MOBILEUM

FIREWALL AND SECURITY SOLUTIONS

Why is security important?

52%

Of consumers would leave or consider leaving their operator because of a security breach

58%

Of enterprises would leave or consider leaving their operator because of a security breach

3rd

Most likely reason to churn.

After price and coverage

2nd

Most likely reason to churn.

After price

62%

Of consumers would want to use 2FA less, stop using or have an alternative

73%

Of enterprises would want to use 2FA less, stop using or have an alternative

Source 2017 and 2018 consumer and Enterprise survey by Mobile Squared (sponsored by Mobileum/EI)

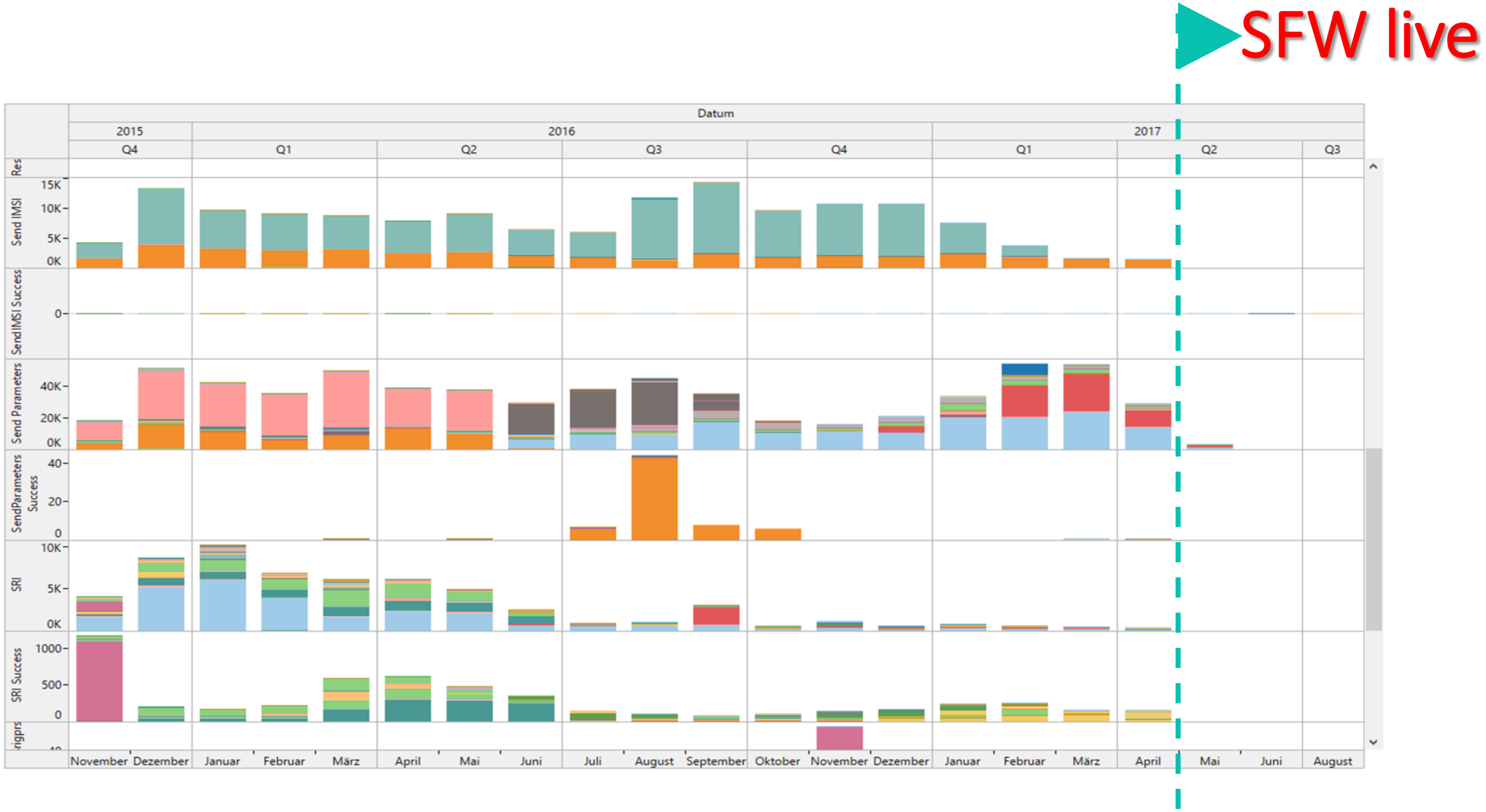
What is the business case?

