

Applying Relay Attacks to Google Wallet

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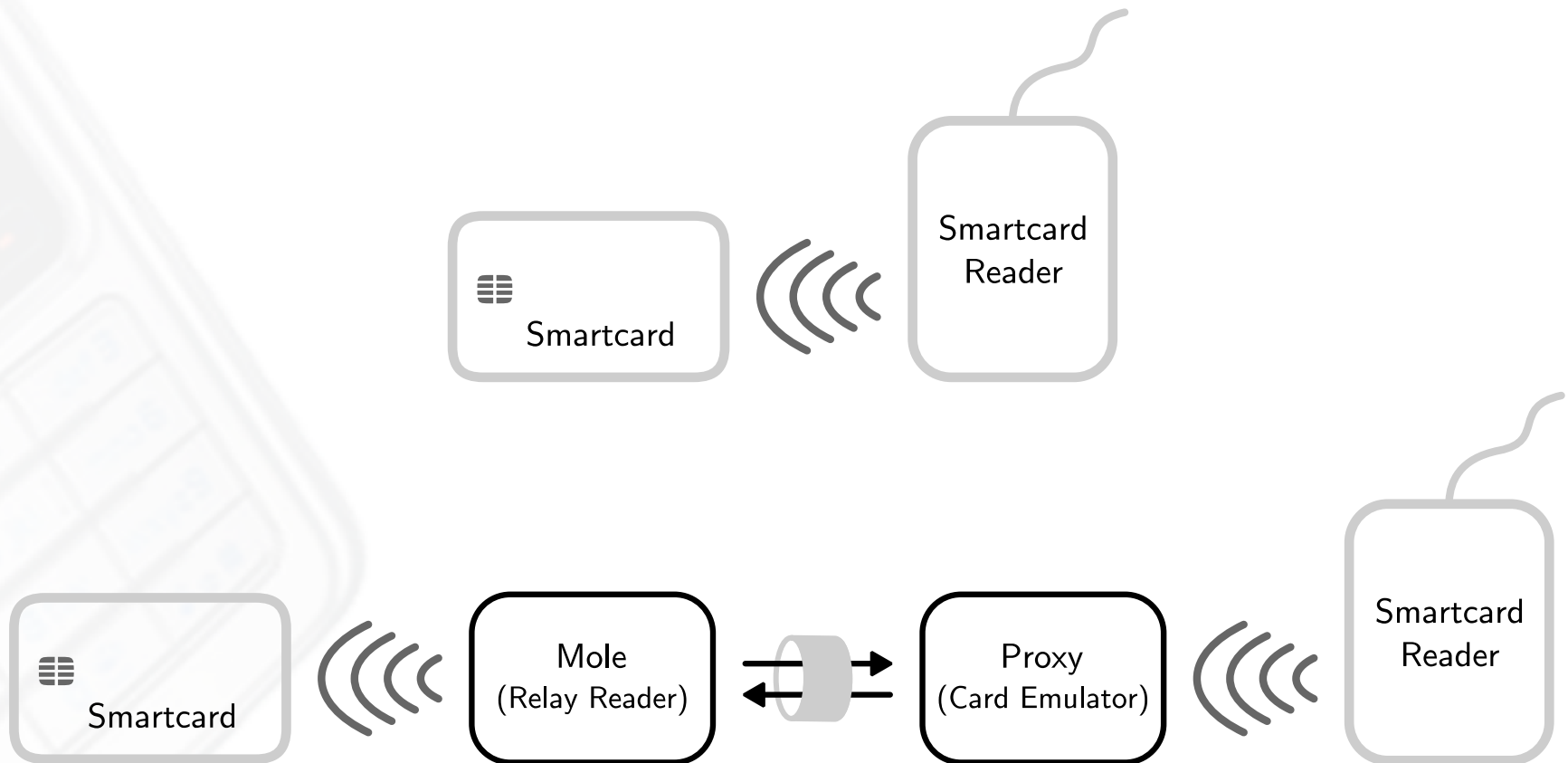
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Outline

- Introduction
 - Relay Attack
 - Software-based Relay Attack
- Google Wallet
- Google Wallet Relay Attack
- Google's Response

