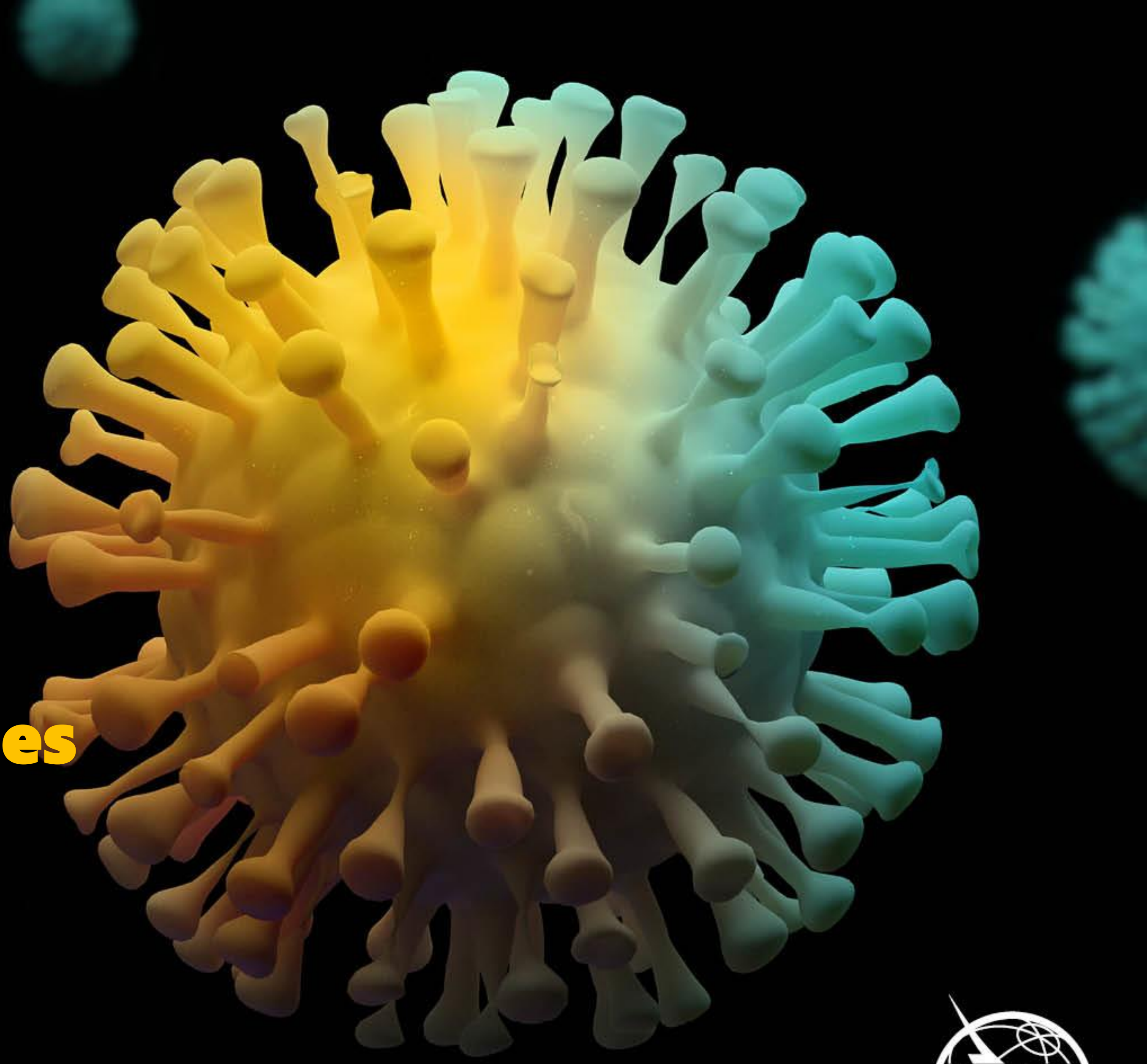
ITUEvents

Insights on Digital Financial Services during COVID-19 Webinar Series

Mitigating telecom infrastructure vulnerabilities



@Assaf Klinger

10/11/2020

A little about myself

- Husband, father (+2), geek 8-)
- Security researcher for the last 18 years
  - Specialize in telecom, IoT & blockchain
  - Member of FIGI SIT WG & DFGI SA WG
  - Member of ITU-T Study Group 11
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FIGI SIT work

