Near Field Communication
Research Lab
Hagenberg

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Security & Privacy Issues of the Signature RTD

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Content

- Partial Signature
- URIs for Certificate and Signature Retrieval
- Missing Framework

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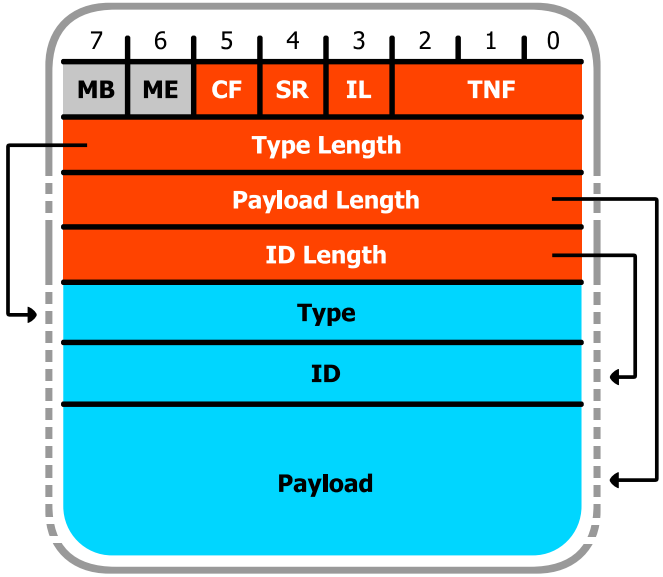
Vulnerability: Partial Signature

- Only Type, ID, Payload fields of NDEF records are signed
- Remaining fields not signed: TNF, IL, SR, CF, length fields
- It is possible to change the semantics of a signed record without invalidating the signature
  - Data can be moved between the three signed fields
  - Records can be hidden from processing
  - Records can be joined into a preceding record‘s payload
  - Parts of an NDEF record‘s payload can be extracted into seperate records
  - Multiple signed NDEF messages can be combined into a new NDEF message



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Moving data between fields

MB	ME	CF	SR	IL	TNF
X	0	0	1	0	external
Type Length 16					
Payload Length 10					
Type “mroland.at:myapp”					
Payload “1234567890”					

original record

MB	ME	CF	SR	IL	TNF
X	0	0	1	1	external
Type Length 13					
ID Length 3					
Payload Length 10					
Type “mroland.at:my”					
ID “app”					
Payload “1234567890”					

after moving data

- The string “app” is moved from the Type field to the ID field
- The signature remains valid!

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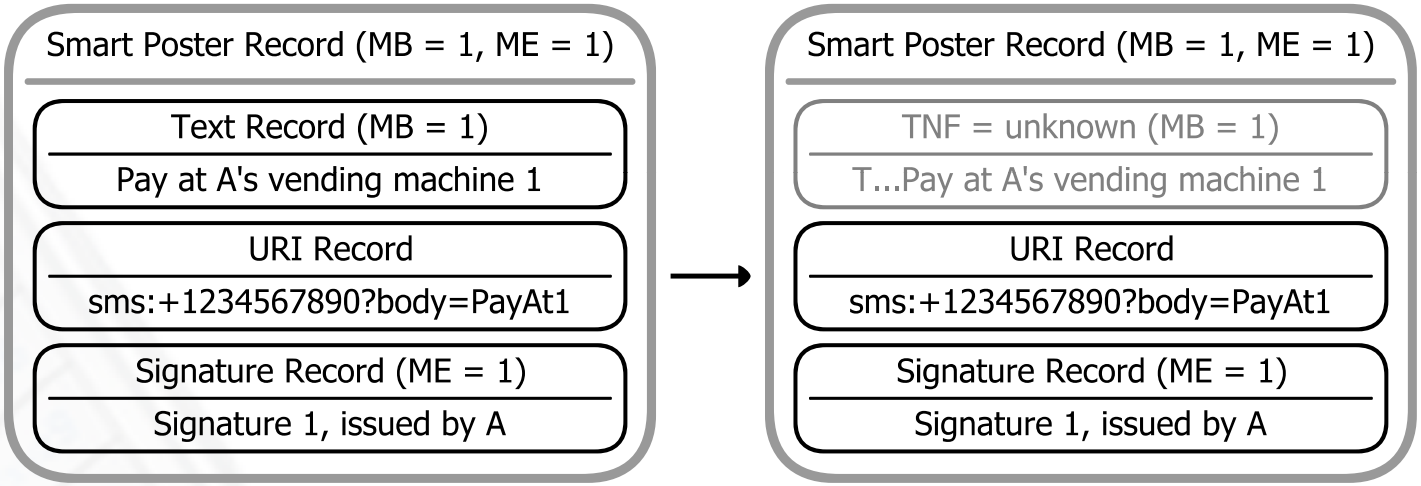
Record hiding