- Brand protection
- Regulation (or threat of)
- Churn
- Fraud
- Fines
- Revenue from legitimate access

The threat is real and can be blocked

(DT before and after. Presented at FASG in 2017 in conjunction with DT)

- Typical reported attacks 0.5-0.05%
- Many are false positives
  - E.g. Hubs, shared networks, VAS mis-config, Anti-steering etc
- DT blocking ~0.02%
- Vast majority of attacks Cat 1
  - ATI – Many commercial services
- Low volume of serious frauds
  - E.g. Fake LU



SFW live

- Note – initially protected only home subscribers then added inbound roamers (see few attacks in Q2)

(Risk of false positives until number plan of all roaming partners well understood)

Recent recognition

November 2017

Evolved Intelligence Signalling Firewall Wins Security Solution of the year

SS7 and Diameter Signalling Firewall received industry-wide recognition at the 2017 Global Telecoms Awards in London, picking up the award for Security Solution of the Year.

December 2017

New report names company as leading Signalling Firewall supplier.

Independent research by Telecom specialists Rocco Market leader for mobile network signalling security firewalls based on feedback from mobile operators worldwide.

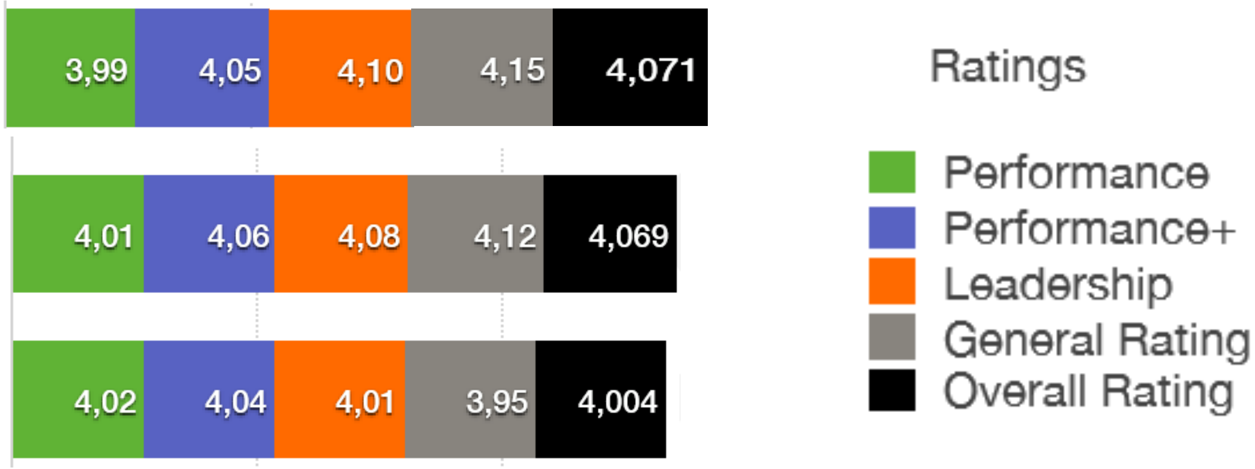
February 2018

GSMA Mobile World Congress award

Firewall won Best Mobile Authentication & Security Solution award at 2018 Mobile World Congress in Barcelona

Snapshot from Rocco Report

Tier 1 Leader Board



MNO Feedback

“Excellent leader in Firewalls"

