ITUWebinars

Digital financial services

Episode #1: Addressing SS7 vulnerabilities affecting digital financial services

14:00 - 15:00 CET
18 February 2025
Fully virtual

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Digital Financial Services (DFS) Webinar Series

Addressing SS7 Vulnerabilities affecting Digital Financial Services

18 February 2025
14:00 - 15:00 CET
Fully Virtual

Join us online!
http://www.itu.int/go/dfs_ws_ss7

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Vaulto

ITUWebinars

Digital financial services

Episode #1: Addressing SS7 vulnerabilities affecting digital financial services

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A LITTLE ABOUT MYSELF

- Husband, father (+2), geek 8-)
- Security researcher for the last 20 years
  - Specialize in telecom, IoT & blockchain
  - Member of ITU-T Study Group 11
  - Member DFGI SA WG
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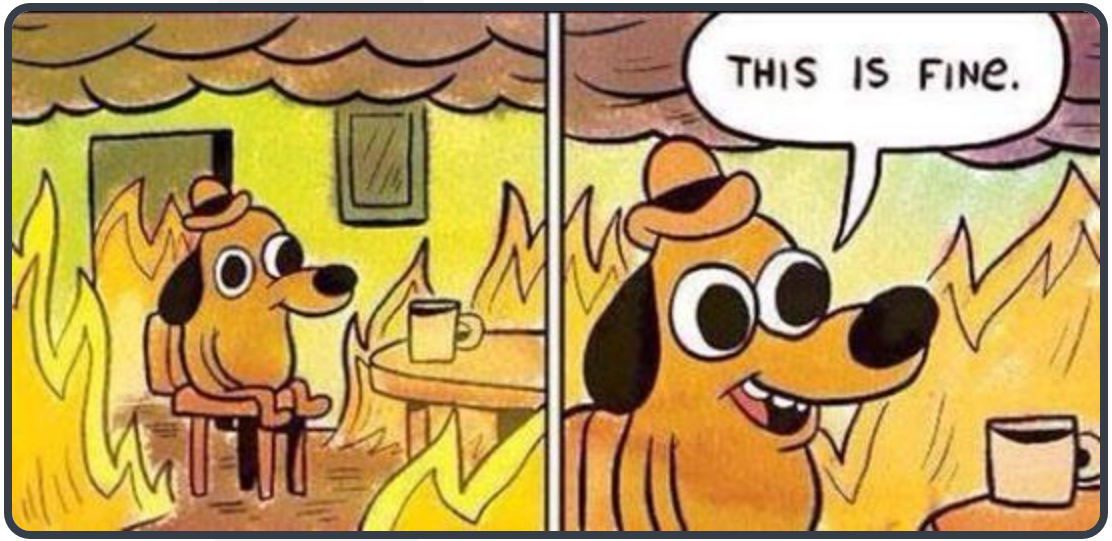
DFS - DIGITAL FINANCIAL SERVICES

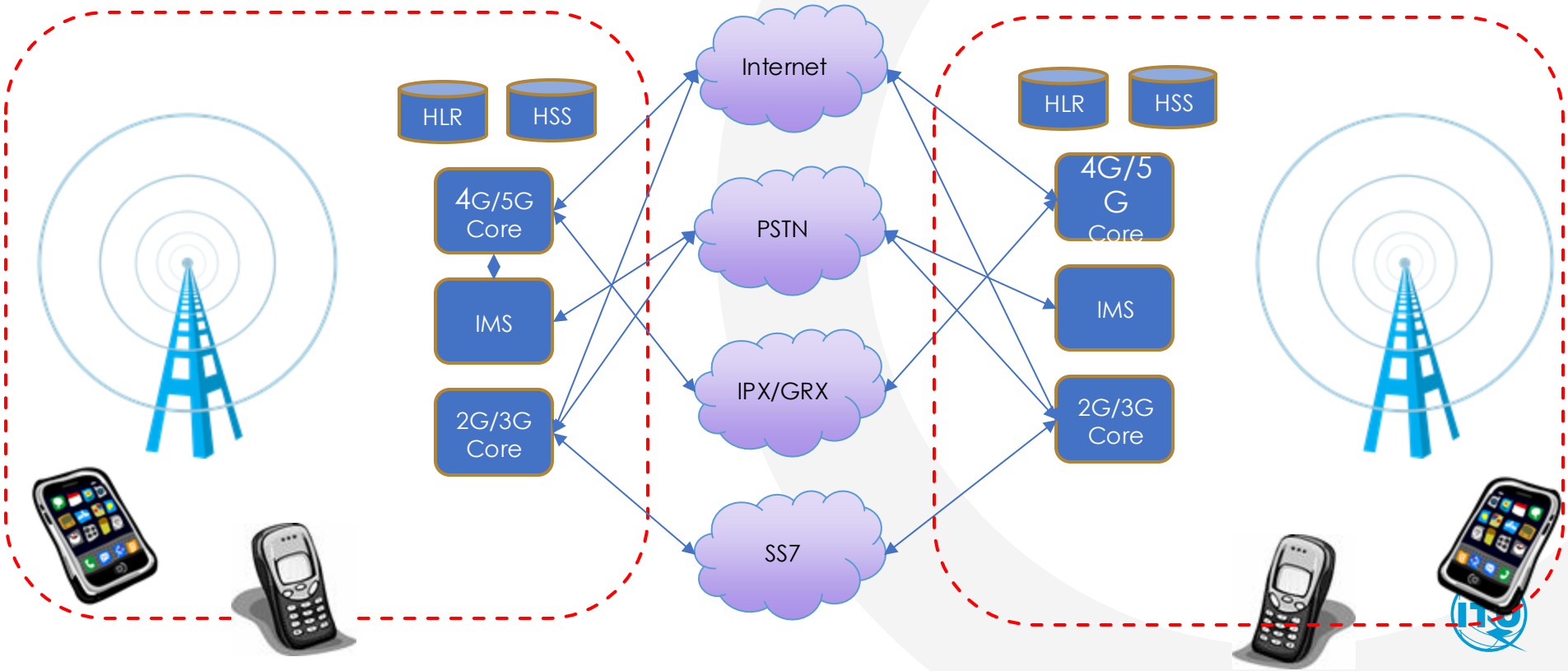
- Digital financial services (DFS) relies heavily on the underlying teleco infrastructure to enable users send and receive money
- DFS is very popular in developing countries where traditional banking infrastructure is not present
- The channels in which the end-user communicates with the DFS provider are mostly USSD and SMS, due to the lack of 3G/LTE deployment in these countries.

