All Your Payment Tokens Are Mine: Vulnerabilities of Mobile Payment Systems

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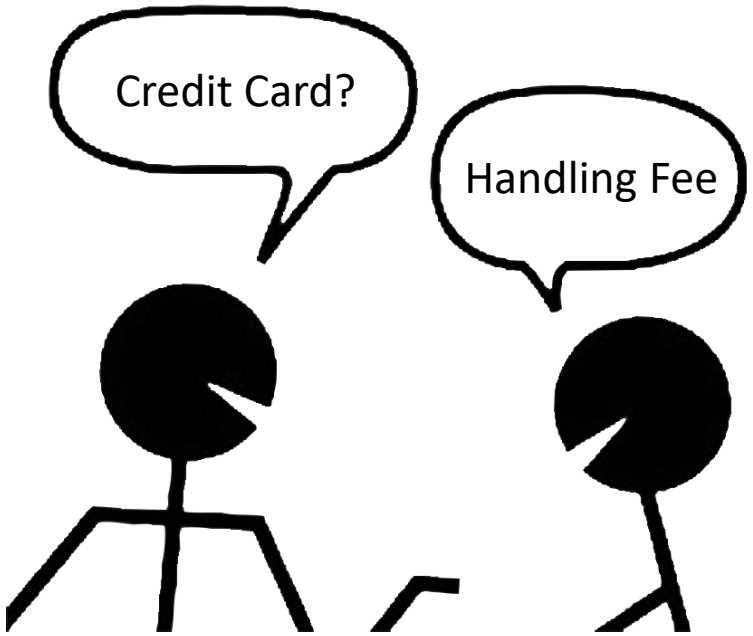
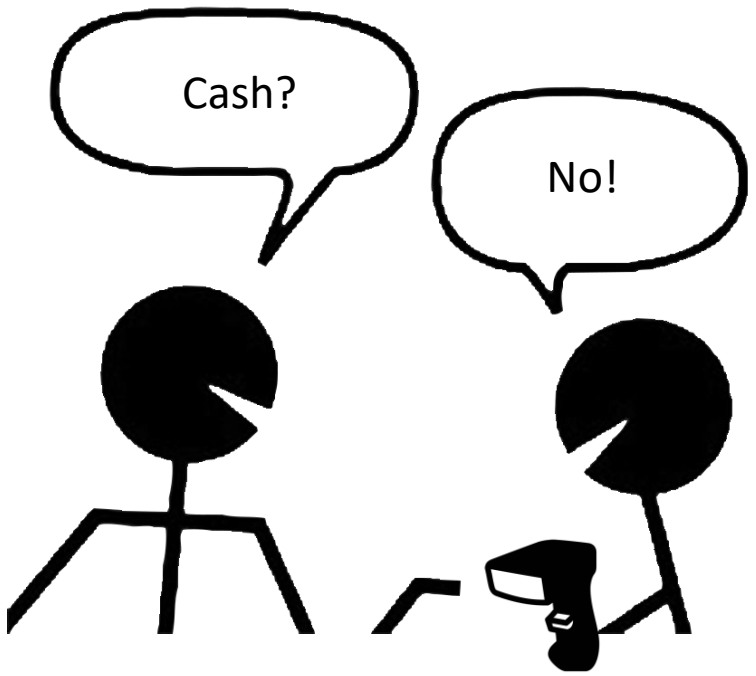
Mobile payment is so popular!



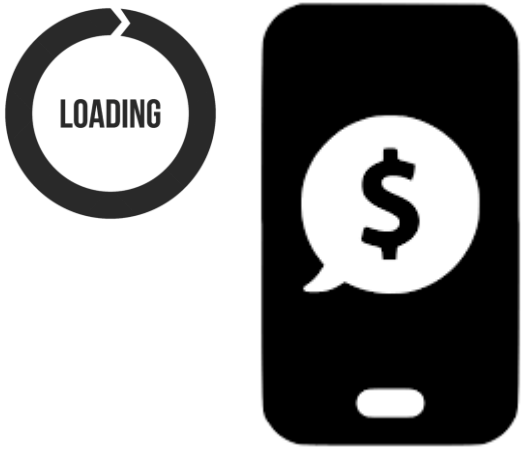


Mobile payment is so popular!

