Effective SS7 protection

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Luca Melette <luca@srlabs.de>

SECURITY
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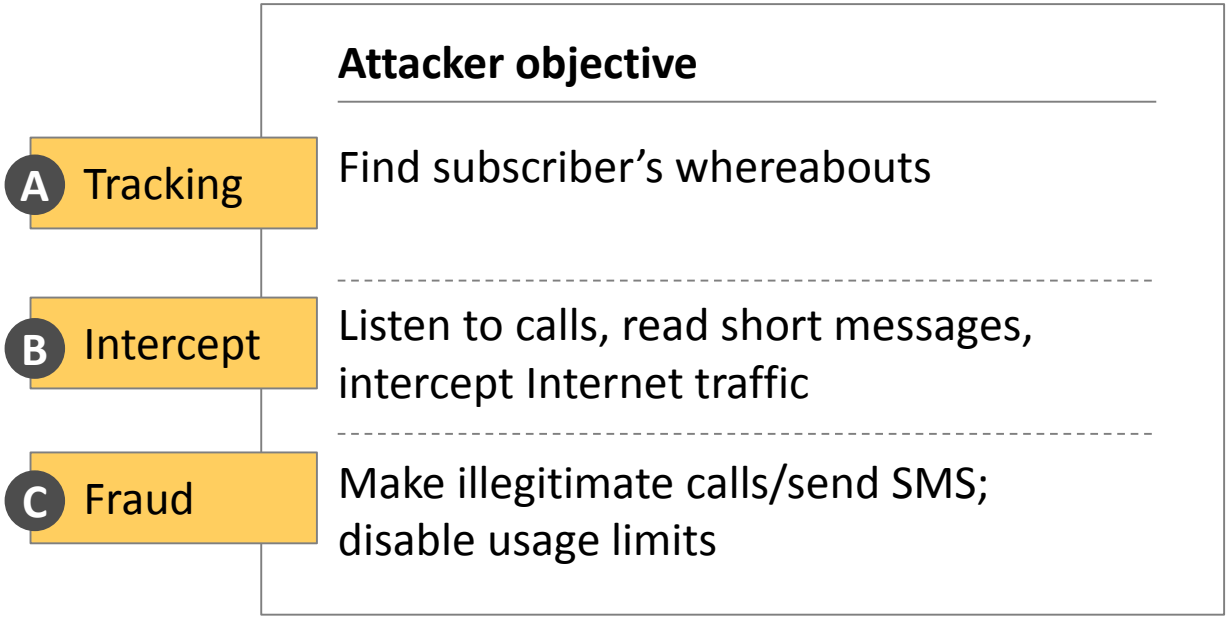
Motivation: Operators and their users still vulnerable to SS7 attacks

