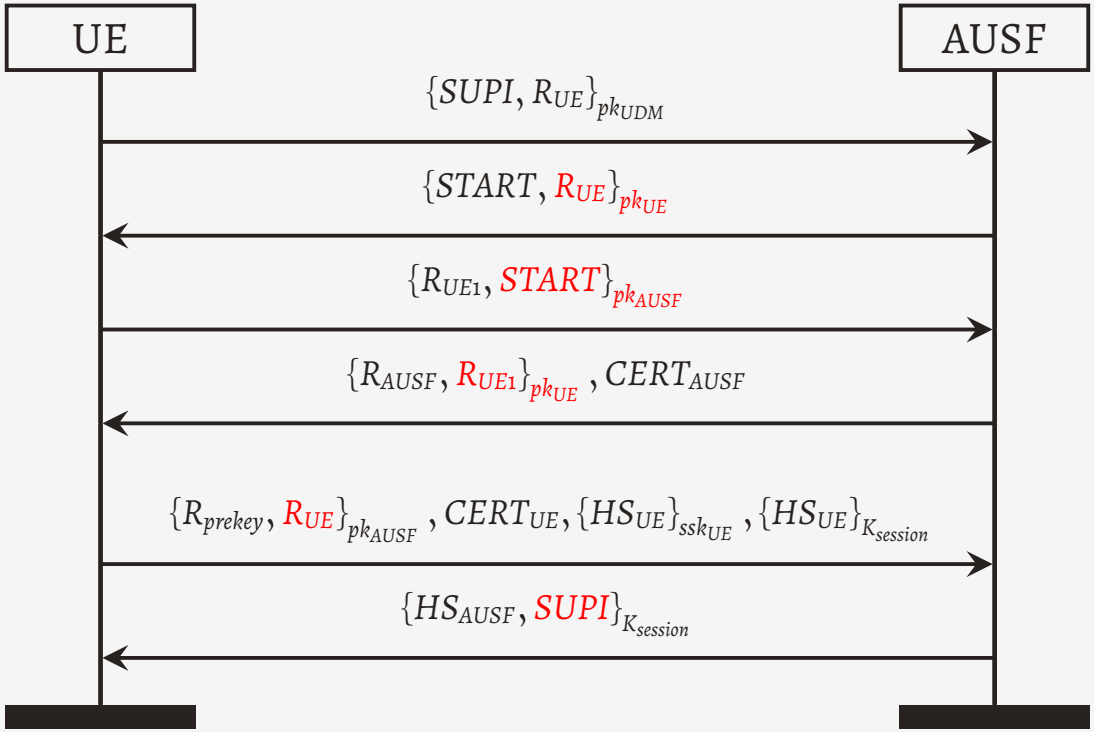
Counterexample for property A1



Counterexample for property A2



Fixing the protocol



THANKS

for your attention!!