

Improving Mobile Security

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Outline

- 1 Background
- 2 GSM Weakness in UMTS
- 3 Application Security Threat
- 4 Electromagnetic Radiation Leaking Key Information
- 5 Conclusion

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- 1 Background
 - Cryptography
 - GSM and UMTS
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Cryptography

Cryptography or 'secret writing' is the study and practice of techniques for securing communications between two parties.

- **plain-text** Readable message to be sent during communications.
- **cipher-text** Unreadable form of the message
- **key** parameter for cryptographic algorithm or cipher
- **cipher** method for transforming plain-text
 - **Encrypt** transform plain-text to cipher-text
 - **Decrypt** transform cipher-text back into plain-text

Cryptography

- **Symmetric cryptography** Both parties share a secret key for encryption and decryption
- **Asymmetric cryptography** Each individual has a public and a private key. Parties use the public keys for encryption and the private keys for decryption

- Global System for Mobile Communications (GSM) is a 2G telecommunication standard developed in the early 90s by the European Telecommunications Institute. Has become one of the most widely used standards, reaching an 80% market share at its height.
- Universal Telecommunications Standard (UMTS) is 3G telecommunication standard based on GSM by the Third Generation Partnership Project in the early 2000s.

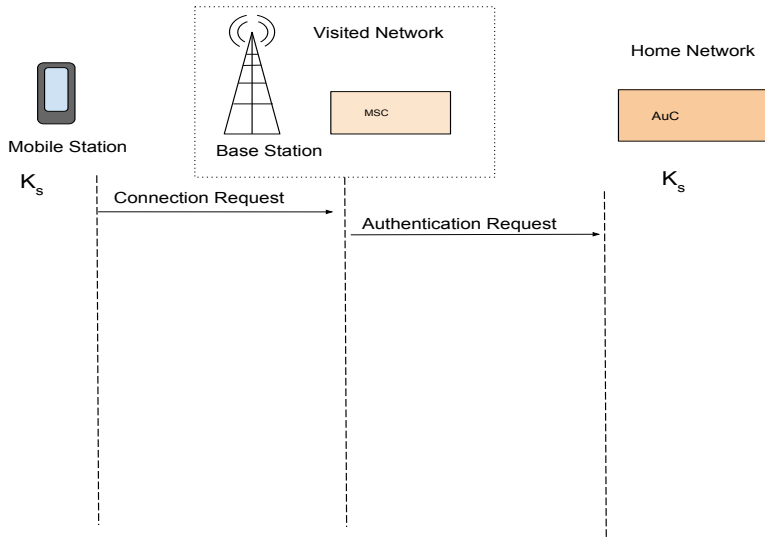
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- 1 Background
- 2 GSM Weakness in UMTS
 - Authentication
 - Man-in-the-middle Attack
 - GSM and UMTS Inter-working Networks
 - Solution
- 3 Application Security Threat
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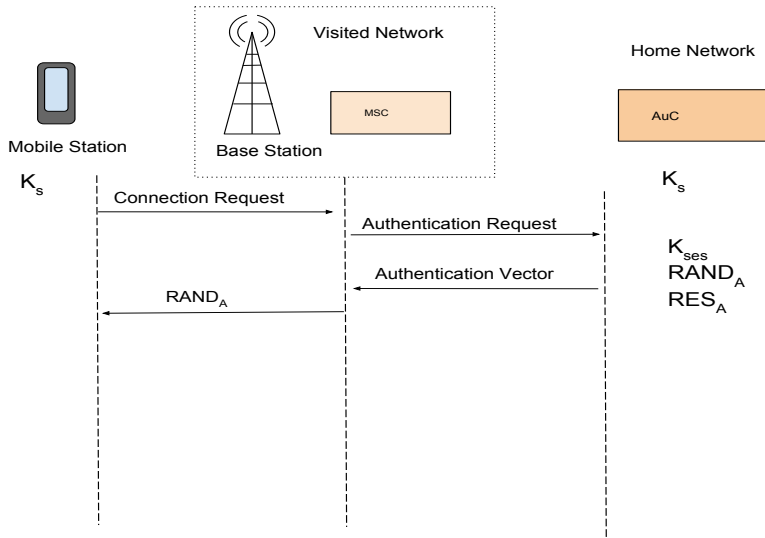
Encryption in GSM and UMTS

- GSM and UMTS both have secret keys that are shared between the mobile and the mobile's home network authentication center.
- GSM and UMTS both utilize the A5 family of encryption algorithms.
 - A5/0
 - A5/1
 - A5/2
 - A5/3