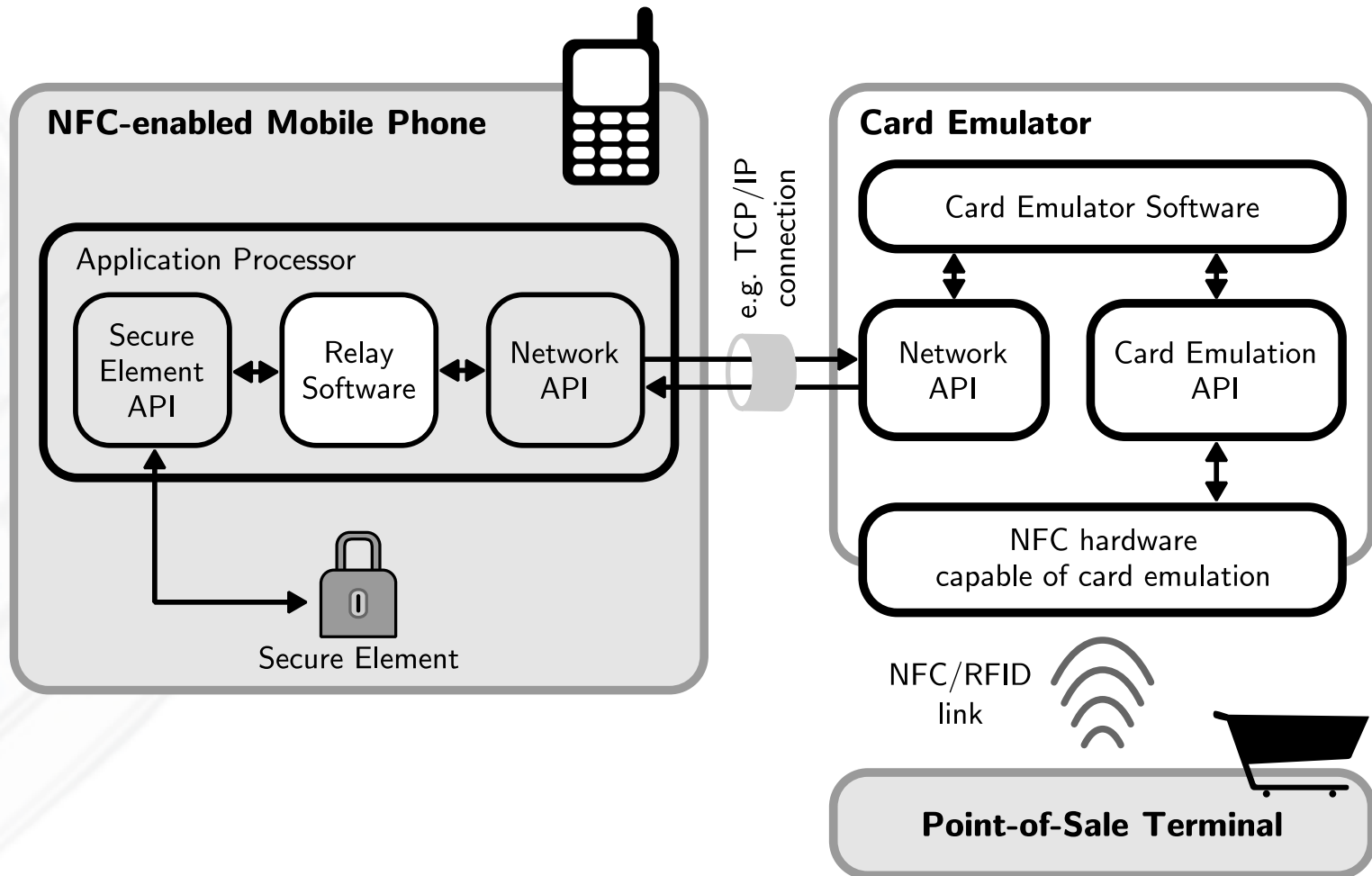
Relay Attack



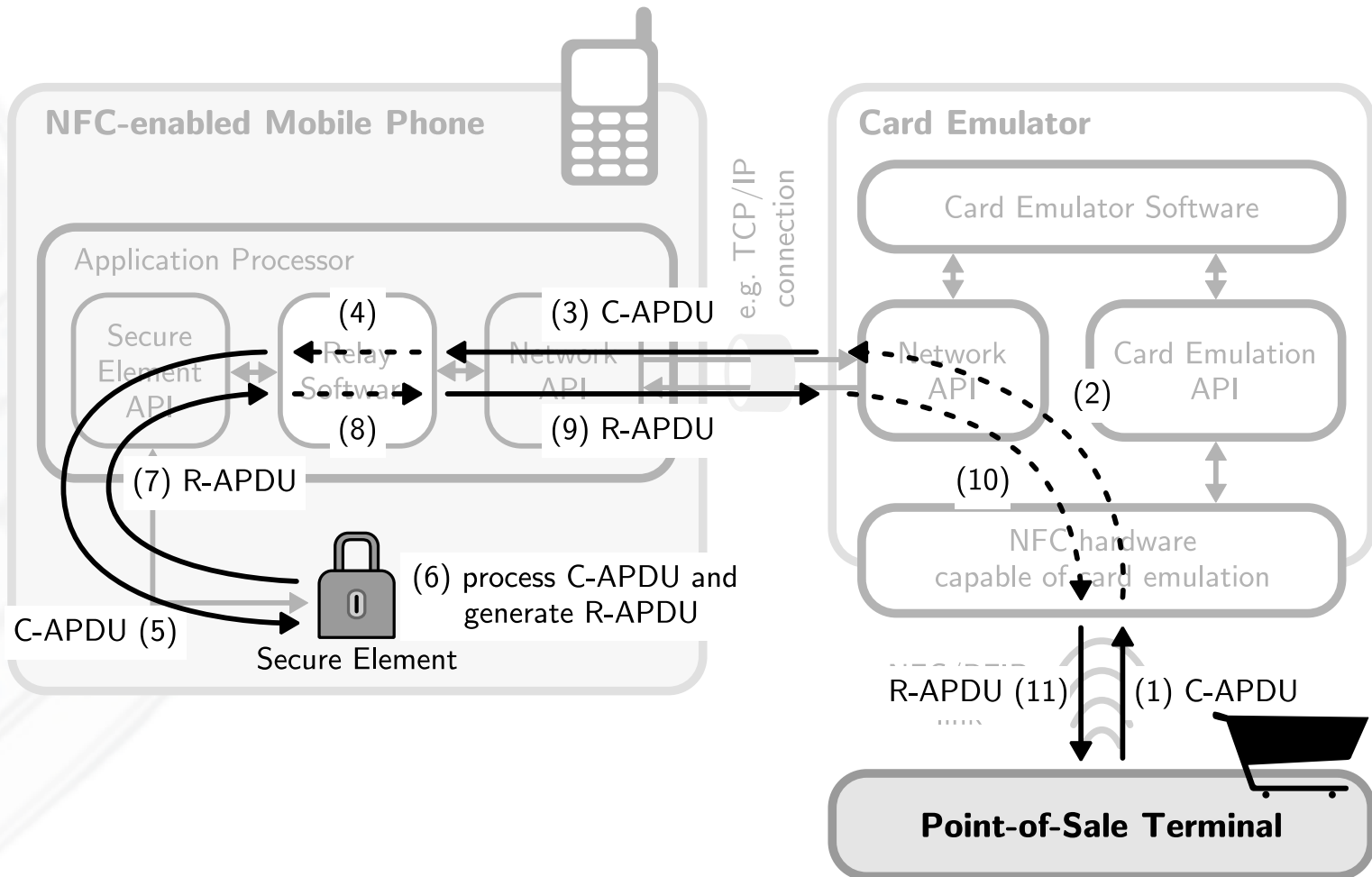
Software-based Relay Attack

- Relay attack: Mole requires **close physical proximity** to device-under-attack
- Software-based Relay Attack:
 - Secure element access through application processor
 - App (software) replaces physical mole
 - App needs access to secure element and network interface(s)
 - Secure element access typically through privilege escalation