SS7: VULNERABILITY BY DESIGN

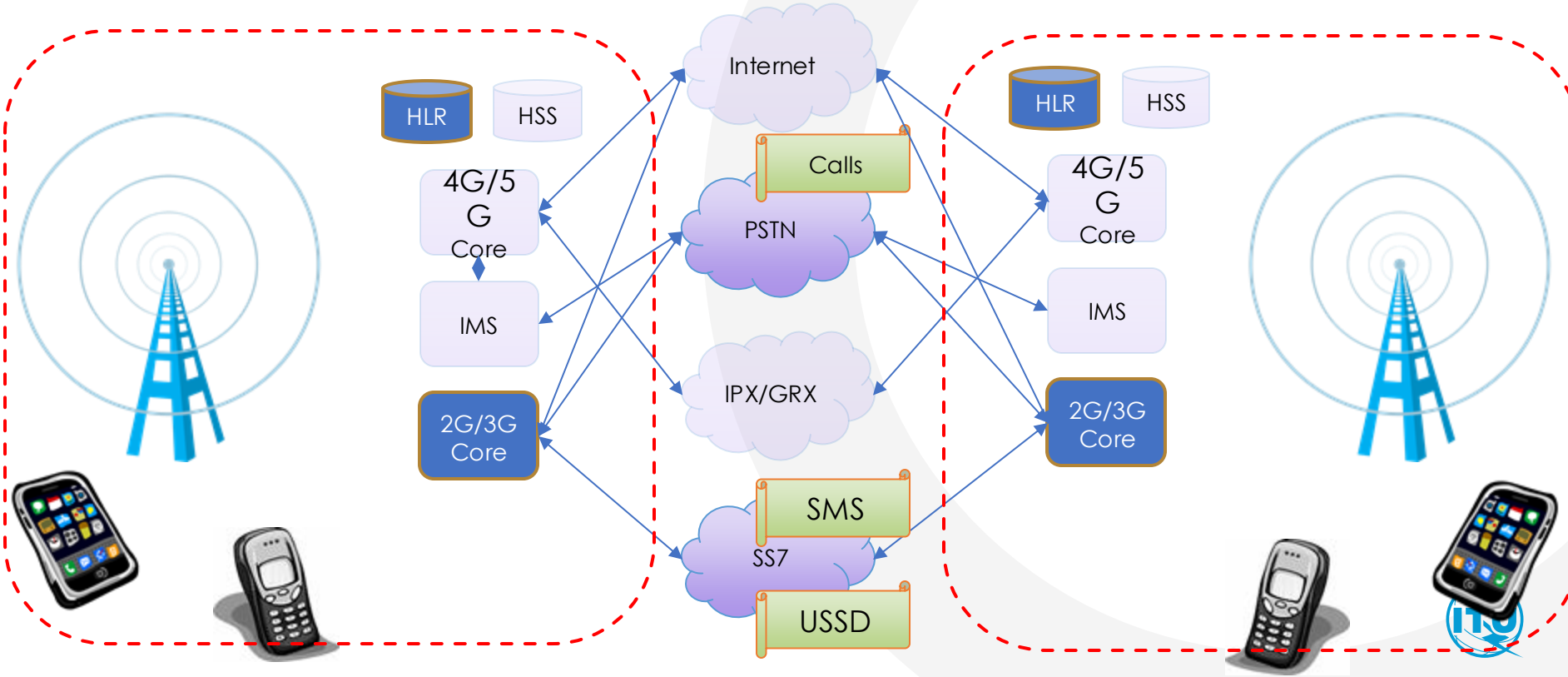
- Flat network (switched, not routed, no NATs)
- Static address allocation (ITU managed)
- All network elements are trusted without question
- No encryption
- No authentication required to join the network