Agenda

- **3 attack scenarios**
- 10 attack messages
- 4 defense measures

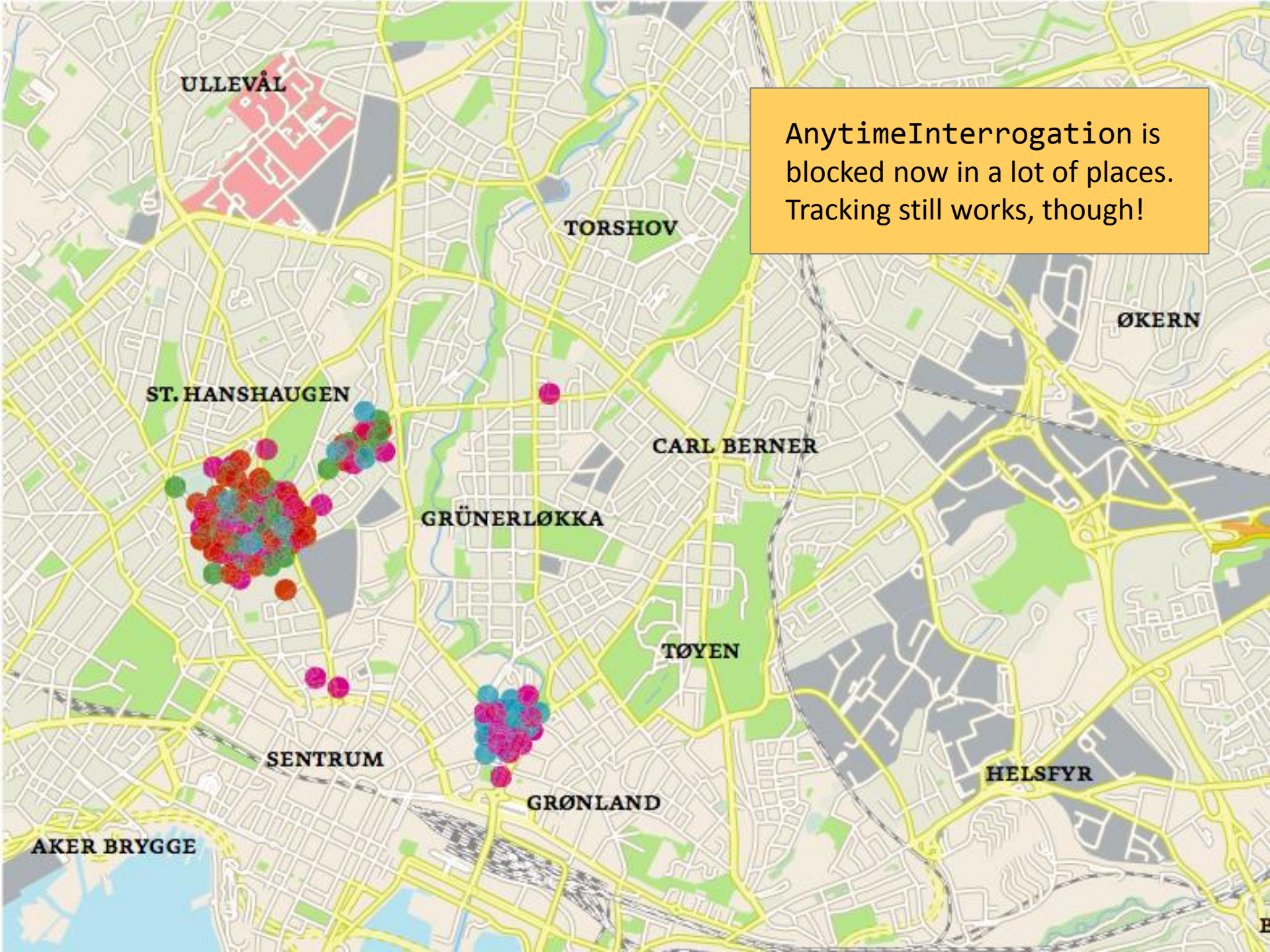
SS7 enables mobile abuse on different frontiers



A **Tracking** through ATI has become commonplace


The Washington Post

For sale: Systems that can secretly track where cellphone users go around the globe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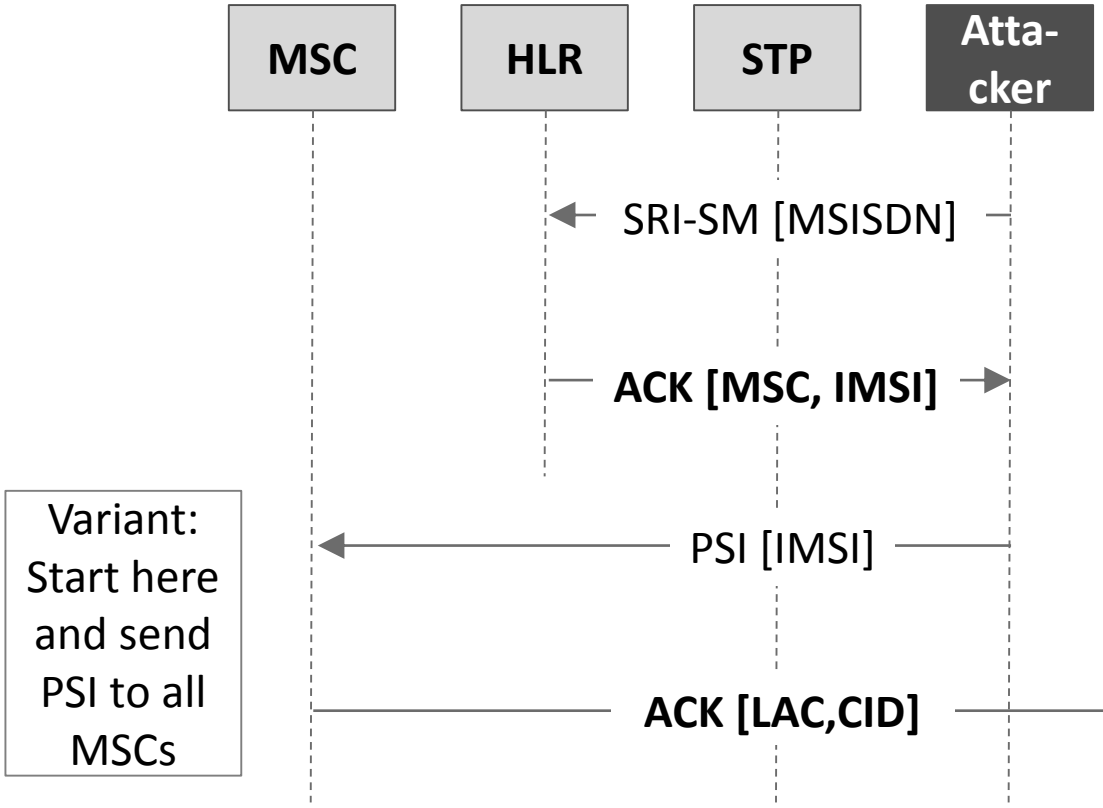
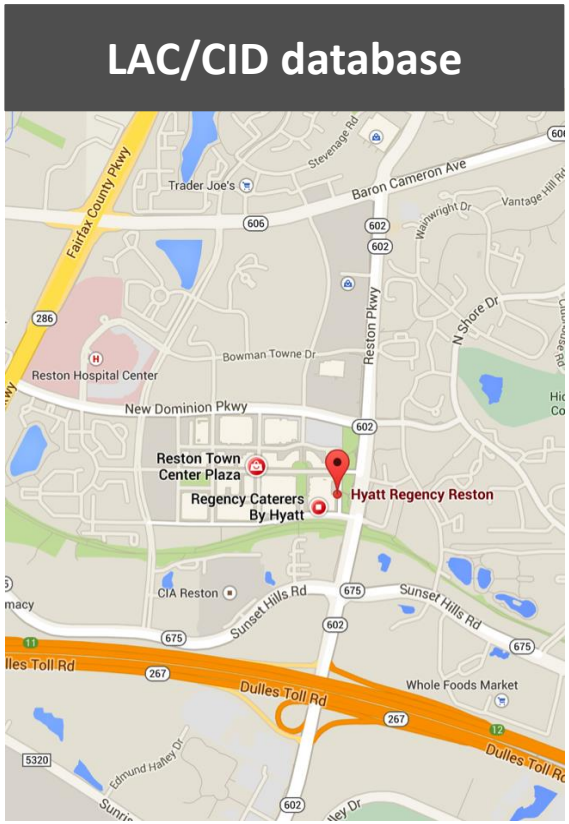
AnytimeInterrogation is blocked now in a lot of places. Tracking still works, though!

