The 5G-AKA Authentication Protocol Privacy

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work done while at the LSV, ENS Paris-Saclay

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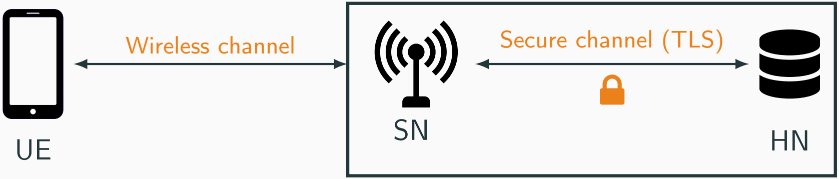
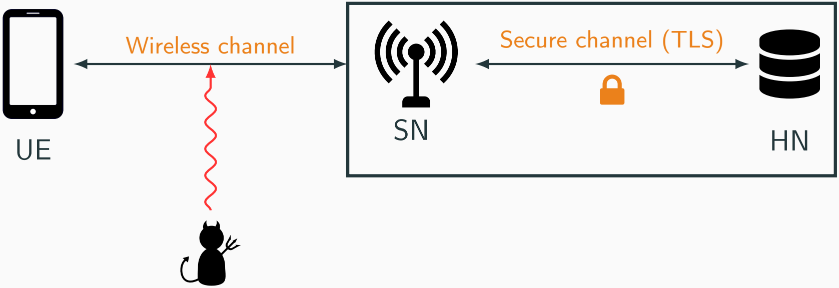
The 4G-AKA and 5G-AKA Protocols

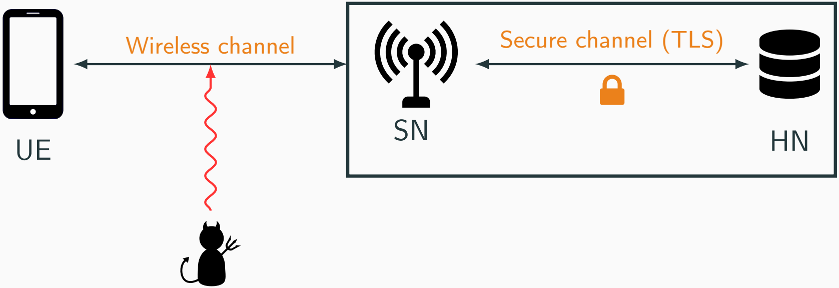
Authentication and Key Agreement Protocol



Authentication and Key Agreement Protocol



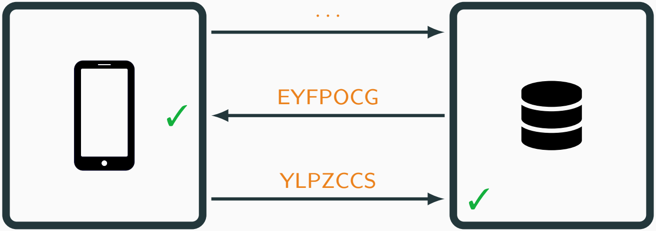
Authentication and Key Agreement Protocol



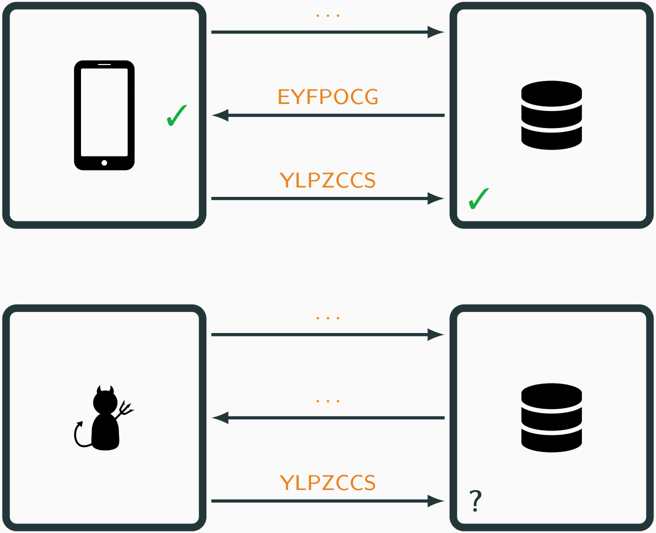
Security Properties

- **Mutual authentication** between the user and the service provider.
- **Privacy** of the user against an outside observer.