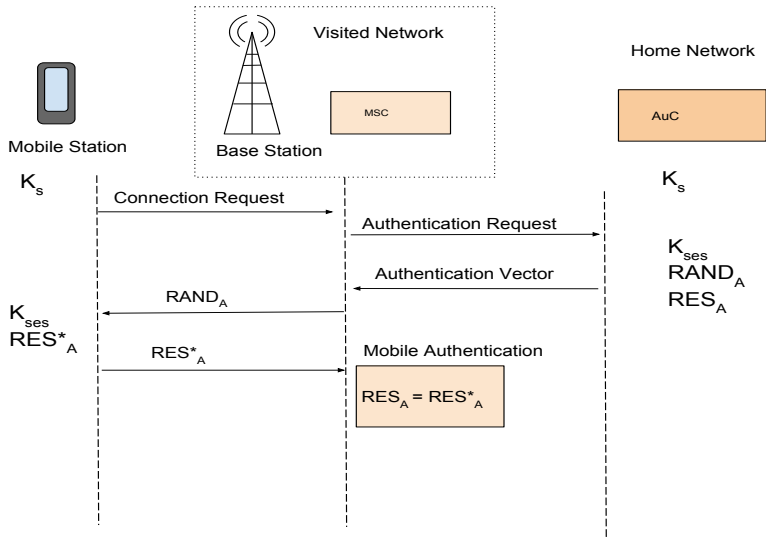
GSM Authentication



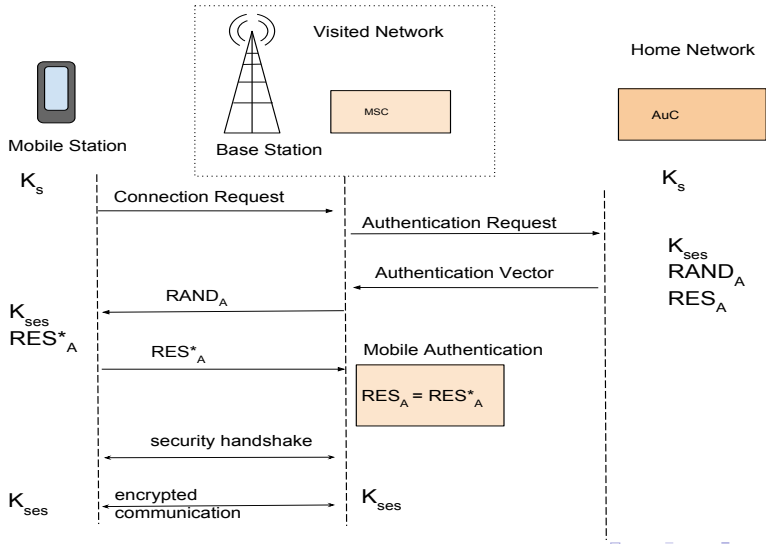
GSM Authentication



GSM Authentication

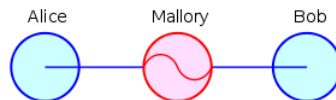


GSM Authentication



Man-in-the-middle Attack

Man-in-the-middle attack is a type of attack in Cryptography where an attacker tricks participants into sending their communications through the attacker.



Man-in-the-middle Attack

TODO: add Example Diagram of Man-in-the-middle attack modeled after example in paper.

Transitional Networks

TODO: bullet points?

There are transitional periods between old and new technologies such as GSM and UMTS are required as old infrastructure and devices are replaced with the new. During these periods both old and new technologies will need to be able to successfully interact with one another.

2011 survey where 2G devices had around 90% population coverage where as 3G only had 45%

GSM and UMTS Inter-working network

In order for GSM and UMTS systems to work all UMTS systems must be capable of performing GSM communication. For encryption this means there needs to be ways of transforming 128 bit UMTS keys into the 64 bit GSM keys

$$K_{ses} = c_3(I_K, C_{ses}) = C_{ses1} \oplus C_{ses2} \oplus I_{K1} \oplus I_{K2} \quad (1)$$

$$C_{ses} = c_4(K_{ses}) = K_{ses} \| K_{ses} \quad (2)$$

$$I_K = c_5(K_{ses}) = K_{ses1} \oplus K_{ses2} \| K_{ses} \| K_{ses1} \oplus K_{ses2} \quad (3)$$

GSM Man-in-the-middle weakness in UMTS

Protecting UMTS from GSM Man-in-the-middle attack

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Applications (Apps)

Application Permissions in Android

Application Threat keyboard Key-logger

KBS Checker

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 - Side channel attack
 - Side channel through EM
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What is a Side channel attack?

RSA Example

Ranged Side channel

Findings

Solution

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Conclusion

Questions

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