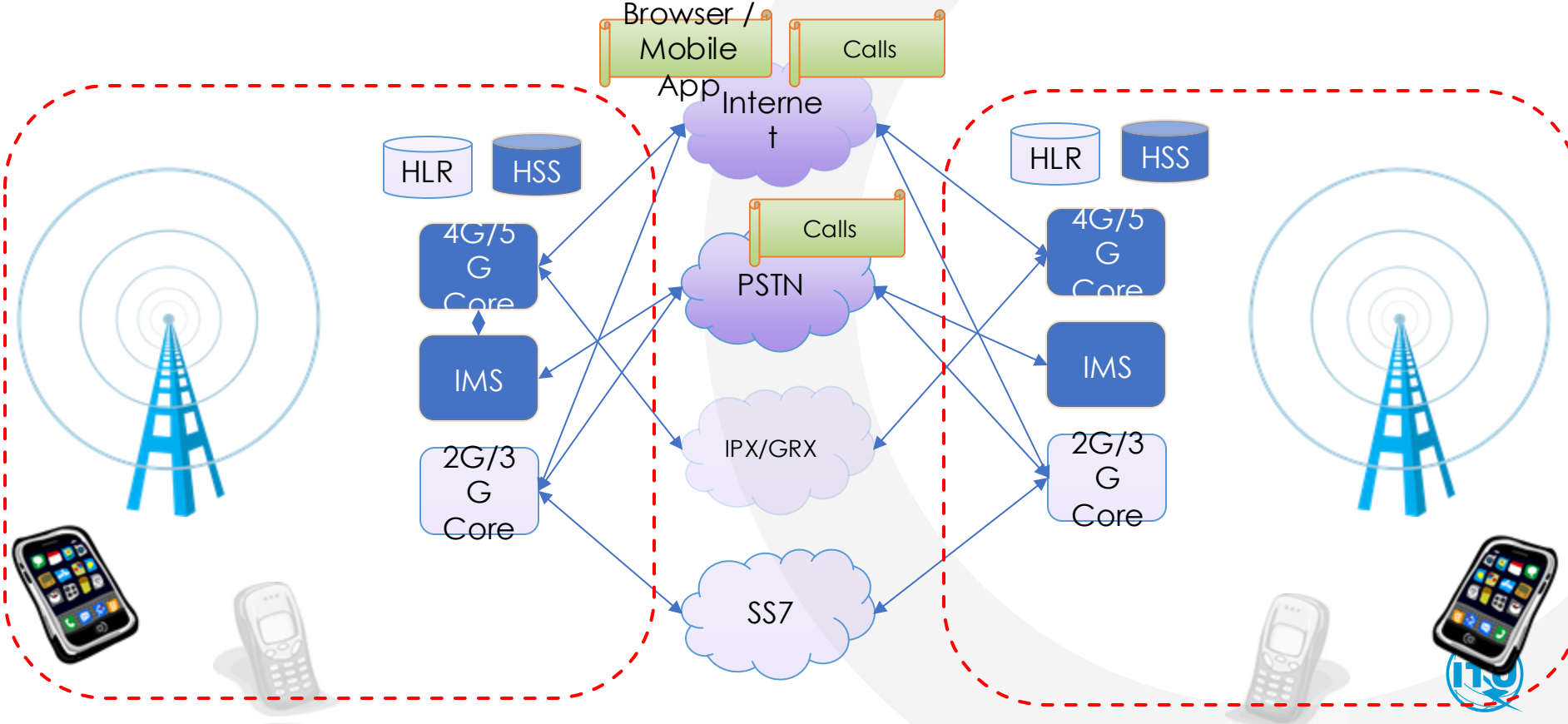
TELCO'S CORE NETWORK



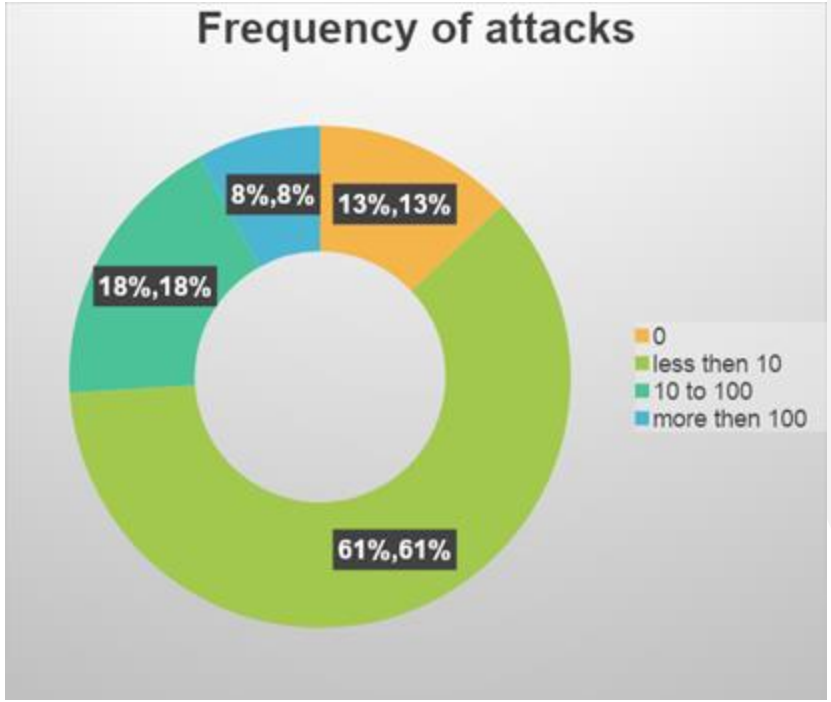
DFS SERVICES OVER TELECOM

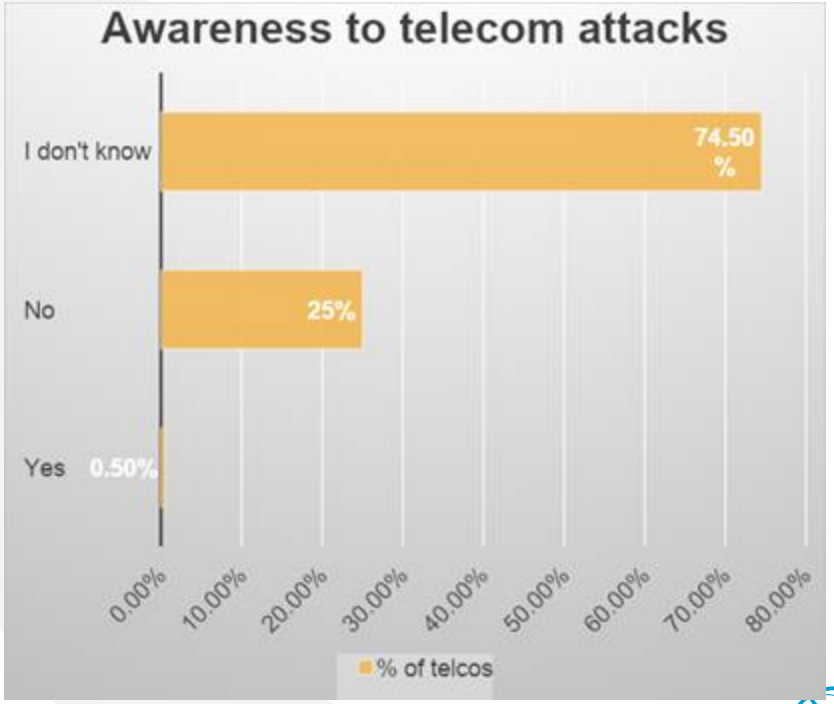


DFS SERVICES OVER MOBILE INTERNET



THE COMMONALITY OF TELECOM ATTACKS





EXAMPLE FROM A MAJOR EU OPERATOR

Cat.	Events	Action	Min.	Max.	Average	
	Total throughput		375 M	517 M	454 M	
1	**All Category 1**					
	ATI, SRI, SendIMSI	Blocked	560	3.835	3.200	100%
2	**All Category 2**		24,6 M	30,1 M	27,8 M	
	- Home IMSI	Blocked	2	40	21	0,75 pm
	- GT Mismatches	Still pass	10.500	19.930	15.300	550 pm
	- SSN Mismatches	Still pass	123	332	210	7,5 pm
3.1	**All Category 3.1**		224 K	360 K	294 K	
	- No or Unexpected Location	Blocked	84	9.700	4.400	1,50%
	- Foreign IMSI	Still pass	3	42	15	51 pm