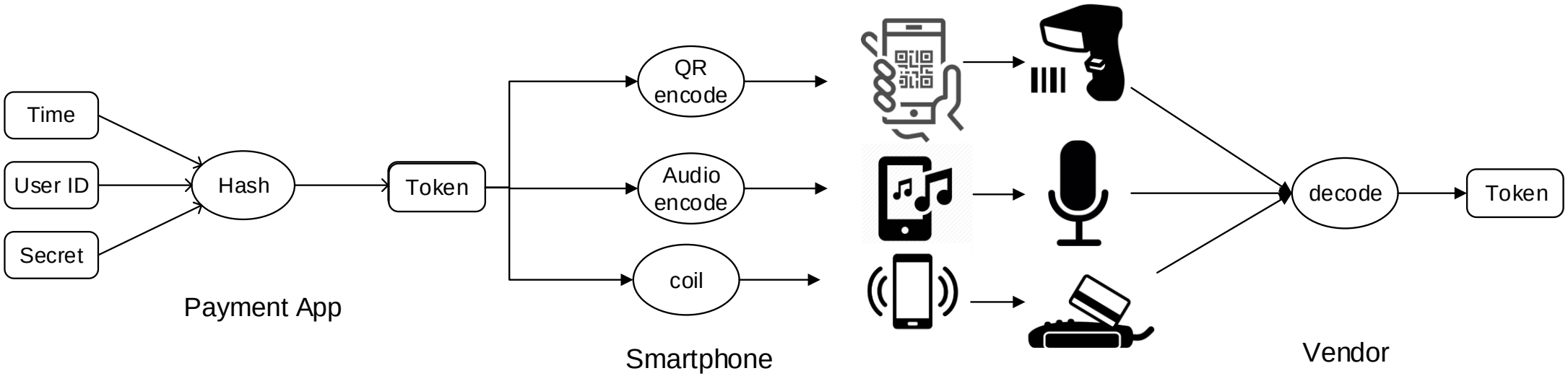
- 16.7 trillion USD transactions solely in China 2017
- China (including HK, Taiwan), India, USA, …
- Restaurant, Taxi, Shopping, …
- Financial Co., Internet Co.

Mobile phone needn’t network

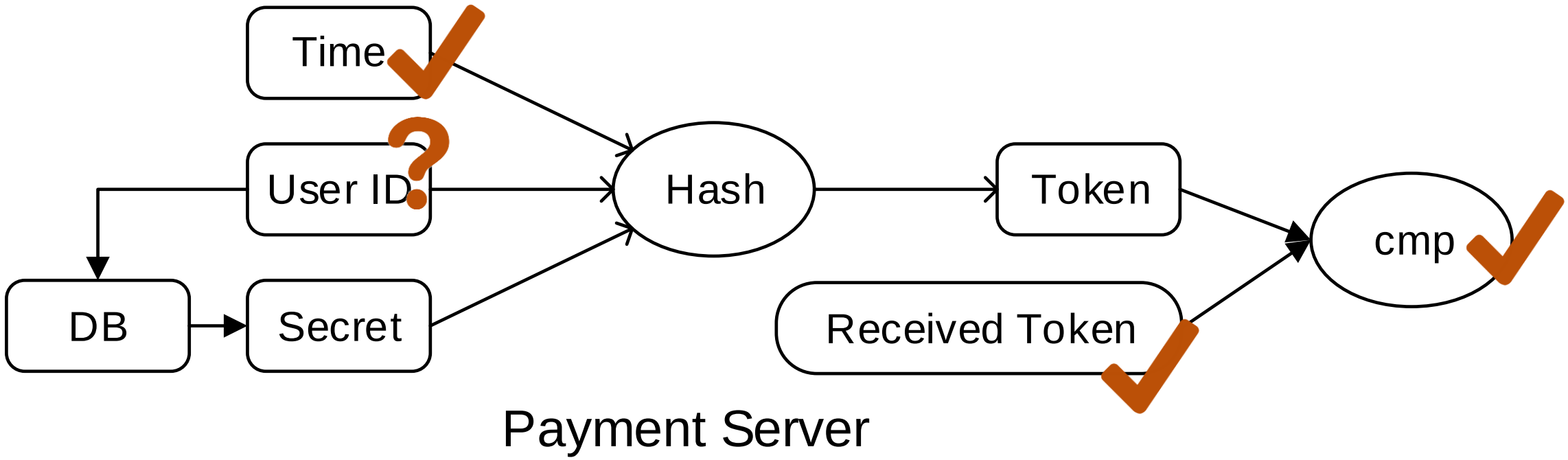
- A lot of transactions happen indoor, where cellular is poor.
- Rapid response.