A Accurate **tracking** is possible with standard messages

Shown in *60 Minutes*

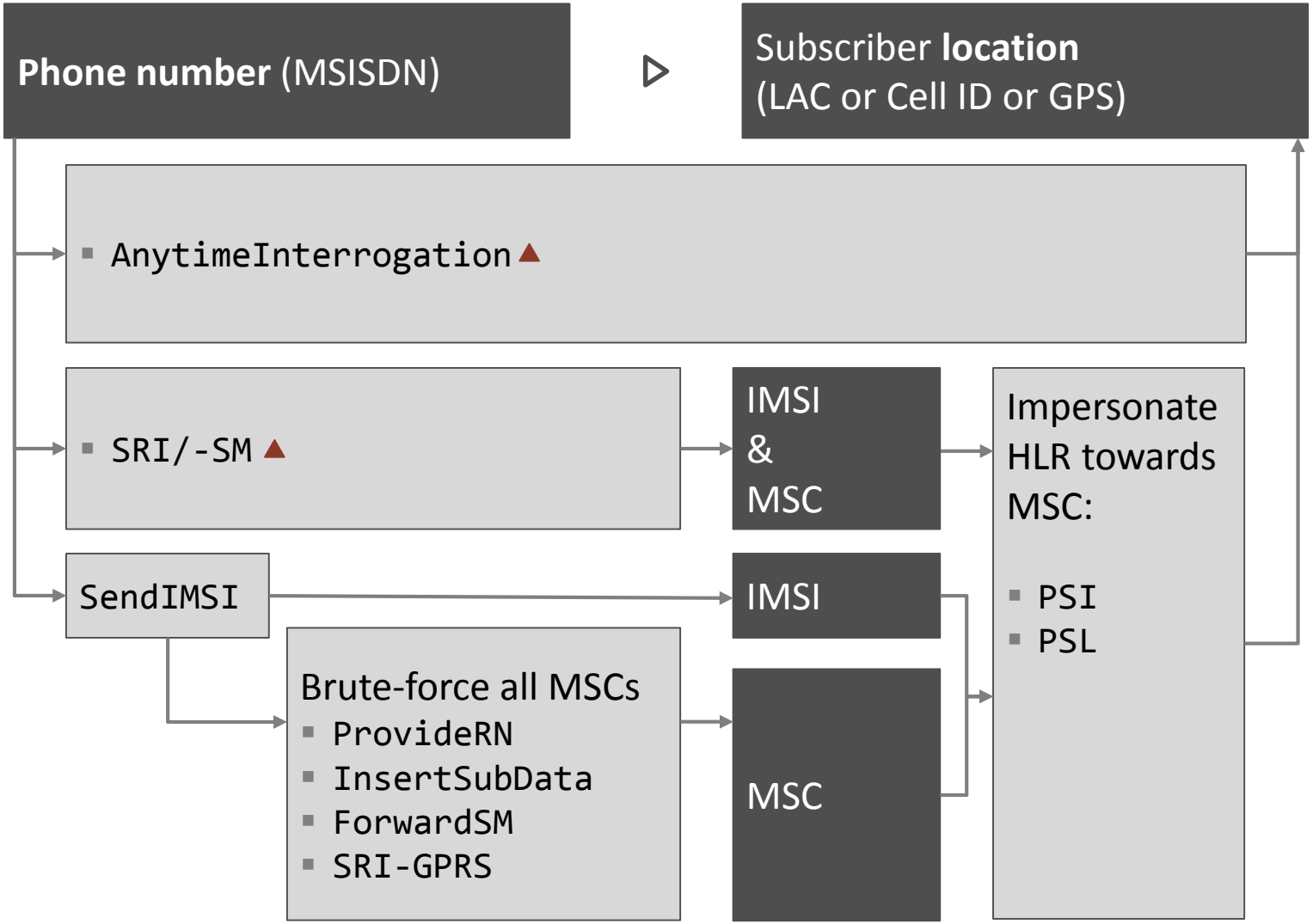
Attack – Probe MSC for subscriber location