MAJOR TYPES OF TELECOM ATTACKS ON DFS

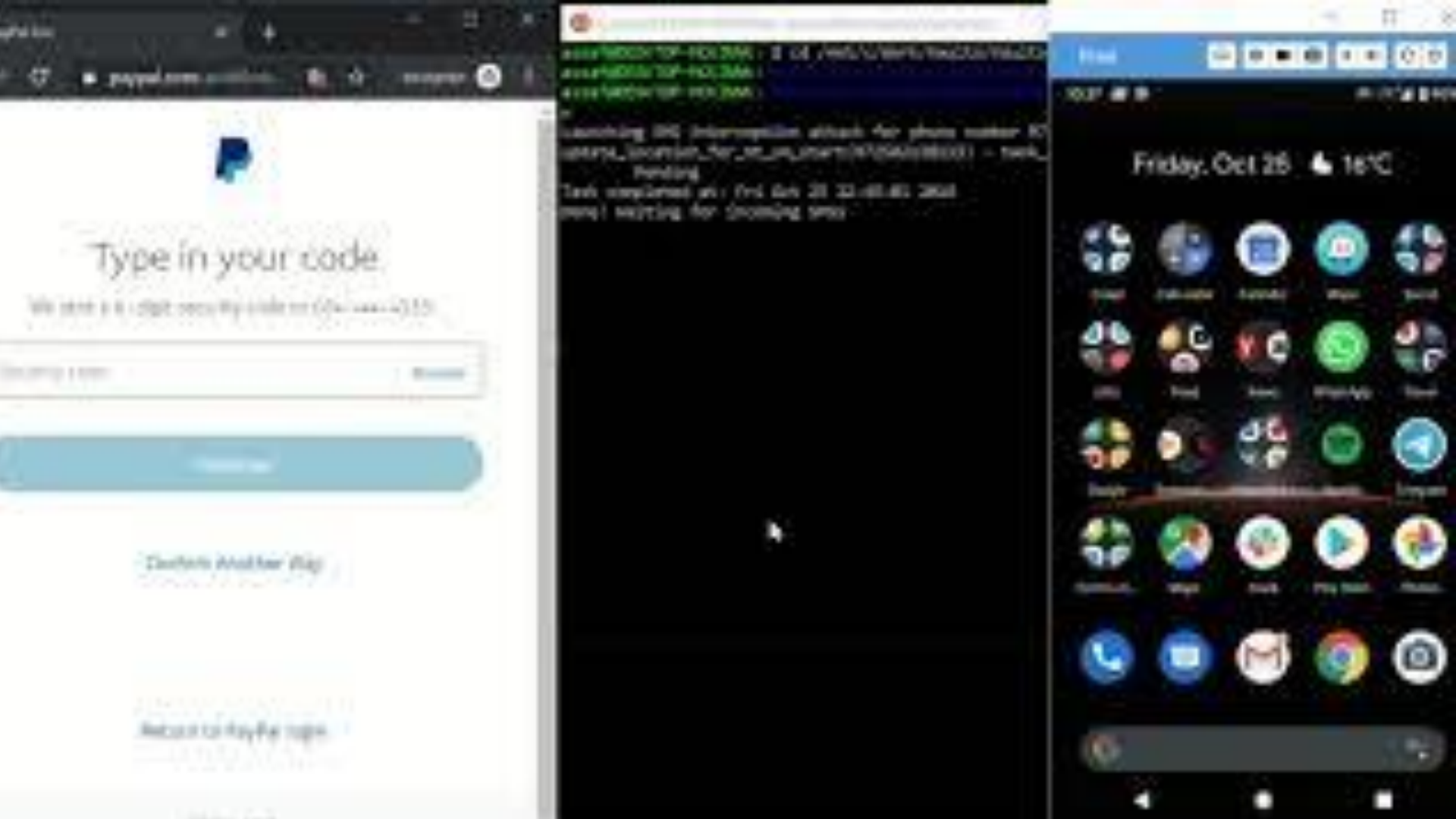
Caller ID spoofing

2FA account takeover

SIM swap

2FA SMS INTERCEPTION

Example


Type in your code
Friday, Oct 25
16°C

SS7 CALL INTERCEPTION

Example

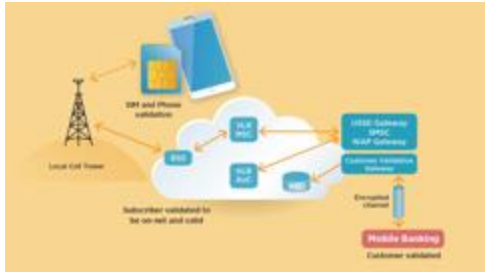

054-255-8192
Attack a mobile phone
Vaulto-galaxyS5
<— Target