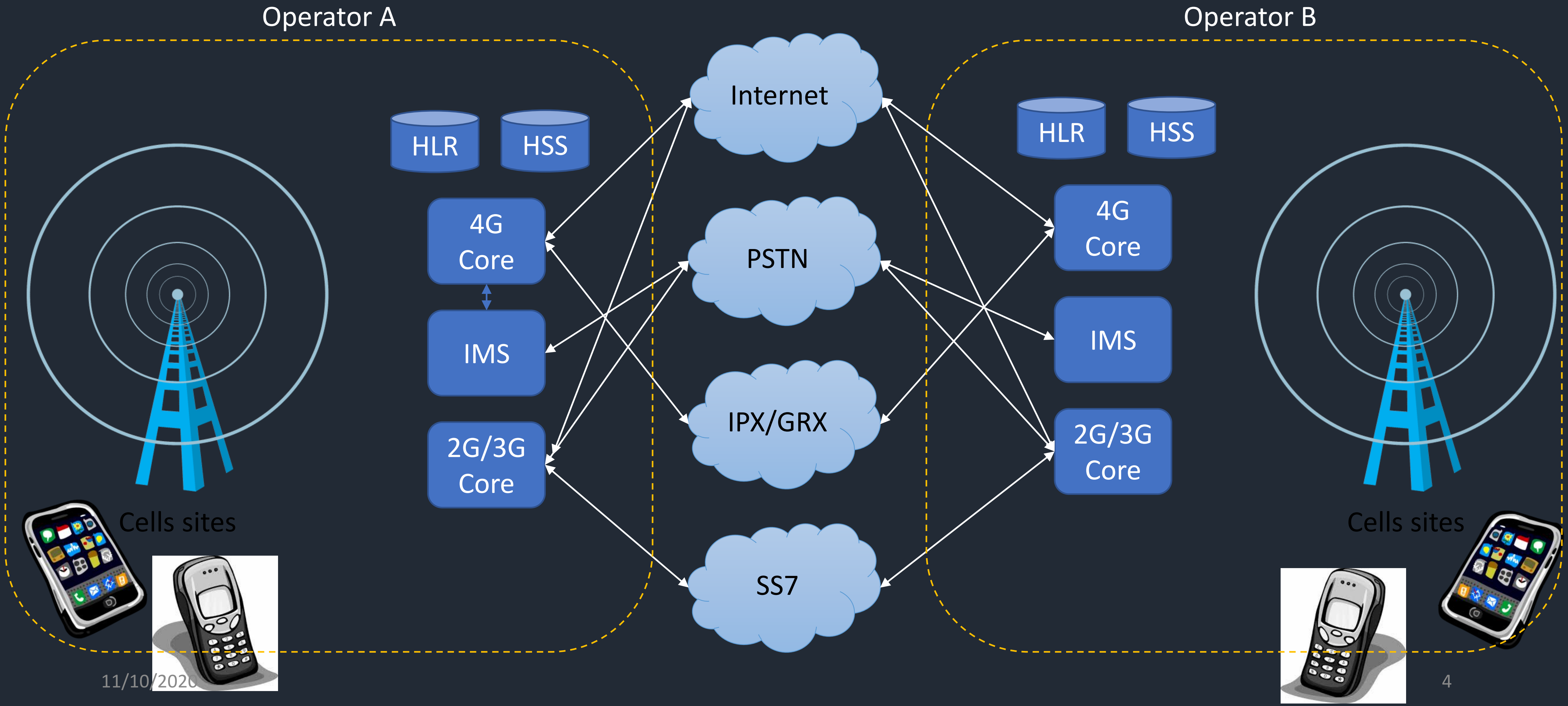
- Analyze the telecom infrastructure for vulnerabilities which enable DFS fraud

- Identify how are these vulnerabilities are exploited in the wild and to what degree

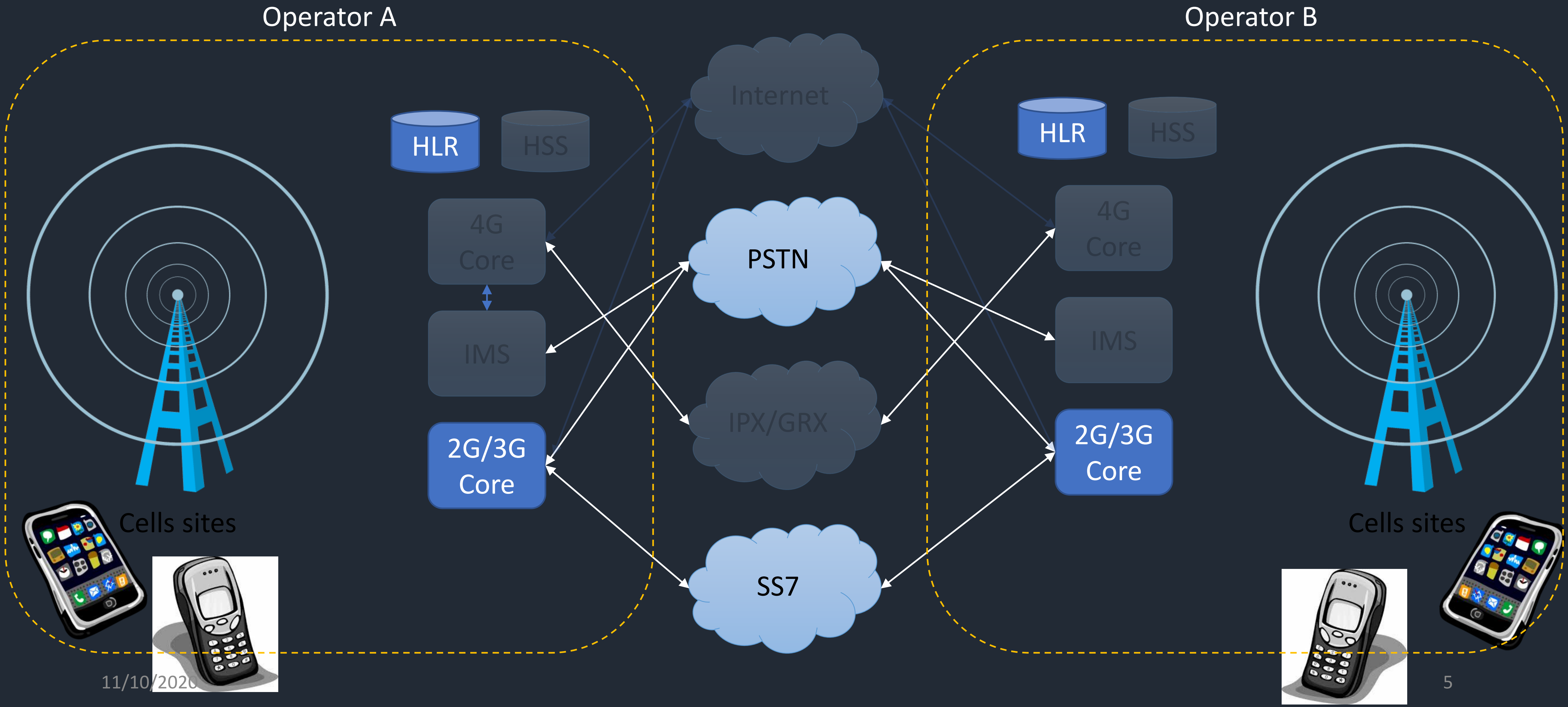
- Recommend mitigation measures for mobile network operators, DFS providers and regulators

- **Main Output →** **Technical report on SS7 Vulnerabilities and mitigation measures for DFS**