Software-based Relay Attack

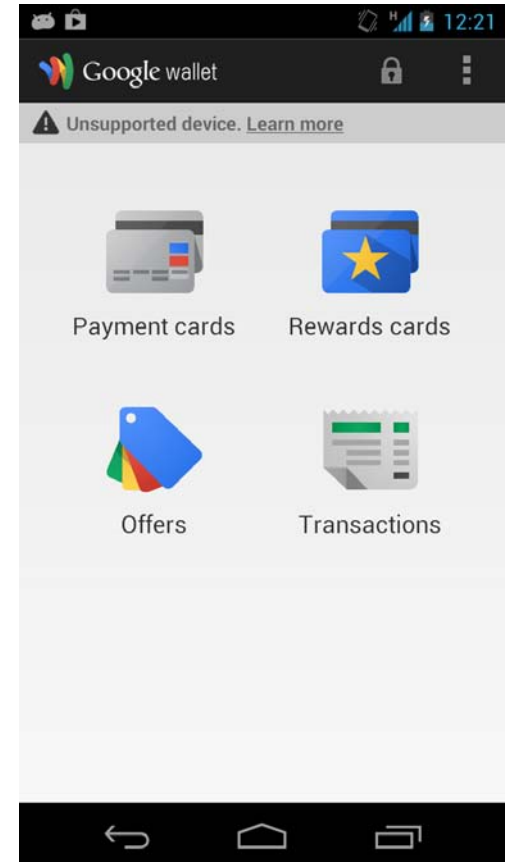


Software-based Relay Attack



Google Wallet

- Container for
 - Payment cards
 - Gift cards
 - Reward cards
 - Special offers
- Android app
 - User interface
- Java Card applets on secure element
 - Secure data storage
 - Interface with POS terminals

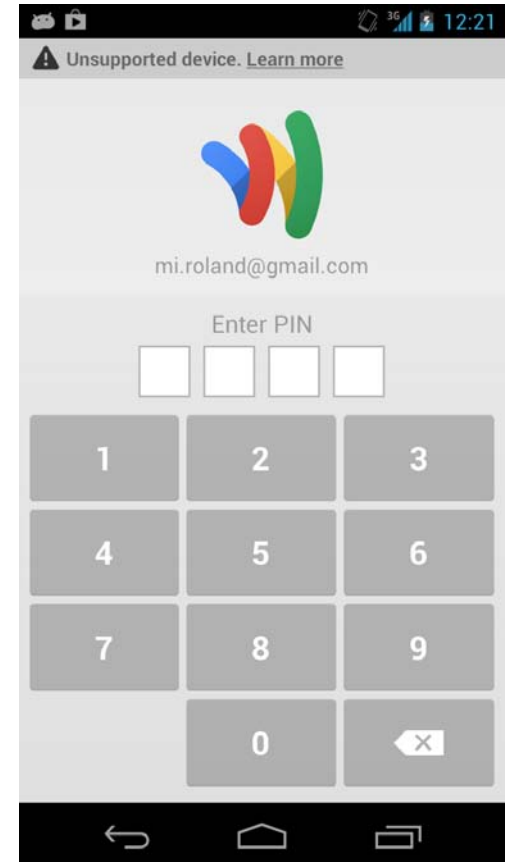


Analysis of Google Wallet

- Focus on communication between
 - Android app and secure element
 - POS terminal and secure element
- Secure element contains
 - Google Wallet on-card component
 - Manages access to payment cards, ...
 - Google MIFARE access applet
 - Provides access to secure element's MIFARE 4K memory
 - EMV-compliant proximity payment application