A **Tracking** can happen using many more signaling messages

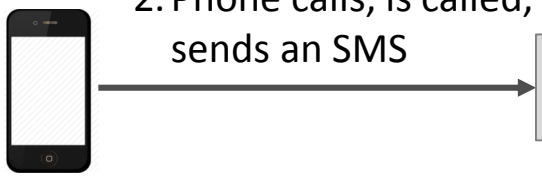
▲ Send to phone number or all HLRs or directly to MSC



B Remote **intercept** is possible through Camel

Shown in *60 Minutes*

Attack – Rewrite numbers over Camel



2. Phone calls, is called, or sends an SMS

MSC

1. `InsertSubscriber-Data(Camel server)` sets "triggering points"

3. Sends destination number to Camel server for verification

4. "Corrects" number

5. Connects call or sends SMS to attacker

Call out	✓
Call in	✓
SMS out	✓
SMS in	✗

Call intercept works for all Camel versions

SMS intercept requires Camel v3

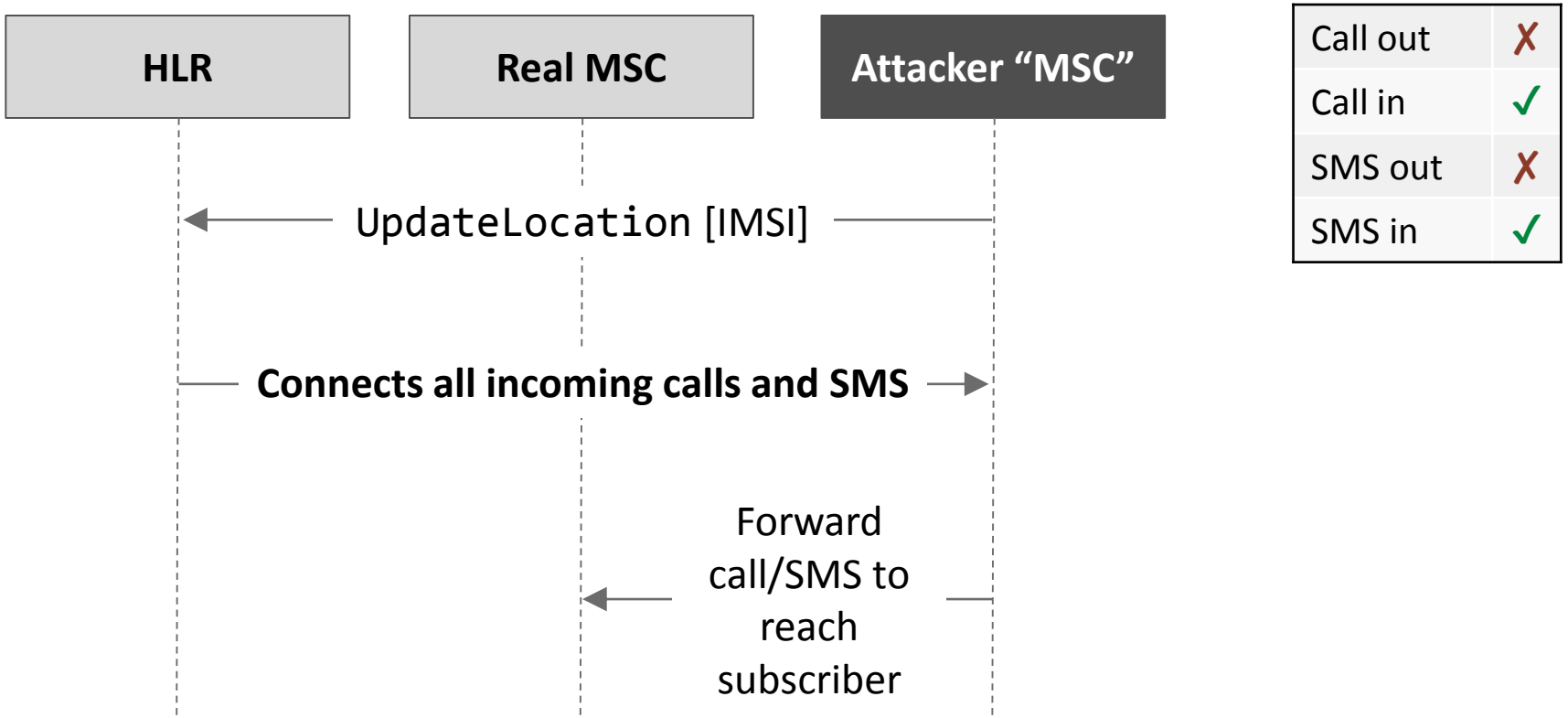
SS7 STP | **gsmSCF** | **MITM server**

Attacker

B Location update also achieves remote **intercept**

Shown in *60 Minutes*

Attack – Register as subscriber



C Selective **denial-of-service** is possible remotely

Signaling message	Send to	Effect
`CancelLocation`	MSC	For some phones: No service until reboot
`DeleteSubData`	MSC	Nothing works until next LU
`InsertSubData`	MSC	
`PurgeMS`	HLR	No Incoming SMS / Calls

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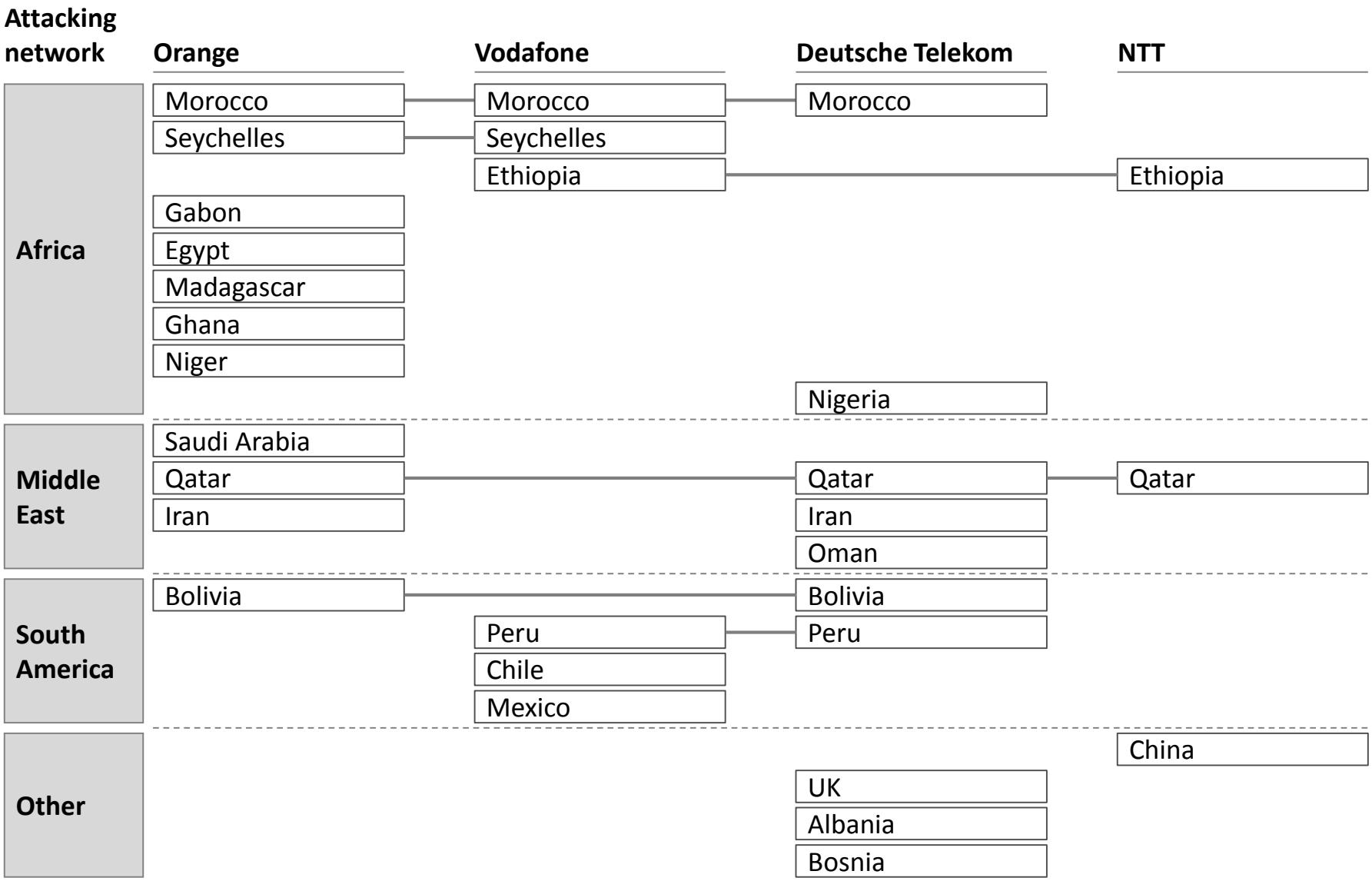
SS7 attacks are happening across the words