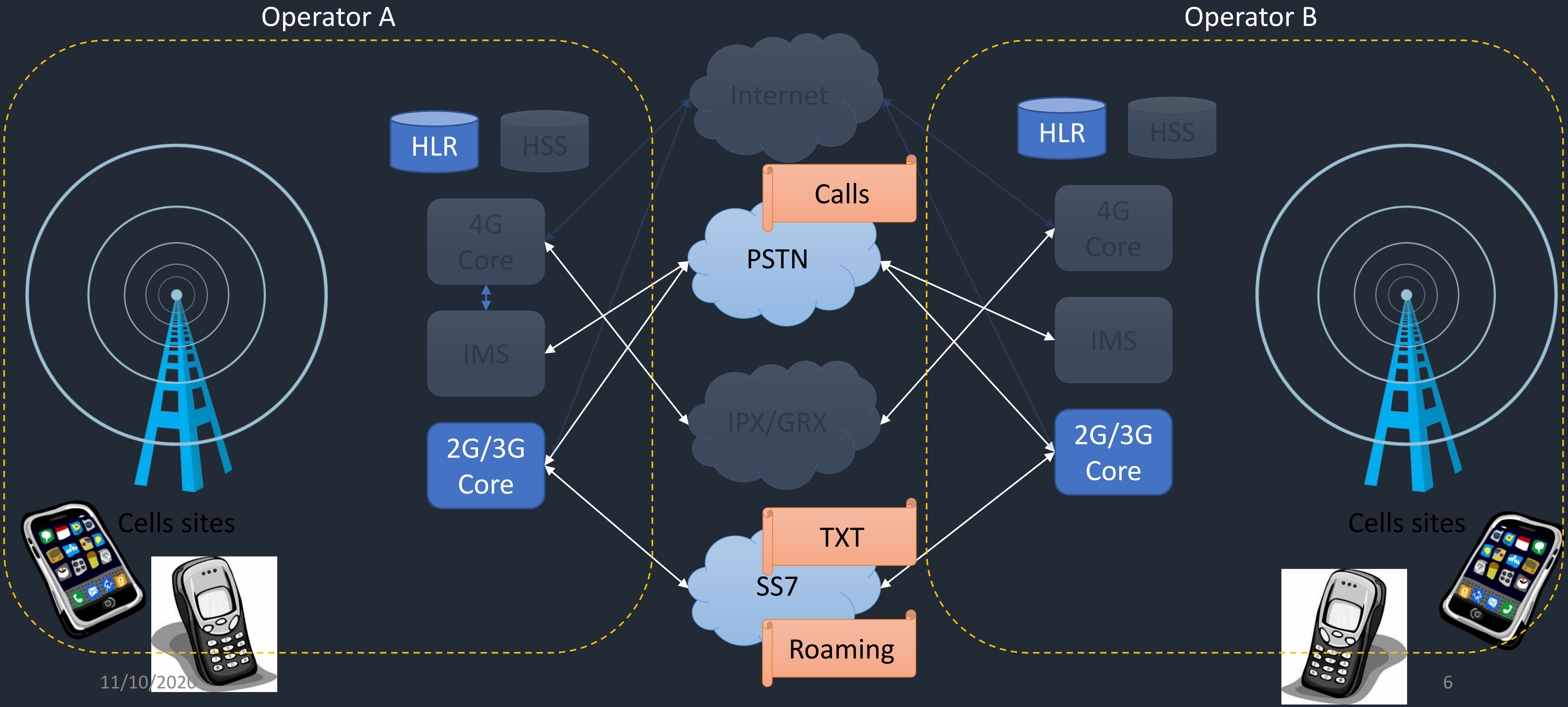
Telco’s core network



Our scope

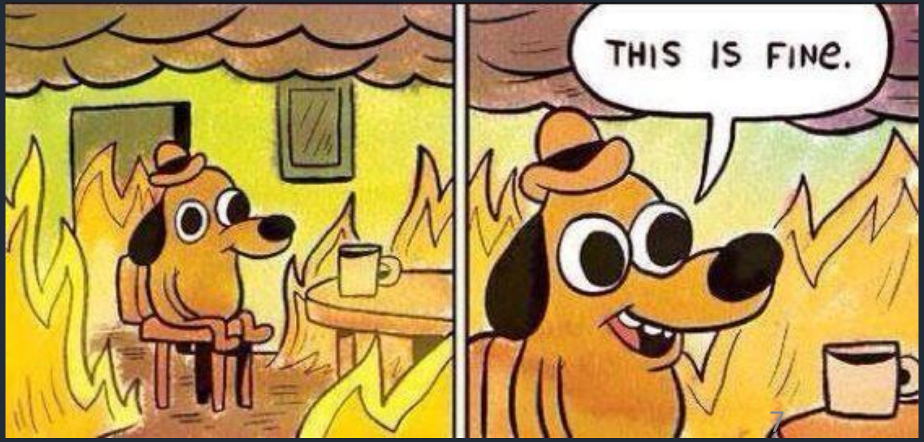

Operator A
Operator B
HLR
HSS
4G
Core
IMS
2G/3G
Core
Internet
PSTN
IPX/GRX
SS7
HLR
HSS
4G
Core
IMS
2G/3G
Core
Cells sites
Cells sites