Offline payment schemes



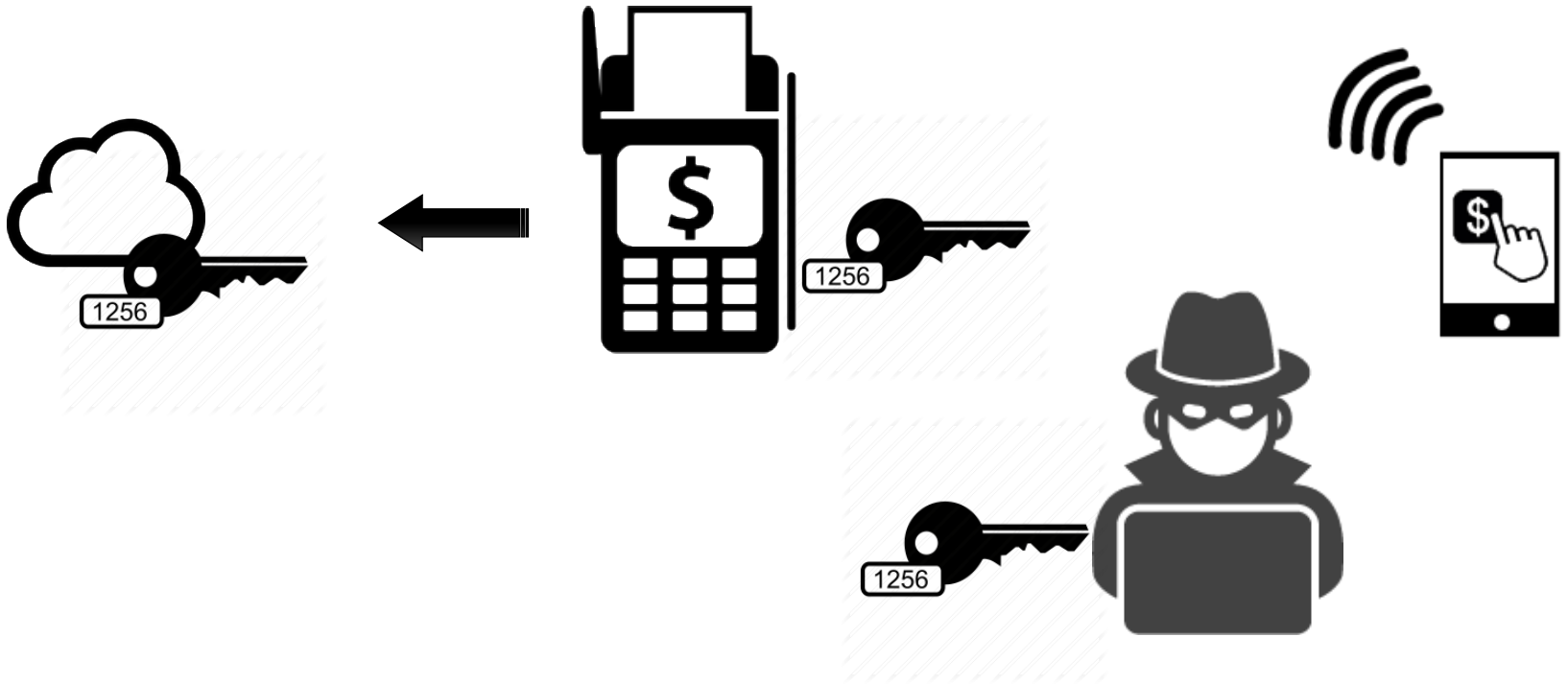
Offline payment schemes



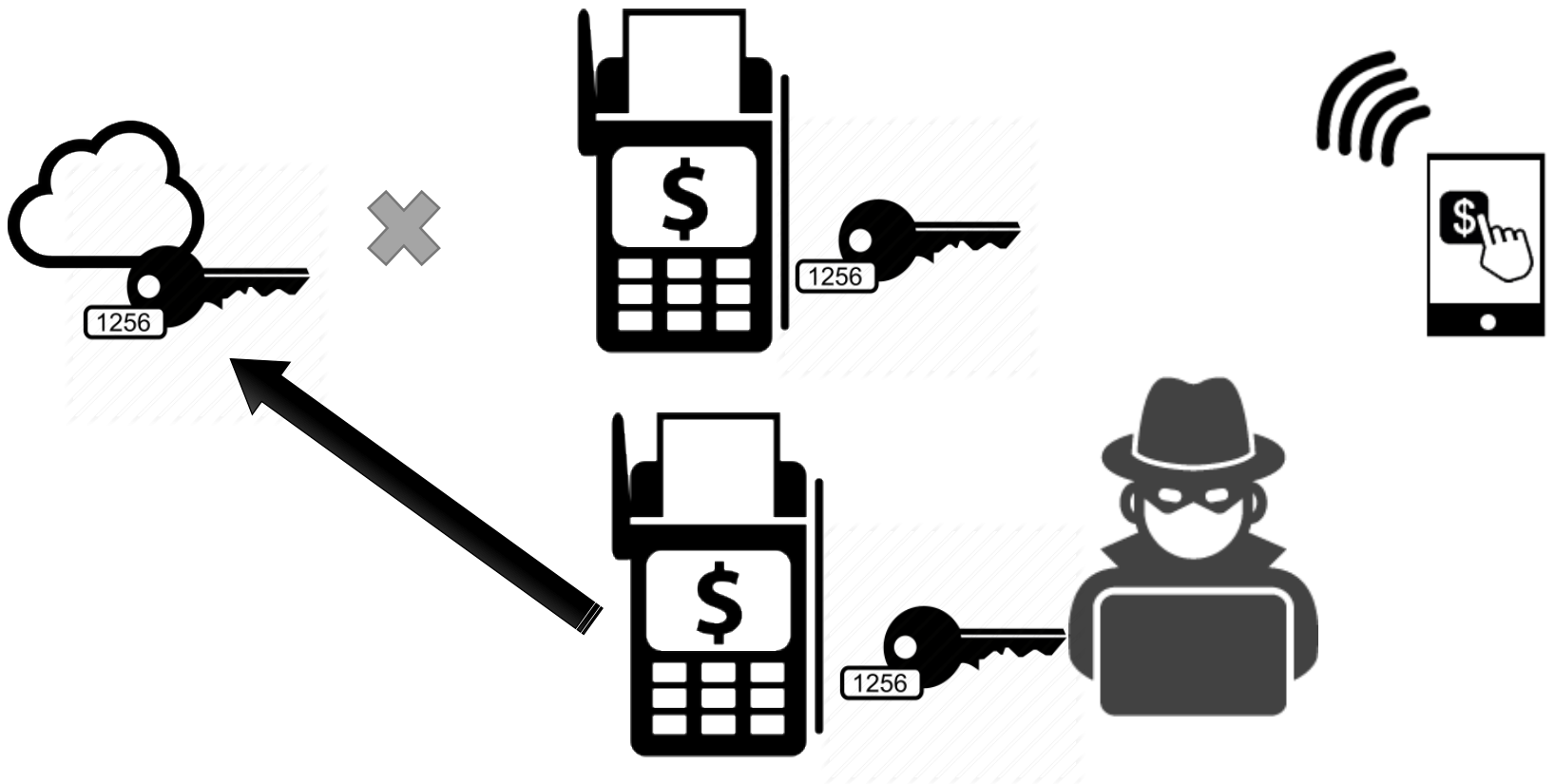
Security weak points

- Token transmission in broadcast channel.
  - No encryption during transmission.
  - It can be sniffed.
- Token is not bound with specific transaction.
  - A sniffed token can be spent at another place.