MITIGATION MEASURES

For DFS providers

- Change the direction of 2FA

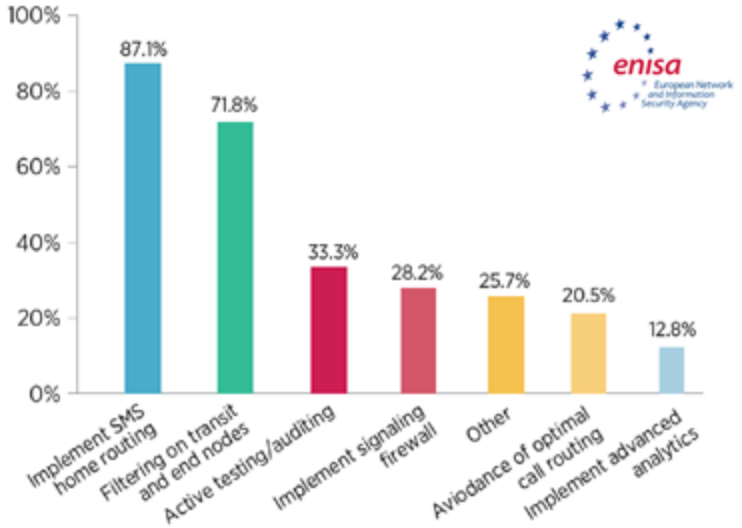
- Use a SIM Validation gateway

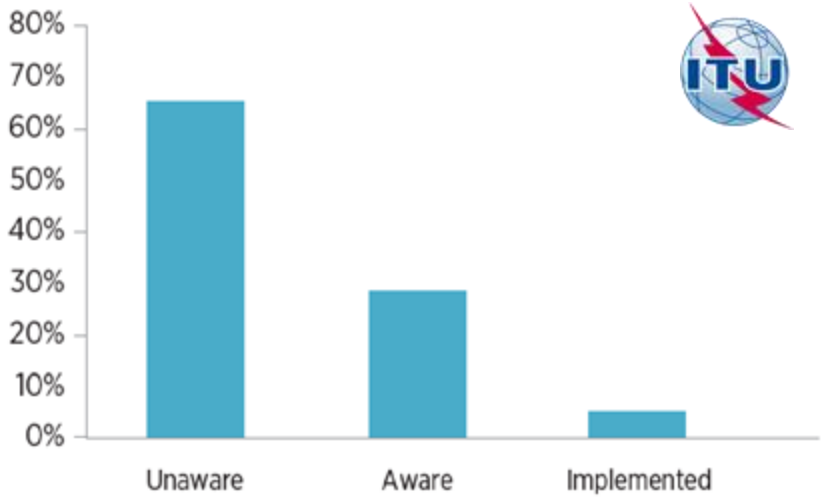


For Operators

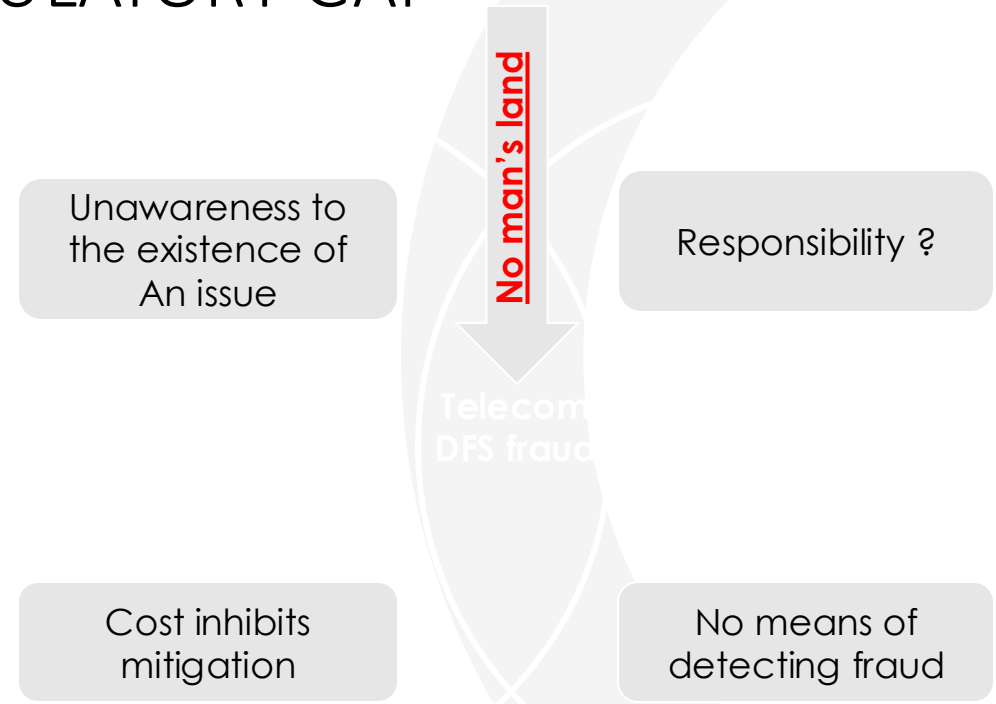
Attack	FS.11 (2/3G)	FS.07 (2/3G)	IR.82 (2/3G)	IR.88 (4G)
Spoofing	✓	✓	✓	×
SMS Hijack	×	✓	×	×
SIM swap	×	✓	✓	✓