Telecom services over SS7



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



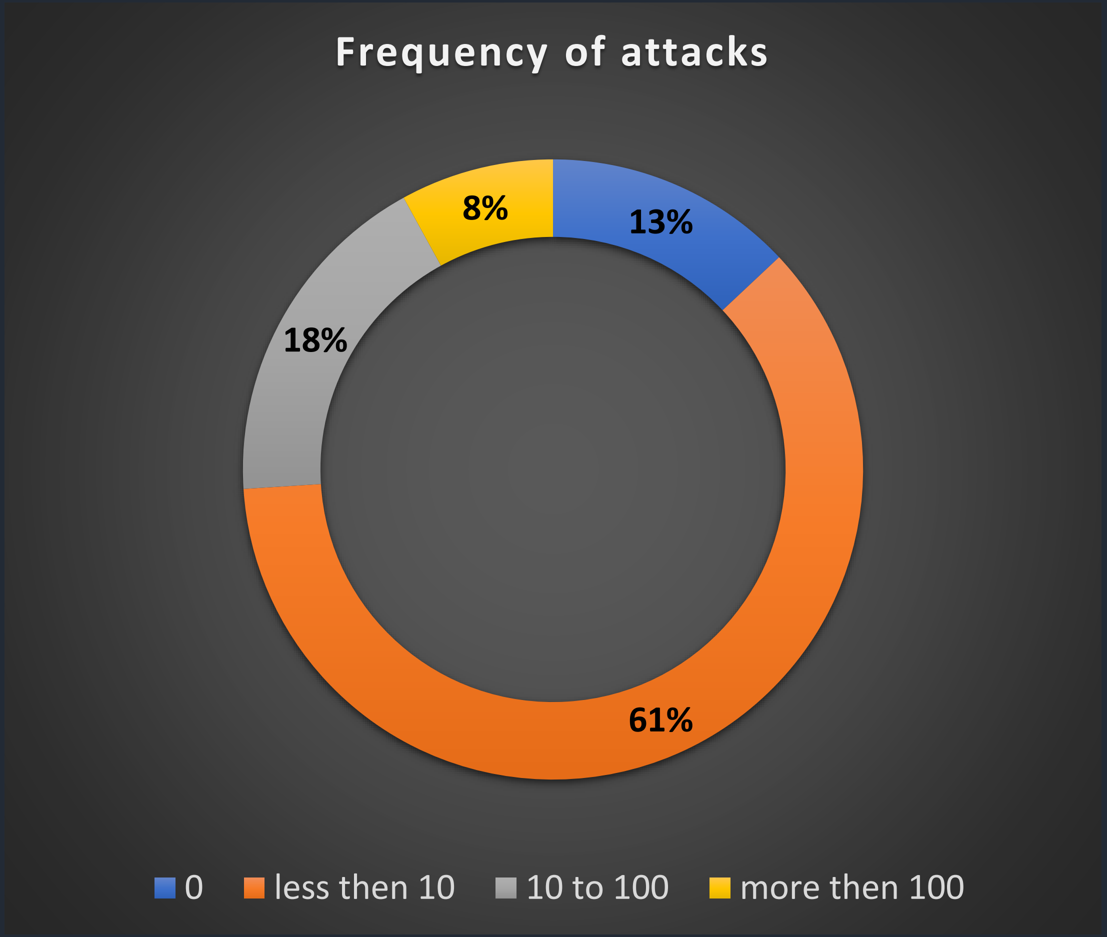
DFS - Digital financial services

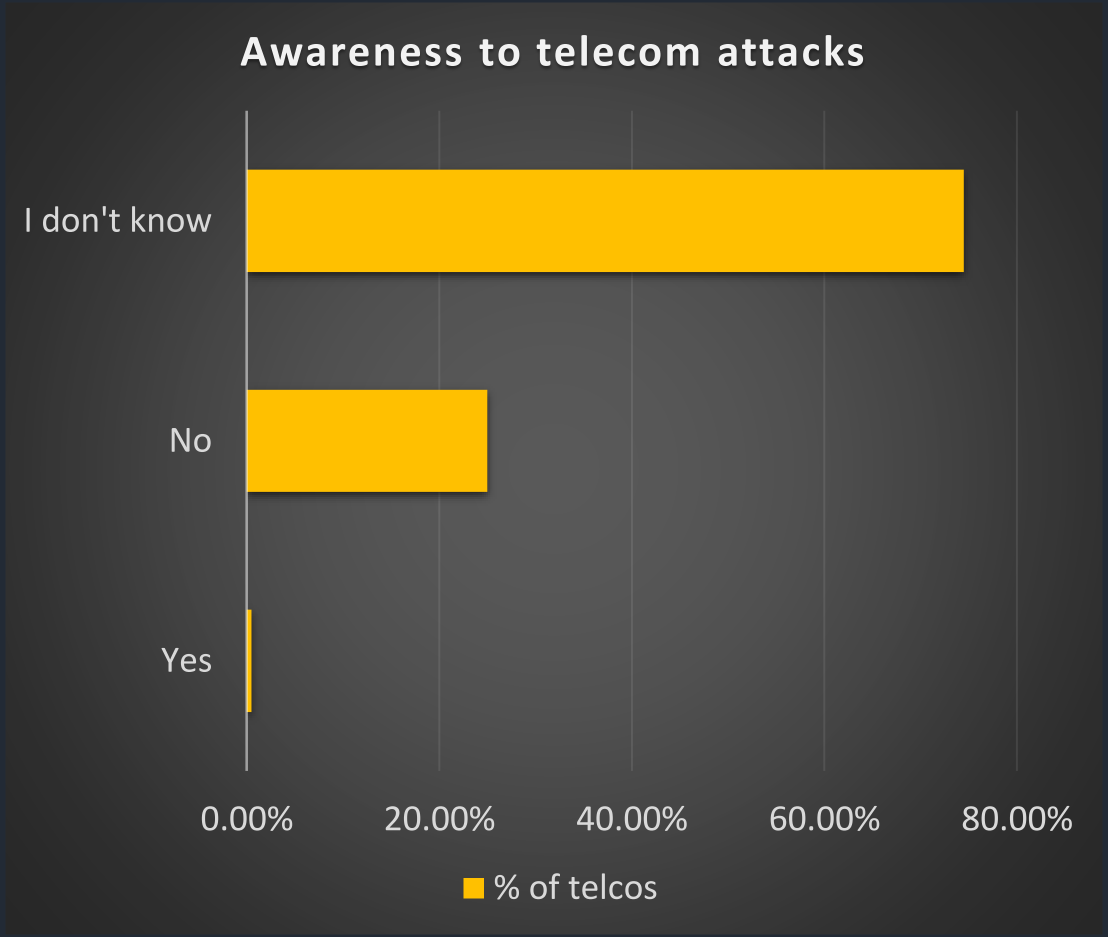
- Digital financial services (DFS) relies heavily on the underlying teleco infrastructure to enable users send and receive money
- The channels in which the end-user communicates with the DFS provider are mostly USSD and SMS, due to the lack of 3G/LTE deployment in these countries.
- According to surveys, less than 30% of the telcos in the European Union (EU) and less than 0.5% of telcos in developing countries have implemented any mitigation measures, despite the existence of such measures.