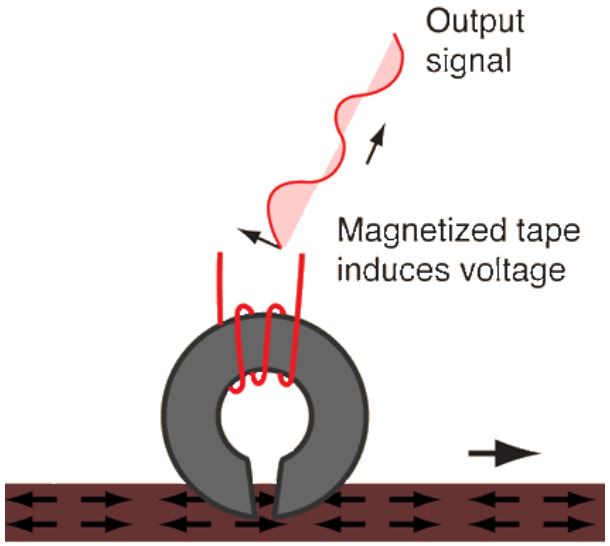
Security is not that bad

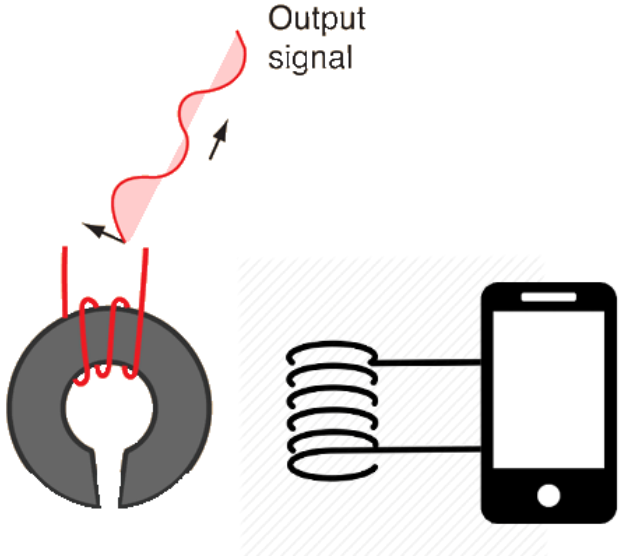


Our attacks



MST based mobile payment