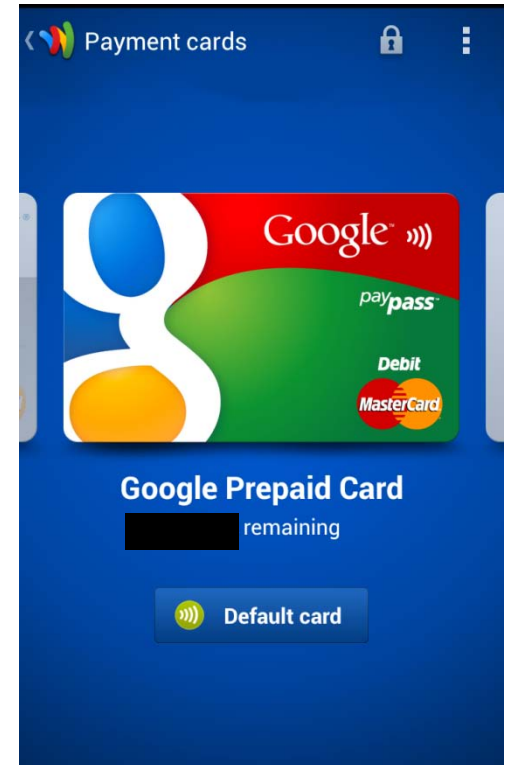
Google Wallet's PIN

- Unlocks access to
 - User interface (Google Wallet app)
 - EMV payment cards
- Issues
 - PIN is verified by Google Wallet app
 - Known attack on PIN hash exists!
 - On-card component does not verify the PIN
 - Unlock command: `80 E2 00 AA 00`
 - PIN is not necessary to unlock Google Wallet → Send unlock command instead!



Google Prepaid Card

- EMV-compliant
- MasterCard PayPass
- EMV Mag-Stripe protocol
 - with dynamic CVC3



Relay Attack on Google Wallet

- Relay app
 - Android app
 - Unlock/lock Google Wallet on-card component
 - Forward APDUs to secure element
 - **Needs root access**
- Card emulator
 - Python application
 - ACR 122U
 - Notebook computer
- POS terminal
 - Hypercom Artema Hybrid
 - ViVOtech ViVOPay 5000

Relayed payment
transaction **successful** →



H-Ä-N-D-L-E-R-B-E-L-E-G

Testterminal
OPP 850

Terminal-ID 54183583
TA-Nr 000219 BNr 0062

Kartenzahlung
MasterCard

EUR 1,00

PAN 5430 0000 0000 0000
EMV-AID A0000000041010
VU-Nr 158632721
AIDPara 0100000002
Genehmigungs-Nr 735259
Datum 20.02.12 17:18 Uhr

Zahlung erfolgt

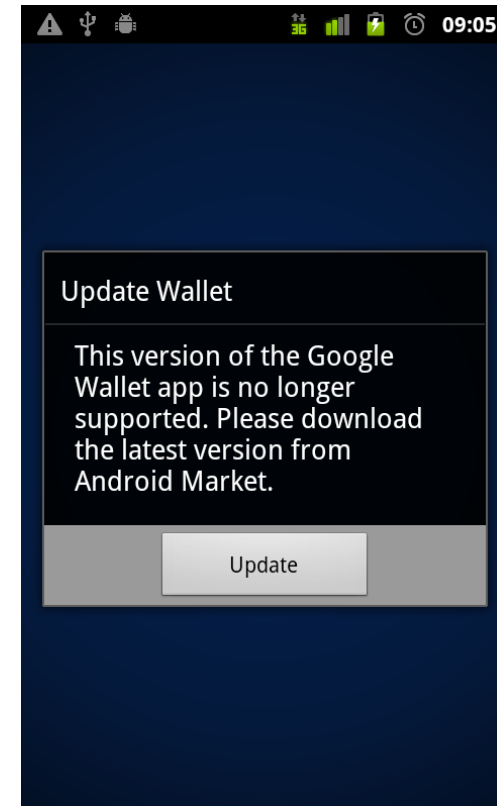
=====
AS-Proc-Code = 00 914
00
Capt.-Ref. = 0010
AID59: 714487
=====

BITTE ZURÜCKGEBEN



Google's Response

- April 2012: Reported to Google
- End of April 2012: New installations no longer vulnerable
- June 2012: New secure element applet
- September 2012: Existing users are forced to install update
- October 2012: PIN verification on secure element



Demo available at
<http://youtu.be/hx5nbkDy6tc>
http://youtu.be/_R2JVPJzufg

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