DFS, Telecom & the regulation gap

- Legacy technology (over 20yo) still active today – e.g SS7
- Published vulnerabilities still in affect, exploited in the wild for theft
- Telcos are not required to mitigate these vulnerabilities
- Misalignment of regulatory interests

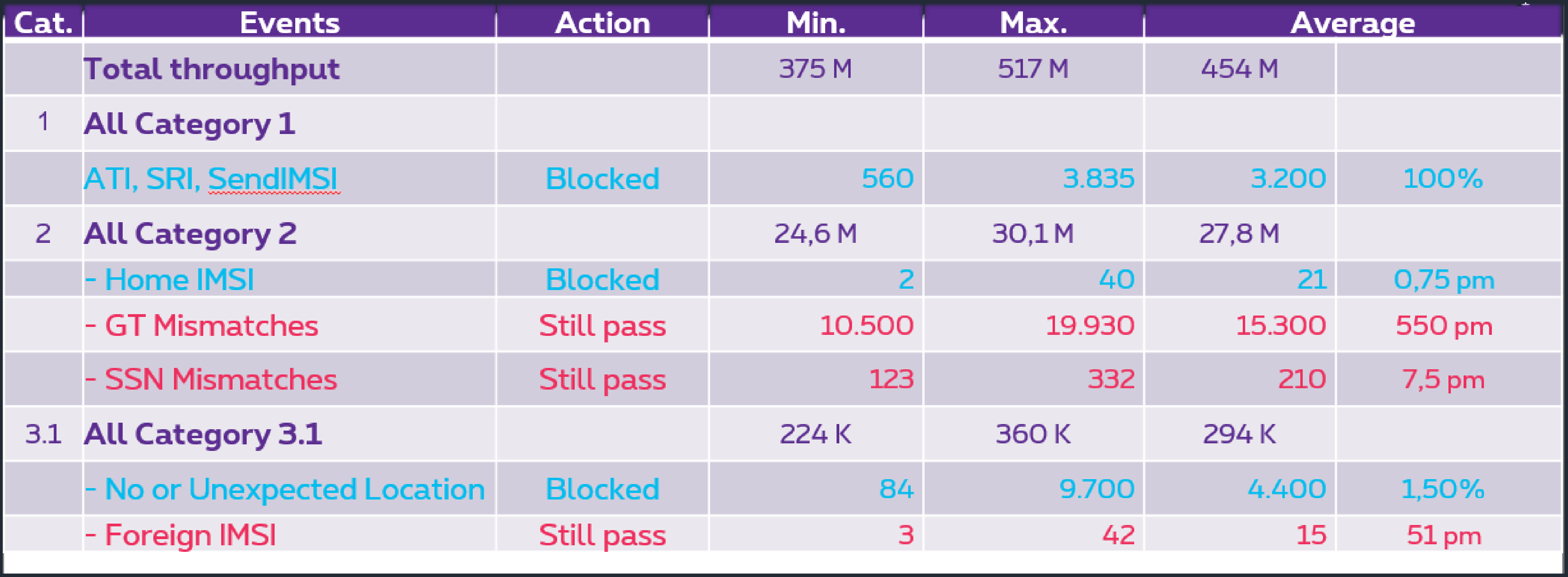
The commonality of Telecom attacks





Example from a major EU operator

Statistics (per-day)