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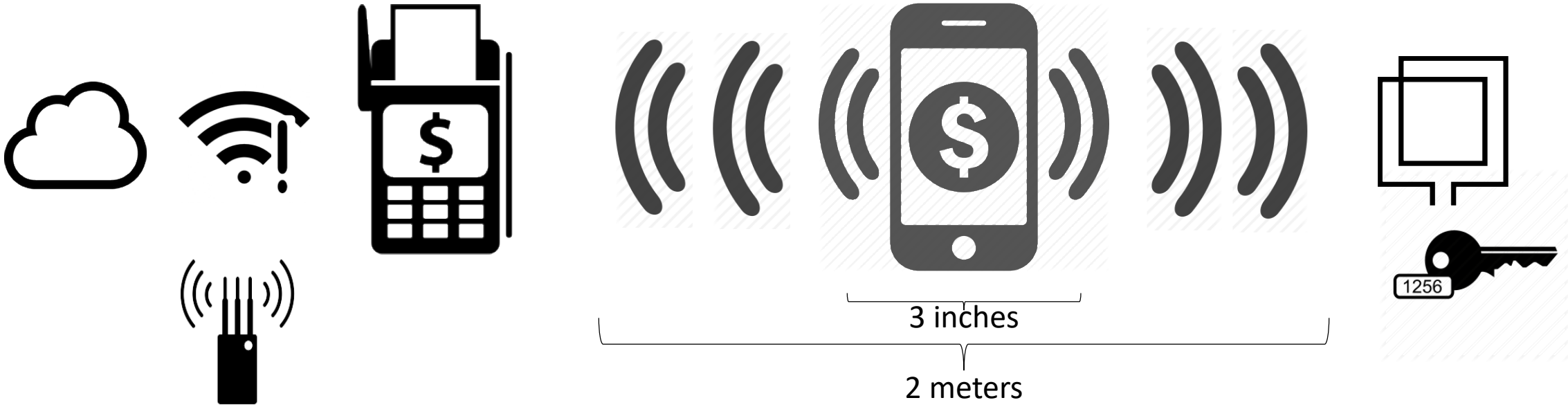
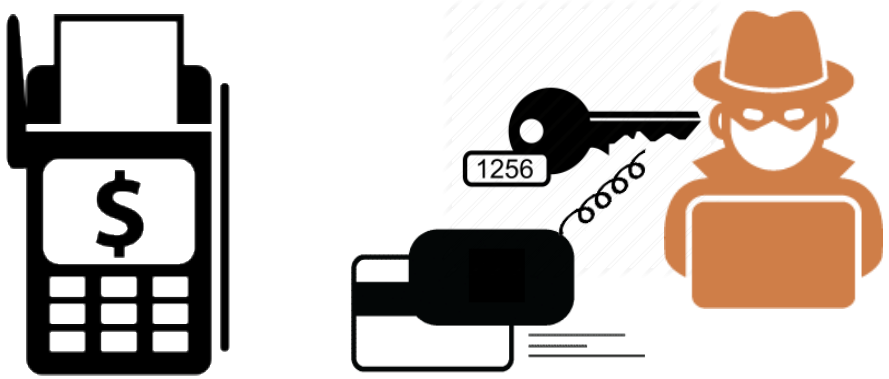
MST based mobile payment