- A record can be hidden from processing by setting a records TNF (Type Name Field) to “unknown” (0x5)
- The signature remains valid!

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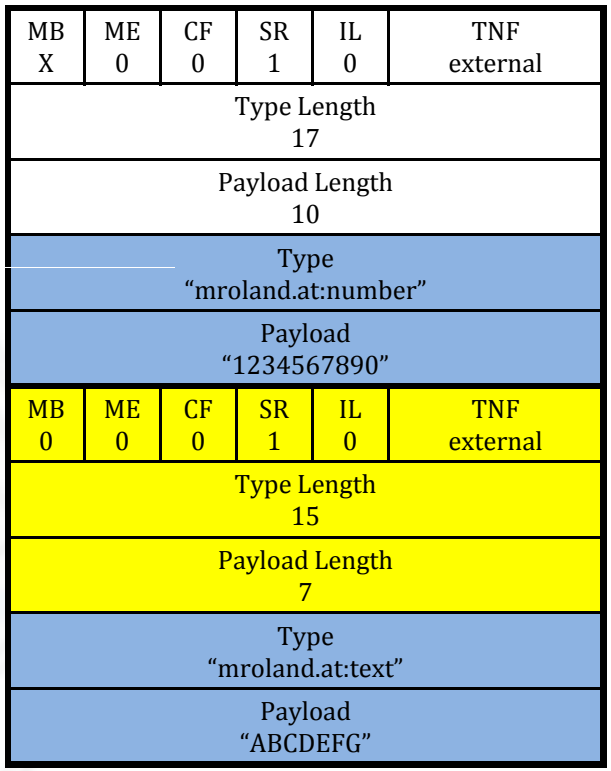
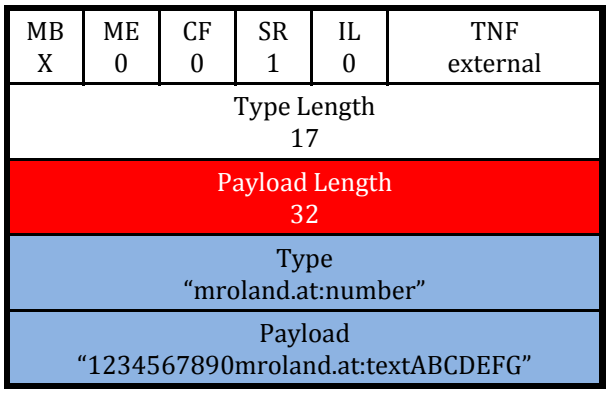
Joining records



original record



after joining data

- The second record's signed fields are merged into the first record's payload field
- The signature remains valid!

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Extracting records

MB	ME	CF	SR	IL	TNF
1	0	0	1	0	well-known
Type Length: 2					
Payload Length: 61					
Type: “Sp”					
Payload					

MB	ME	CF	SR	IL	TNF
1	0	0	1	0	well-known
Type Length: 1					
Payload Length: 26					
Type: “U”					
Payload: 0x00 “sms:+1234567890?body=Pay1”					

MB	ME	CF	SR	IL	TNF
0	1	0	1	0	well-known
Type Length: 1					
Payload Length: 27					
Type: “T”					
Payload: 0x02 “en” “Pay at vending machine 1”					

Signature Record

MB	ME	CF	SR	IL	TNF
1	1	0	1	0	well-known
Type Length: 2					
Payload Length: 69 + size(Signature Record)					
Type: “Sp”					
Payload					

MB	ME	CF	SR	IL	TNF
1	0	0	1	0	unknown
Type Length: 0					
Payload Length: 35					
Payload: “Sp” 0x91 0x01 0x1A “U” 0x00 “sms:+1234567890?body=Pay1” 0x51 0x01 0x1B					