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

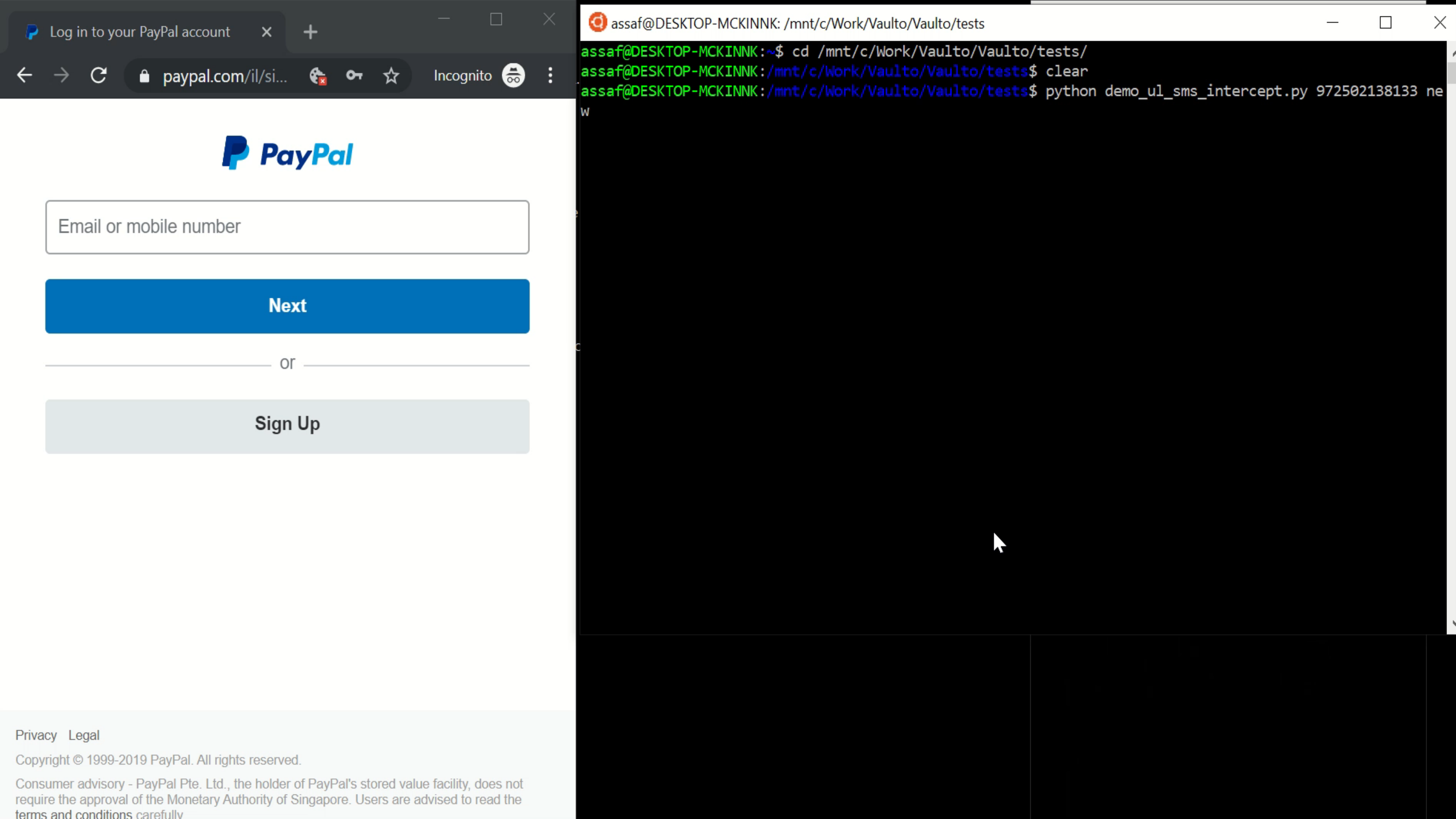
Caller ID spoofing

2FA account takeover

SIM swap

2FA SMS interception

Example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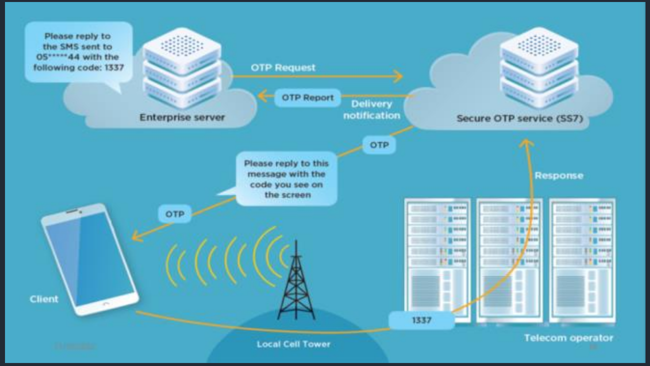
```
assaf@DESKTOP-MCKINNK:~$ cd /mnt/c/Work/Vaulto/Vaulto/tests/
assaf@DESKTOP-MCKINNK:/mnt/c/Work/Vaulto/Vaulto/tests$ clear
assaf@DESKTOP-MCKINNK:/mnt/c/Work/Vaulto/Vaulto/tests$ python demo_ul_sms_intercept.py 972502138133 ne
w
```