IMPLEMENTATION OF COUNTERMEASURES





THE REGULATORY GAP



Mitigation Measures

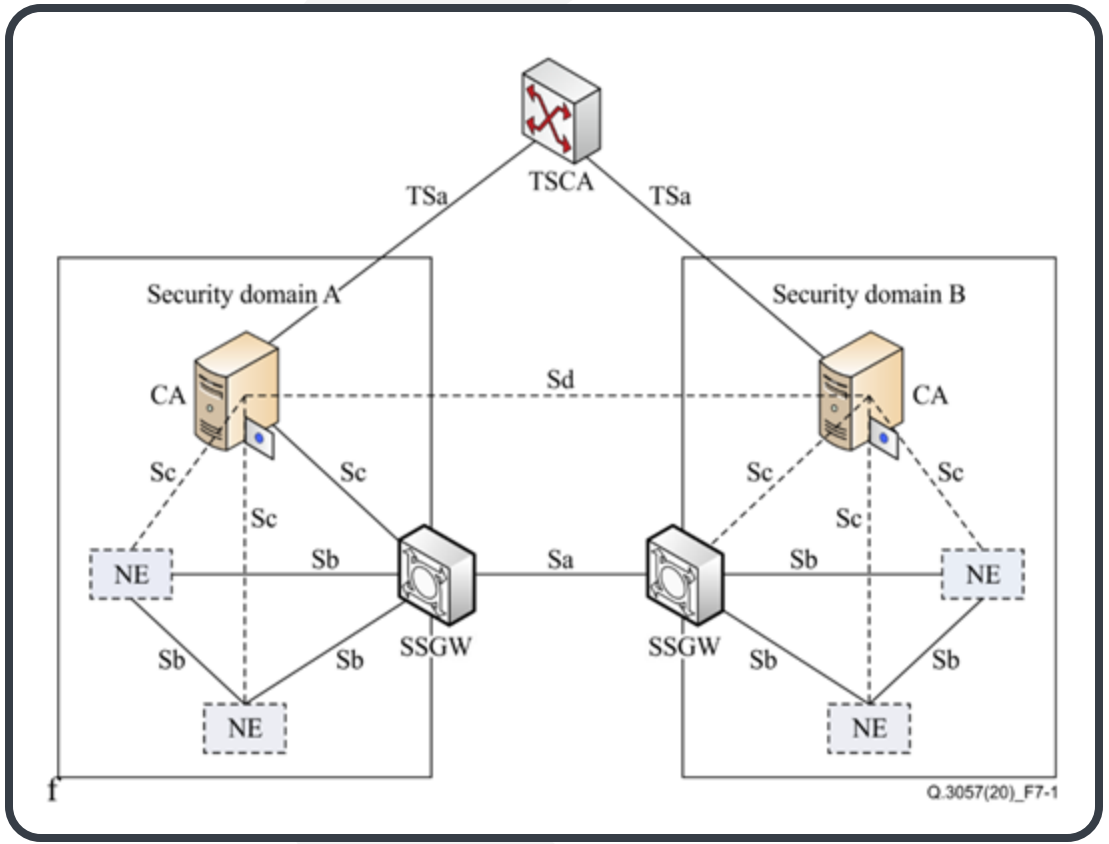
1. **Standardize trust in telecom signaling**
   - On going work in ITU-T study group 11
2. **Build an international trust chain**
   - WTSA Resolution 65 and on going work in study group 2 and study group 11
3. **Create a security posture baseline**
   - Telecom regulators to establish baseline security measures
4. **Close the regulatory gap by (financial <-> telecom)**
   - bilateral Memorandum of Understanding (MOU) related DFS should be in place between the telecommunications regulator and the central bank

Standardize trust in telecom signaling

- SG11 conducts several activities to advance SS7 security
  - Recommendation ITU-T Q.3057, Q.3062 & Q.3063 were approved in 2022
  - Technical report on USSD encryption was released in 2021
- ITU conducts security clinics and webinars on how to address SS7 vulnerabilities

ITU-T Q.3057 & Q.3062

- Add digital signature to SS7 messaging (based on TCAP-SEC)
- Prevents hackers from impersonating legitimate network functions on the SS7 network
- Enables operators to manage trust of other operators
- Using PKI as a reference model