○ Some ○○ Thousands ○○○ Millions

		Observed attacks [GSMA FASG reports]			
	Attack message	**Orange** 22 countries	**Vodafone** 19 cntrs	**Deutsche Telekom** (Germany)	**NTT** (Japan)
Tracking	1. ATI	○○○	○○○	○○○	○○
	2. SRI-(SM)	○○○	○○	○	○○○
	3. PSI	○	?	○	○○○
	4. PSL	○	?	-	○○
	5. SendIMSI	○○	○○	○○	○○
Remote intercept	6. ActivateSS				
	7. Update location				
	8. ISD				
Fraud	9. DSD				
	10. SendID				

? No measurements reported to the FASG so far

Attacks originate in a diverse set of networks



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An SS7 firewall is necessary to defend from advanced attacks

	Defense	Messages	Where
Block	▪ Drop these messages	1. ATI 2. SRI 5. SendIMSI 10. SendID	1 **STP**
Re-route	▪ Home-routing + IMSI obfuscation	2. SRI-SM	2 **HLR**
Check origin	▪ Compare GT and IMSI: Is the operator asking about their own subscriber?	3. PSI 8. ISD 9. DSD	**Simple SS7 firewall**
Check location	▪ Compare GT with subscriber location: Is your subscriber in that country?	6. ActivateSS 7. UpdateLoc	3 **State-full SS7 firewall -or- simple firewall + ATI**

4 **+ Monitor, Monitor, Monitor!**

Take away

It's about time to solve 99% of the current SS7 problem by

- **… addressing 3 attack scenarios (Track, Intercept, Fraud) …**
- **… which rely on 10 SS7 messages …**
- **… that we can rejected using just 4 defense measures: STP, HLR, SS7 Firewall, and Monitoring!**

Questions?