Authentication Protocol



Authentication Protocol



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EYFPOCG

✓

YLPZCCS

✓

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YLPZCCS

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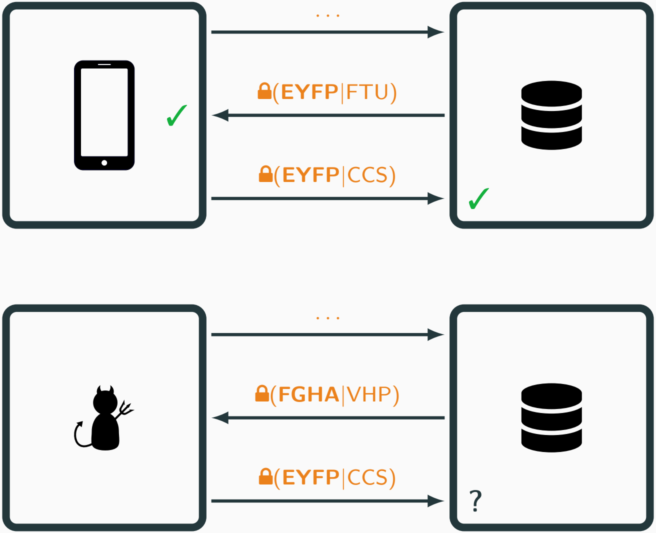
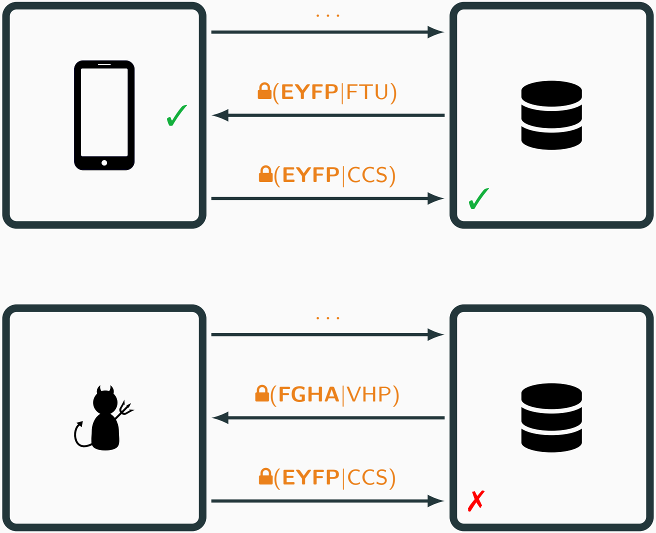
Authentication Protocol



Authentication Protocol



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🔒(**EYFP**|FTU)

✓

🔒(**EYFP**|CCS)

✓

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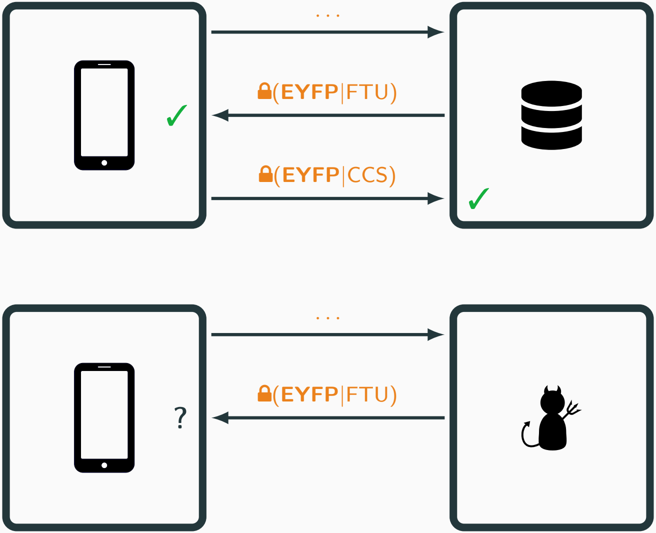
🔒(**FGHA**|VHP)

🔒(**EYFP**|CCS)