ITU-T Q.3063
CALLING LINE IDENTIFICATION AUTHENTICATION

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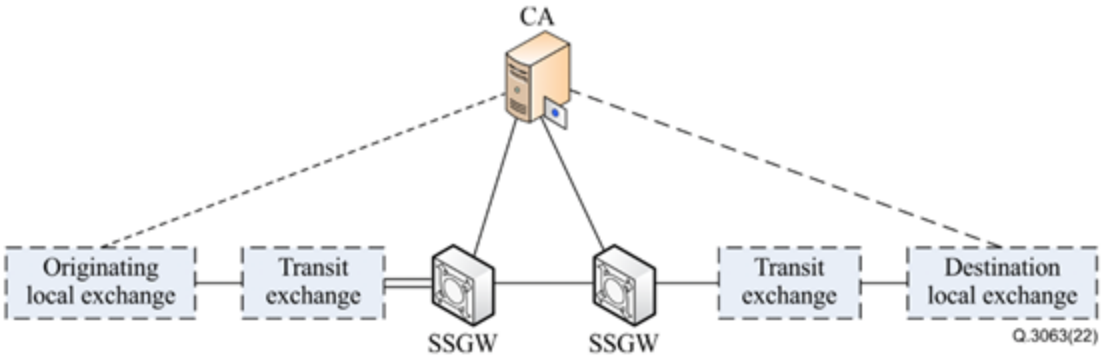

TR-USSD ENCRYPTION

- Advances in encryption implementation and sim card technology enable advanced crypto to run from STK
- USSD encryption can be implemented, **and be quantum safe**
- The TR surveys **available** technologies that can be used **today**
- The quantum safe crypto can be used in feature phones (STK)

Standardize trust in telecom signaling - Q.TSCA

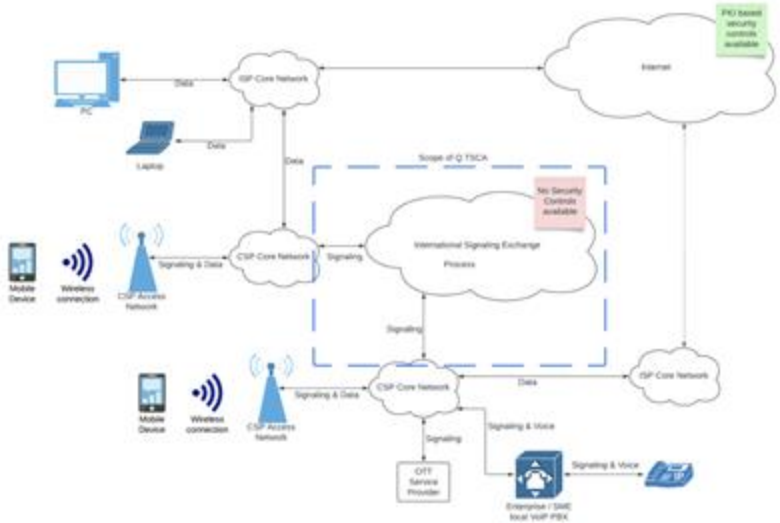

Figure 1 - current connectivity of CSPs to the international signalling exchange networks

Figure 2 - general representation for the TSCA trust chain.

Create a security posture baseline - Q.DMSA

- Telecom signaling networks are critical to the operation of mobile networks
- they are also susceptible to a range of sophisticated attacks.
  - Simple, Single Request Attacks
  - Single Protocol, Multi-Request Attacks
  - Multi-Protocol Attacks
  - Cross-Generational Signaling Attacks

Signaling attack detection methods - Q.DMSA

- SSGW Authentication and Verification: ensuring only legitimate messages enter the core network, the SSGW blocks forged or manipulated signaling requests that might otherwise trigger attacks.
- Rate Limiting and White-List Enforcement: crucial for mitigating simple, single-request attacks and multi-request attacks that attempt to overwhelm network elements.
- Heuristics Analysis: catches subtle, engineered discrepancies that may indicate tampering or malicious intent, especially effective against multi-protocol and multi-request attacks
- Anomaly Detection: monitor traffic patterns across the network, can detect inter-operator anomalies (such as SMS routes that deviate from standard A2P channels) as well as subscriber-level anomalies (such as unusual activity during off-peak hours)
- Cross-Protocol Consistency Checks: verify that information remains consistent as it passes between different protocols (e.g., confirming that data extracted via SS7 matches corresponding Diameter or SIP messages)

THANK YOU

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https://www.itu.int/en/ITU-T/dfs/Pages/share-platform.aspx

ITUWebinars

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Episode #2: Securing Mobile Payment Applications - 1

14:00 – 15:00 CET
26 March 2025
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