MB	ME	CF	SR	IL	TNF
0	1	0	1	0	well-known
Type Length: 1					
Payload Length: 27					
Type: “T”					
Payload: 0x02 “en” “Pay at vending machine 1”					

Signature Record

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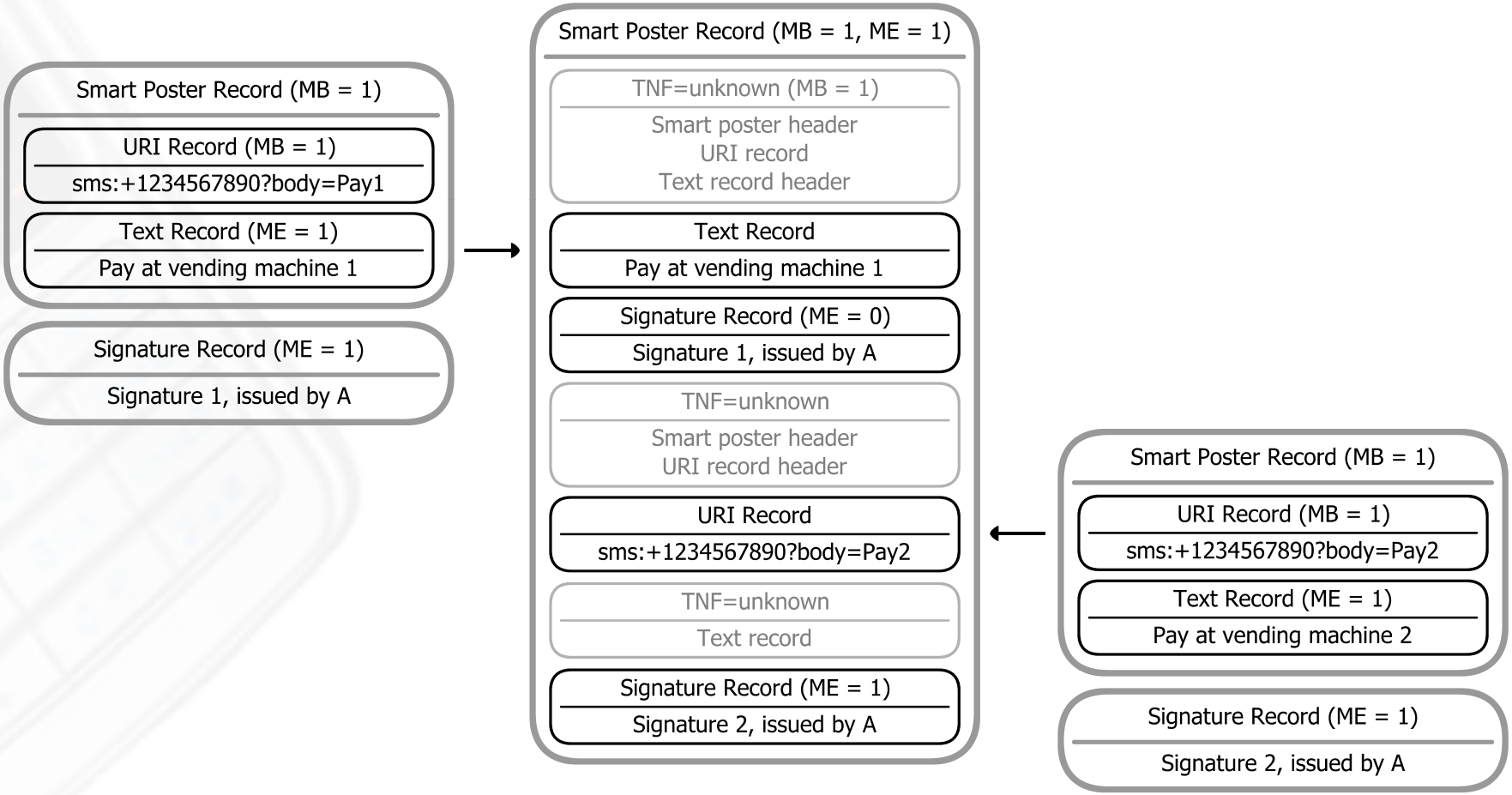
Record composition



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Proposed solution/workaround

- Include header fields (except MB, ME) into signature
  - \+ Prevents record hiding & manipulation
  - − No rearrangement of record chunks
  - − No conversion between short and normal-length records
- Sign accumulated length fields of all record chunks after the record payload
  - \+ Allows rearrangement of record chunks
  - \+ Can be independent of short record flag
- Enforce a “one signature per context” policy (e.g. one smart poster == one signature record)
  - \+ Prevents record composition
  - − Less dynamic?