Luca Melette <luca@srlabs.de>

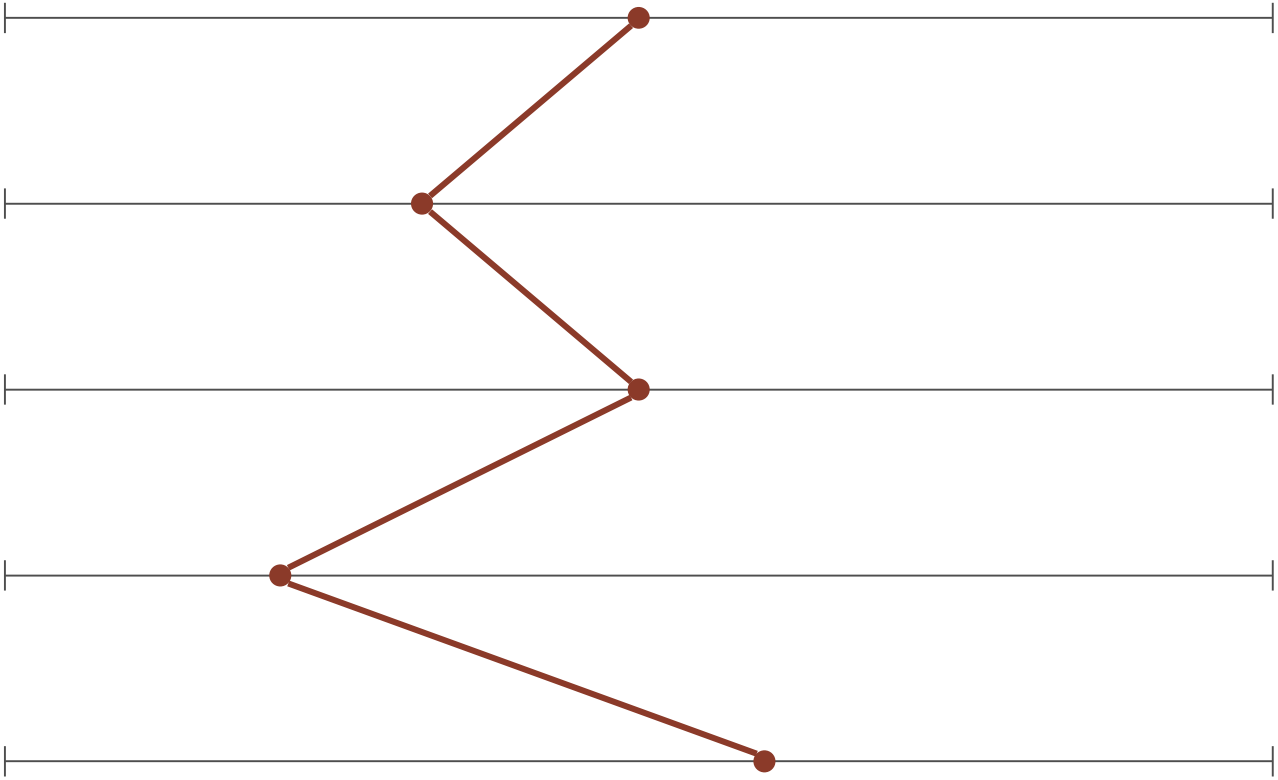
Protection from **SS7 threats** varies; can be improved