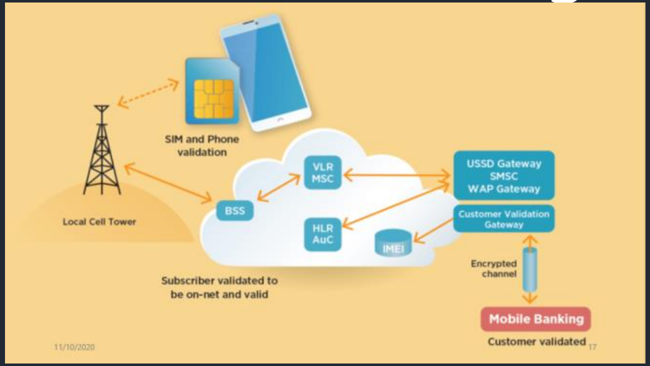
Mitigation Measures

For DFS providers

- Change the direction of 2FA



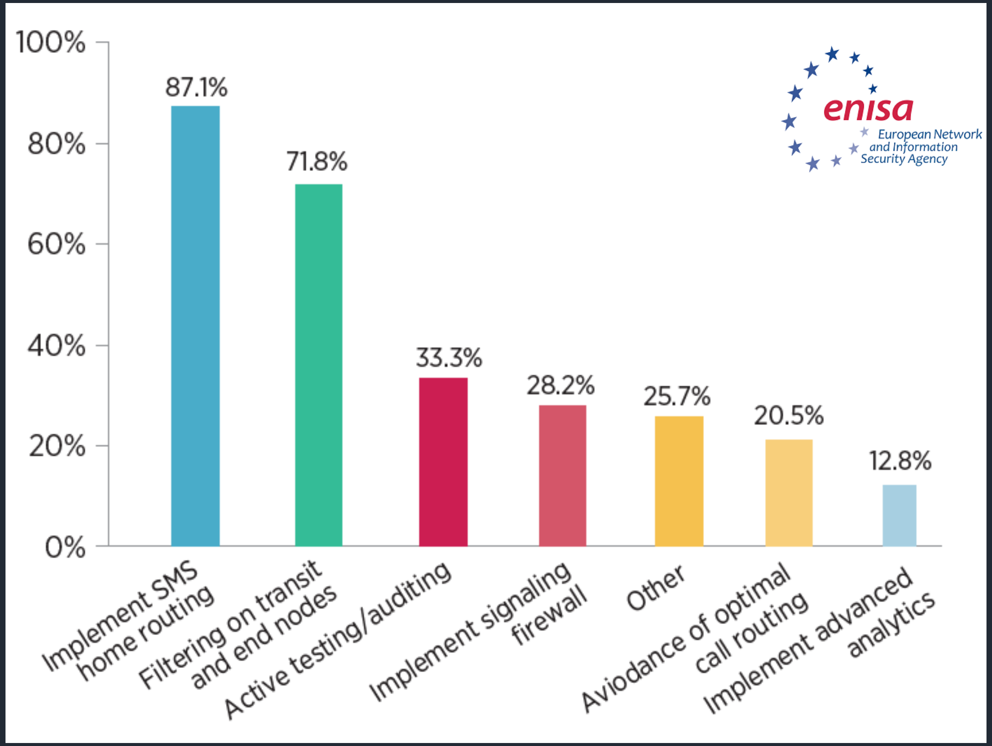
- Use a SIM Validation gateway

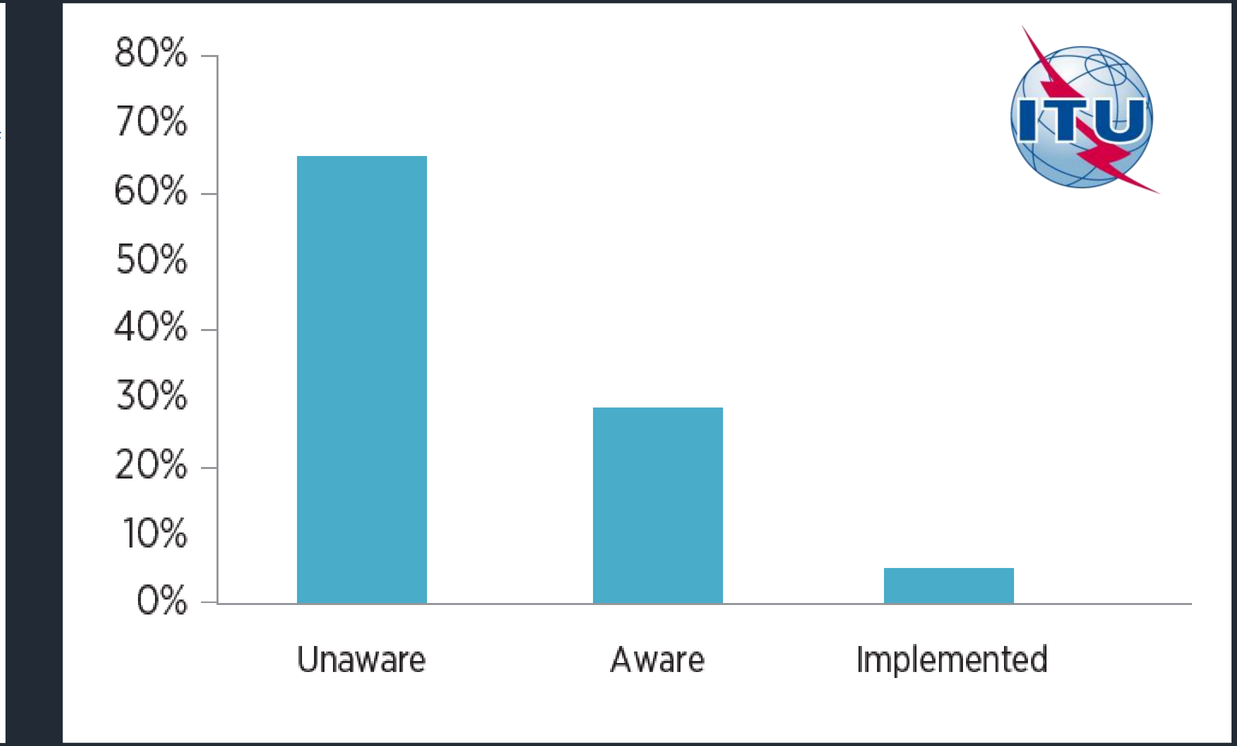


For Operators

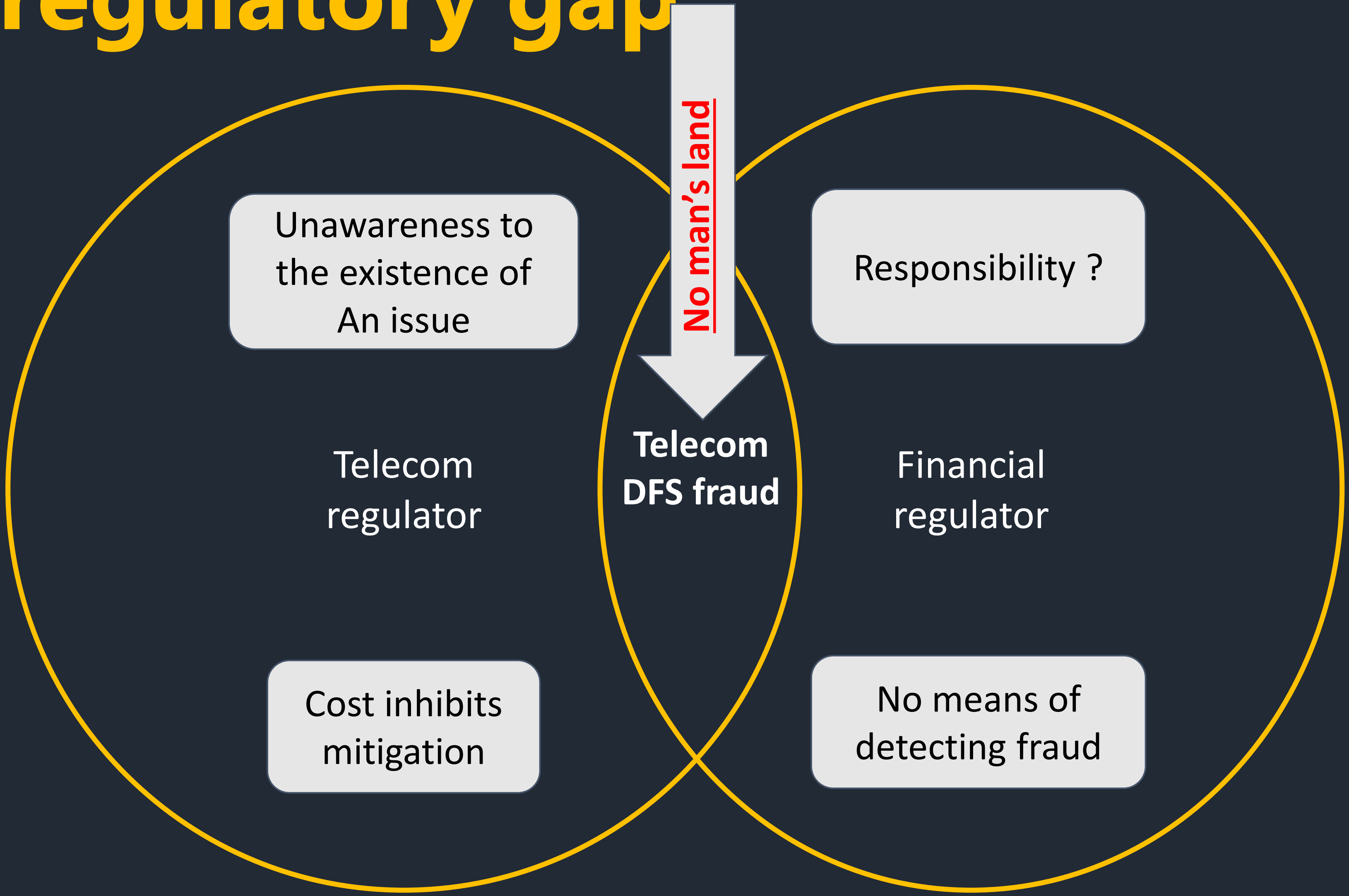
Attack	FS.11 (2/3G)	FS.07 (2/3G)	IR.82 (2/3G)	IR.88 (4G)
Spoofing	✓	✓	✓	×
SMS Hijack	×	✓	×	×
SIM swap	×	✓	✓	✓