✗

Authentication Protocol



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🔒(**EYFP**|FTU)

✓

🔒(**EYFP**|CCS)

✓

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🔒(**EYFP**|FTU)

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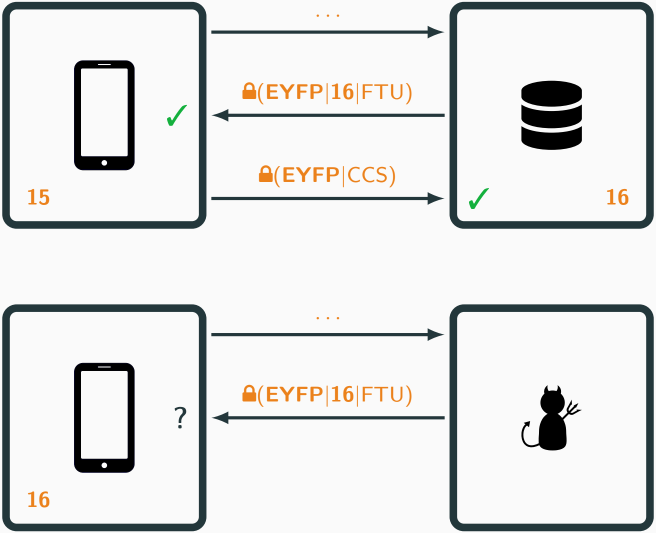
Authentication Protocol



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🔒(**EYFP**|**16**|FTU)

✓

🔒(**EYFP**|CCS)

15

✓

16

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🔒(**EYFP**|**16**|FTU)

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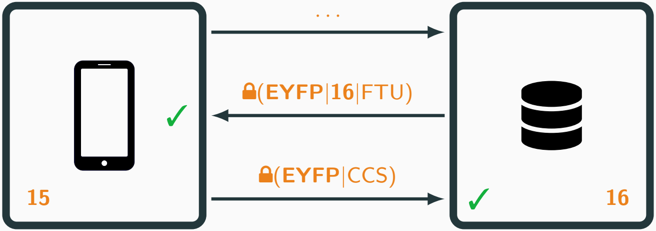
16

Authentication Protocol



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🔒(**EYFP**|**16**|FTU)

🔒(**EYFP**|CCS)

✓

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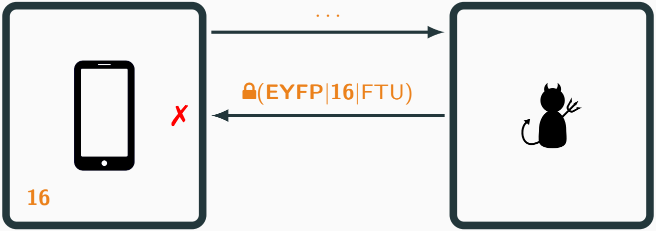
15

16



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🔒(**EYFP**|**16**|FTU)

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Security of the Protocol

Is this secure?

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For authentication, yes.

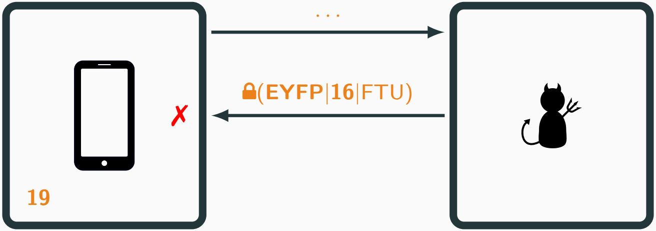
Security of the Protocol

Is this secure?

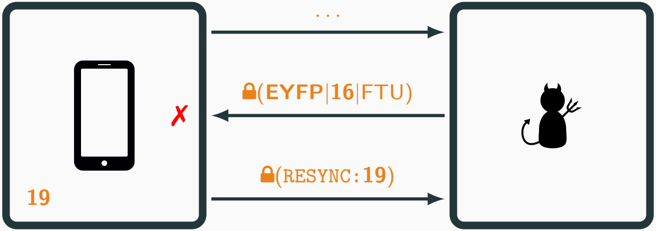
For authentication, yes.

For privacy, no.