Exposure scan available from SRLabs

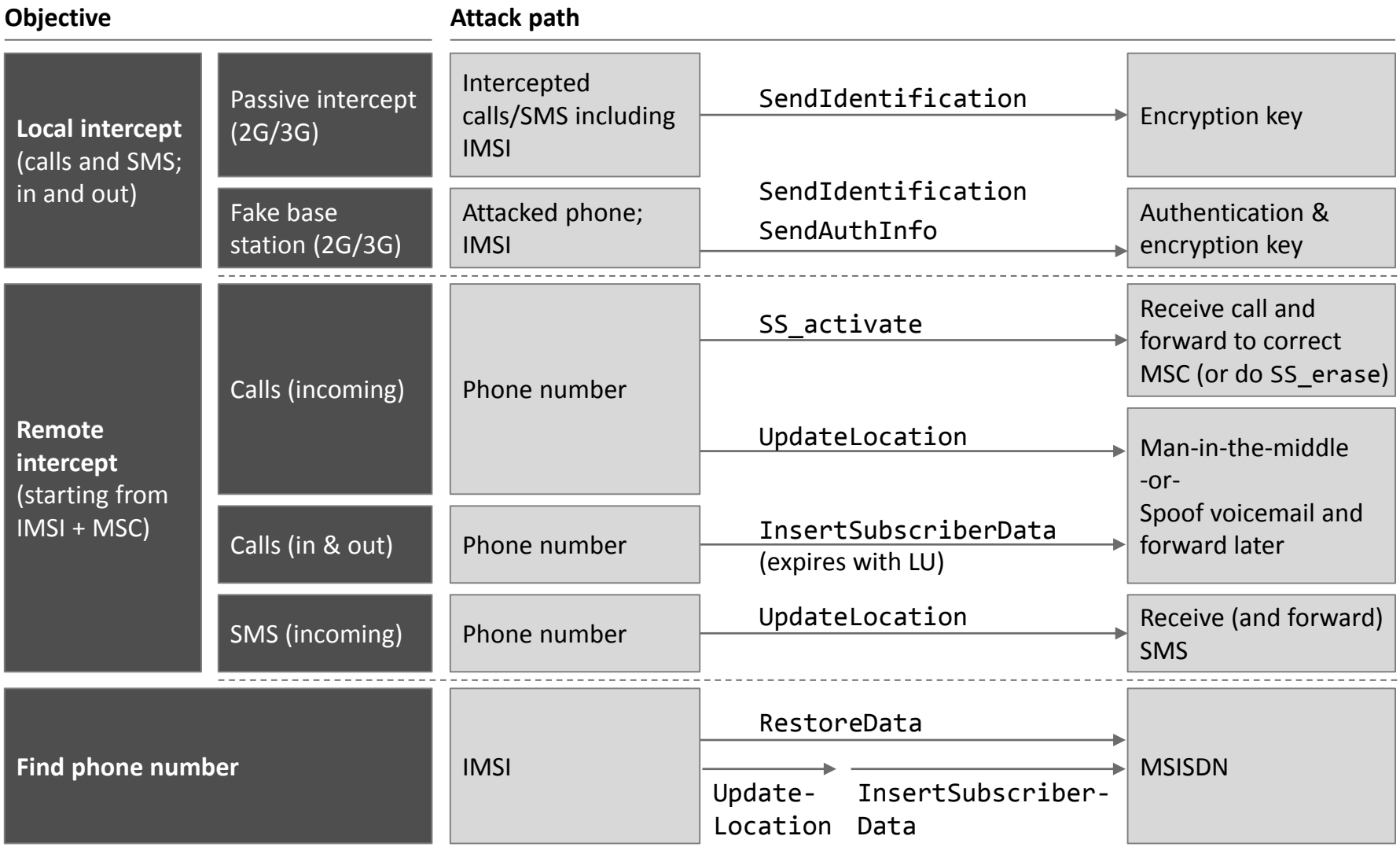
Illustrative

Threat category

		Unprotected	Standard attacks prevented	Advanced attacks prevented
A	**Tracking** – Remotely query subscriber location			
B	**Intercept** – Read SMS or listen to calls, locally or remotely			
C	**Denial-of-service** – Remotely disrupt subscribers service			
D	**Fraud** – Add premium number charges to bill			
E	**Spam** – Subscribers with SMS			



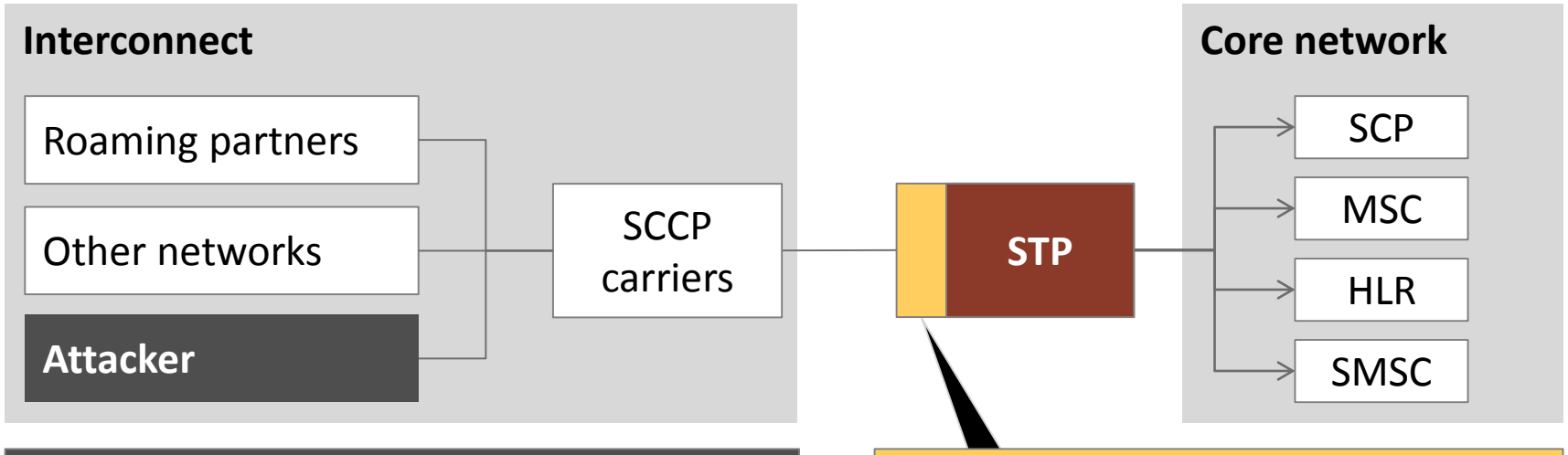
B Local and remote **intercept** is enabled through various signaling messages



Not all SS7 attacks can simply be blocked

Abuse scenario	Example SS7 attack message	Mitigation effort
1 **Local passive intercept**	▪ `SendIdentification`	▪ **Easy –** Block message at network boundary
2 **IMSI Catcher**	▪ `SendAuthenticationInfo`	▪ **More complex –** Messages are required for operations, need to be plausibility-checked
3 **Rerouting attacks**	▪ `SS_activate/register` ▪ `UpdateLocation` ▪ Camel messages ▪ (Probably others)	

STP is the central instance for SS7 filtering



Attacker strategy

- Impersonate interconnect partners
- Address target elements by GT or SSN
- Issue unexpected MAP commands

STP defense

- **Block.** Verify that CgPA belongs to a trusted partner
- **L3 Firewall.** Enforce GT / SSN relationships
- **L7 Firewall.** Enforce MAP / GT relationships