Implementation of countermeasures





The regulatory gap



Recommendations

1. **Educate**
   - Education for telecom and financial services regulators on SS7 vulnerabilities and impact to DFS
2. **Regulate**
   - Regulation and legal framework to include measures for signaling security and reporting of such incidents
3. Create a security posture baseline
   - Telecom regulators to establish baseline security measures for each category (3G/4G/5G)
4. Close the regulatory gap by regulatory coordination (financial <-> telecom)
   - bilateral Memorandum of Understanding (MOU) related DFS should be in place between the telecommunications regulator and the central bank.
5. Incentivize the industry
   - create regulation that passes the financial damage from DFS fraud to the DFS providers and to the telcos, creating a financial incentive for action on their part
6. Industry cooperation and incentivization
   - Forums should be created where all commercial actors in the DFS ecosystem meet and interact regularly
   - Establish or promote a platform for security incident data sharing

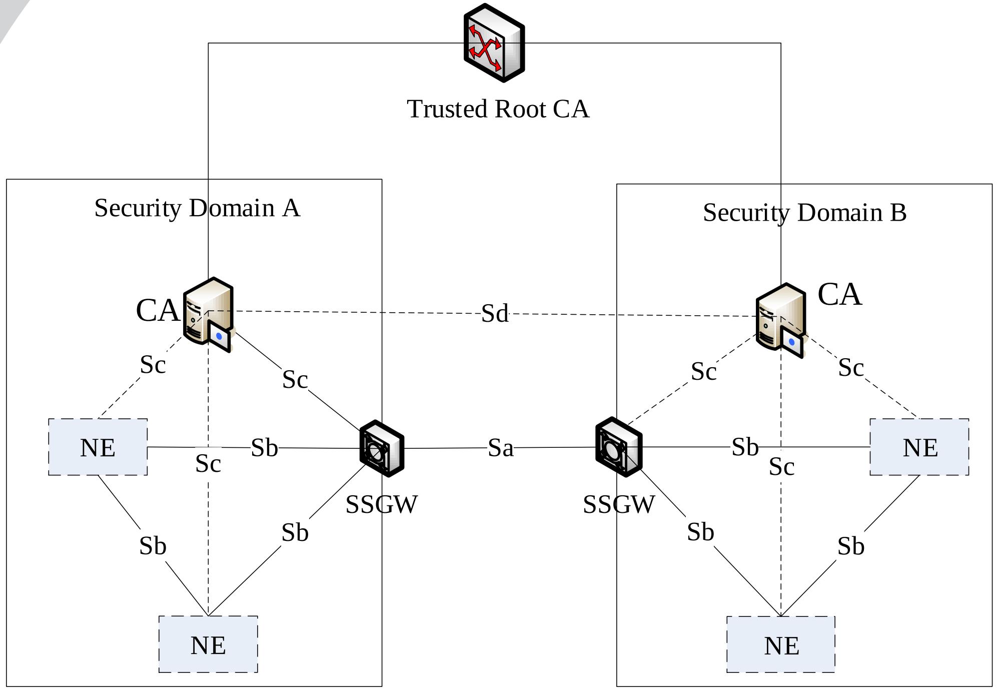
Recommendations implementation

Educate

- SG11 conducts several activities to advance SS7 security
  - Recommendation ITU-T Q.3057 was approved in April
  - Technical report on USSD encryption scheduled to be released in March
- ITU conducts security clinics and webinars on how to address SS7 vulnerabilities

ITU-T Q.3057

- 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 TLS 1.3 as a reference model



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)

Regulate

- This is up to each country to do
  - Local regulators need to put in place regulation to **mandate** the implementation of countermeasures in the telecos (communication regulators) or in the DFS providers (financial regulators) **and audit** the security posture of each operator / provider
  - Setup a round table discussion with all local stake holders: DFS, Telcos, Financial and communication regulators

Incentivise

- DFS can implement countermeasures regardless of telco / regulatory action to mitigate fraud and lower the financial damage from fraud
- Encourage global grant programs for technological innovation in the field of DFS fraud protection (with regards to SS7 vulnerabilities)
- Encourage the deployment of packet data networks (3G / LTE) in rural areas to enable more sophisticated forms of authentication to DFS

Thank you

For questions please reach out to:

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