Privacy Attack



Privacy Attack



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🔒(**EYFP**|**16**|FTU)

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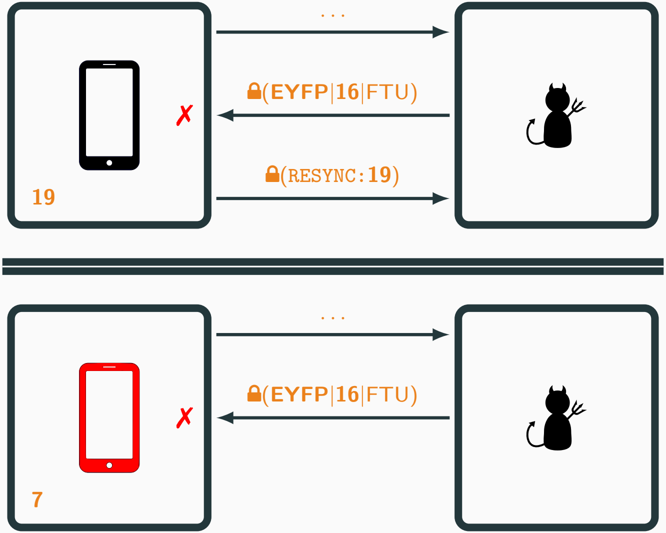
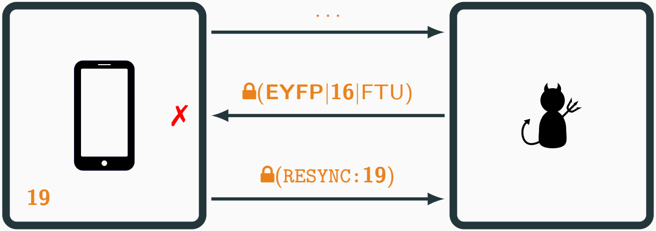
🔒(RESYNC:**19**)

19

Privacy Attack



Privacy Attack



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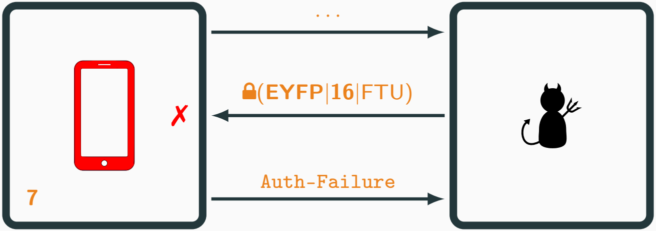
🔒(EYFP|16|FTU)

🔒(RESYNC:19)

19



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🔒(EYFP|16|FTU)

Auth-Failure

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Unlinkability

Privacy Attack

The adversary breaks the user privacy by finding **links between the user sessions** of the protocol.

Unlinkability

Privacy Attack

The adversary breaks the user privacy by finding **links between the user sessions** of the protocol.

Unlinkability

The adversary **cannot track** a user through its protocol sessions.

Goal

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Design a modified version of AKA, called AKA^{+}, such that:

- Provides some form of **unlinkability**.

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- Provides some form of **unlinkability**.
- Satisfies the design and efficiency **constraints** of 5G-AKA.

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Design a modified version of AKA, called AKA$^+$, such that:

- Provides some form of **unlinkability**.
- Satisfies the design and efficiency **constraints** of 5G-AKA.
- Is **proved secure**.

Theorem

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The AKA$^+$ protocol is σ-unlinkable for **an arbitrary number of agents and sessions** when:

- The asymmetric encryption $\{\_\}_{\_}^{\_}$ is $\textsc{ind-cca}_1$.
- H and H$^{\mathsf{r}}$ (resp. Mac^1–Mac^5) are jointly $\textsc{prf}$.

Conclusion

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Contributions

- Presented the basics of the 5G-AKA protocol.
- Showed a known privacy attacks against 5G-AKA.
- Proposed a fixed version, and proved it secure in the computational model.

Thanks for your attention

References i

[Arapinis et al., 2012] Arapinis, M., Mancini, L. I., Ritter, E., Ryan, M., Golde, N., Redon, K., and Borgaonkar, R. (2012).
New privacy issues in mobile telephony: fix and verification.
In *the ACM Conference on Computer and Communications Security, CCS'12*, pages 205–216. ACM.