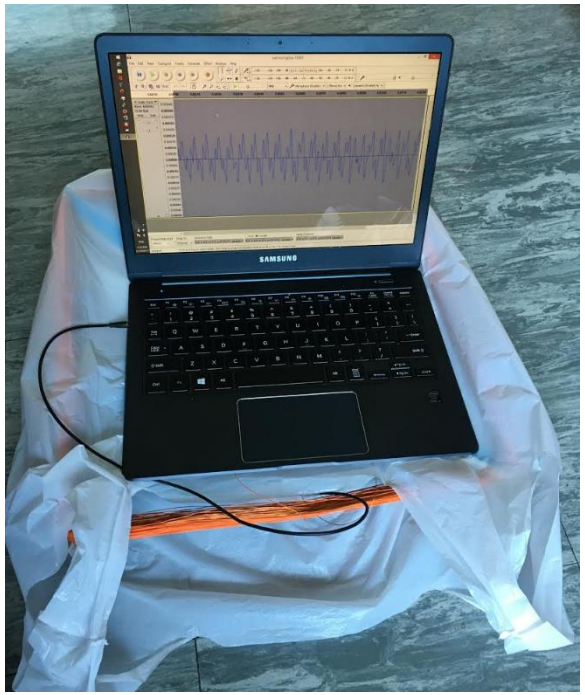
Attack MST



Attack MST

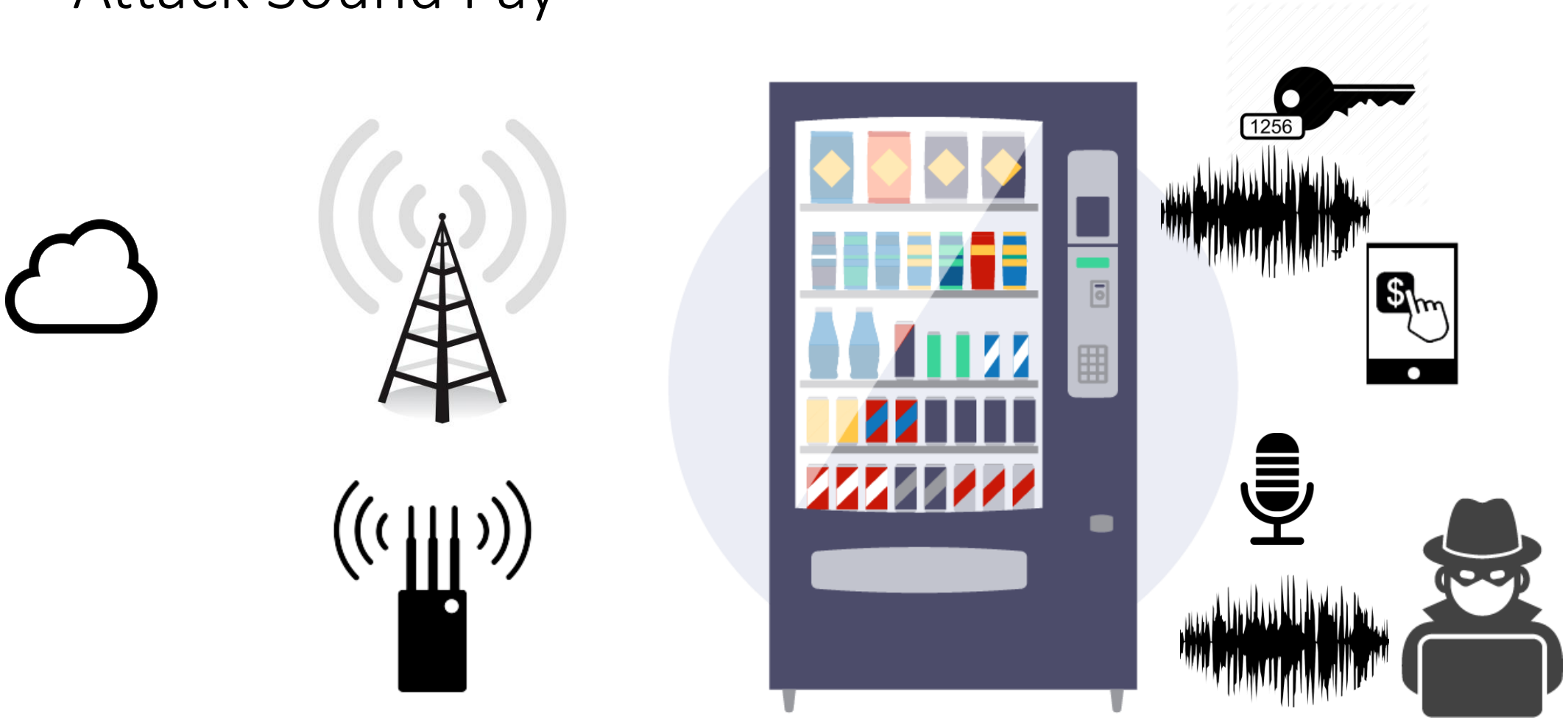


Devices used to attack MST

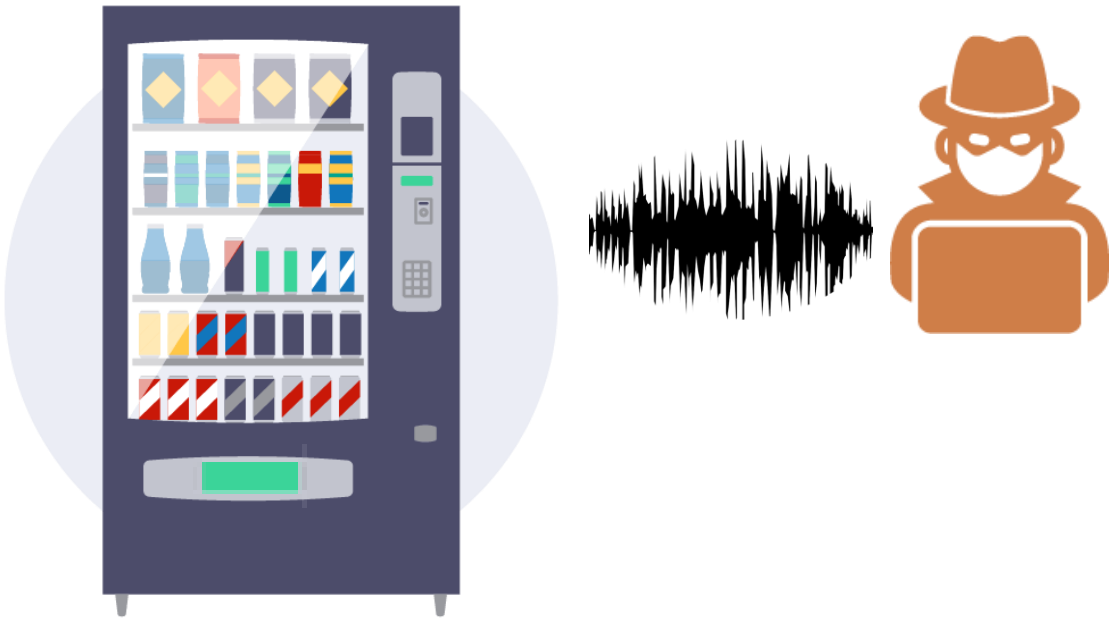


Sound Pay

Attack Sound Pay



Attack sound pay



QR code payment

- An extremely popular payment method.
- Payment Mode
  - B2S mode: A phone scans QR code printed on a paper to pay.
  - B2L mode: A phone presents QR code under POS scanner to pay.

Attack QR code payment, sniffing

Attack QR code payment, interrupting

- A malware a draw a white block.
- To prevent the code from legally recognized.
  - Positioning mark is critical for decoding.
  - POS machine can no longer decode the QR code.
- The sniffed QR code token is kept alive.
  - Attackers spend the token during the period.

Bonus attack

- Payment QR code is meant to be sensitive.
- But can also be used as **name card for transfer**.

Bonus attack, token sniffing

Payee, victim

Payer, infected

Quit? Token will be consumed.

Stay? User will notice.

Bonus attack, token protection

Payee, victim

Payer, infected

Initiate a Bluetooth pairing.
Then quit.

Bonus attack, token protection

Payee, victim

Payer, infected

A window **flashes** in victim's phone.
Some hundreds of ms.
Normal transaction goes on.

Remedy

- Report the attack to the service provider (the No.1 provider in China).
- The service provider revoked payment QR code as name card.

Lessons from the attacks.

- Payment token is so sensitive.
- Token should be bound to a transaction when being generated.

Q&A

- Thank you for your time.