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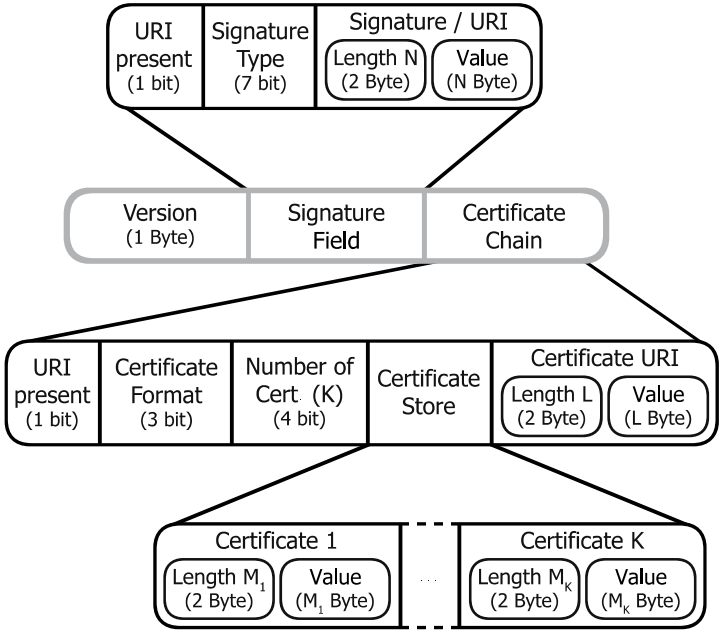
Vulnerability: URIs in Signature Record

- Signature RTD uses URIs to reference signatures and certificates stored in remote locations
- Privacy risk!
  - If URLs are accessed without notification, the user's privacy can be invaded by collecting user data (IP addresses, cookies …)
  - **No need to actually use the service offered by the tag!**
- URIs have no integrity/authenticity protection
  - URIs are retrieved prior to signature verification!
  - **More evil scenarios possible ;-)** *(→ see next slide)*



URIs in Signature Record (cont'd)

- Collection of usage & user data by an attacker
  - Replace URLs of the signature record with URLs controlled by the attacker
  - When request is received:
    - Collect data
    - Redirect request to original URL (user will not notice this attack)
- Access locations that are only accessible by the user
  - Locations protected by IP based access control, local network segments …
  - An attacker can use specially crafted URLs to trigger operations in the context of the user
    - E.g. send Facebook message, issue HTTP GET request on user's LAN
- Trigger URL parsing vulnerabilities of the underlying operating system

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Proposed solution/workaround

- Disallow URI references in signature records
  - \+ Prevents URI abuse
  - − May significantly increase signature size
- Authorize specific URIs based on the installed root certificate (i.e. root certificate carries set of allowed URIs)
  - \+ Prevents URI abuse
  - − Tag usage can still be tracked by URI owner
  - − URIs can only be managed by the root CA
    - CA must manage URIs / a scheme for delegating URIs to issued certificates is necessary

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Missing Framework

- Signature RTD only defines the data structure of the signature record
  - Digital signature guarantees that issuer posesses a certain signing key
  - BUT: No information about trustworthiness of issuer
- Usable digital signatures requre a certificate infrastructure
  - Set of ultimately trusted third parties issue certificates
    - Certificate: a certain issuer **possesses** a **specific secret** signing key and is allowed to issue **trusted** signatures for **specific actions/records**
- Framework needs to give answers to several questions:
    - Who is allowed to issue trusted certificates? (Who are the root CAs?)
    - What does a certificate certify?
    - How are certificates linked to content? (Should every issuer be allowed to sign any records? Link to record type, URIs …)

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