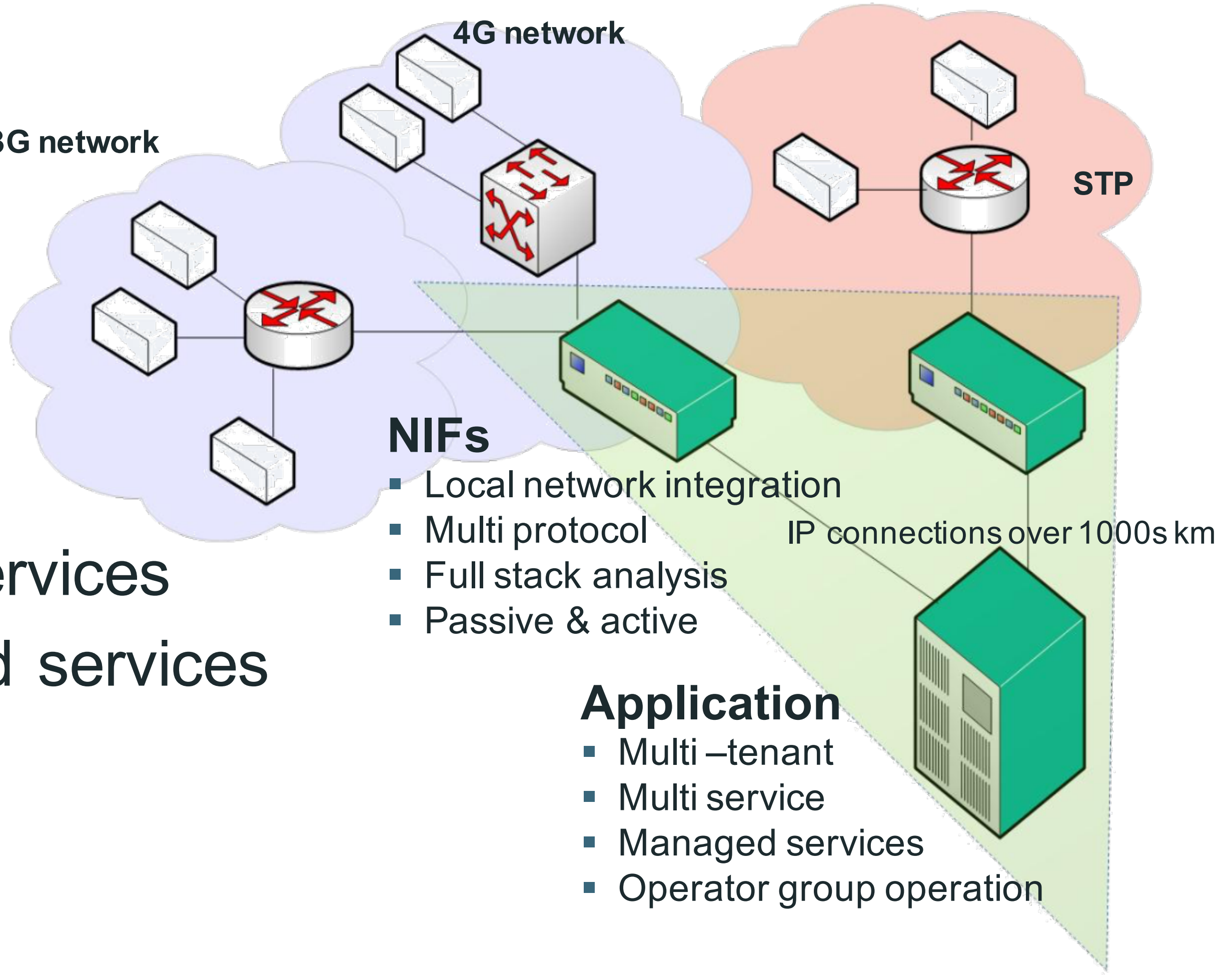
“The Number one vendor of SS7 Firewall”

“Strong leadership in Signalling and Firewalls”

“They have a great reputation and we are always inspired with how much intelligence information they have”

Architecture

- Hybrid cloud architecture
  - No need to choose between central/local
  - Local integration. Central operation.
- Same architecture for roaming & security
- Inherently multi-tenant
- Same platform active/passive, 3G/4G, all services
- Ideal for groups, channel partners, managed services
- Hosting centres in UK
- Enables quick/remote deployment



NIFs

- Local network integration
- Multi protocol
- Full stack analysis
- Passive & active

Application

- Multi –tenant
- Multi service
- Managed services
- Operator group operation

Firewall modules

Firewall Security Features

Insight

- Historic analysis of unusual signalling (e.g. scanning)
- Drill down to find new threats
- Tracking changes in behavior
- Reporting and searching
- Full signalling trace

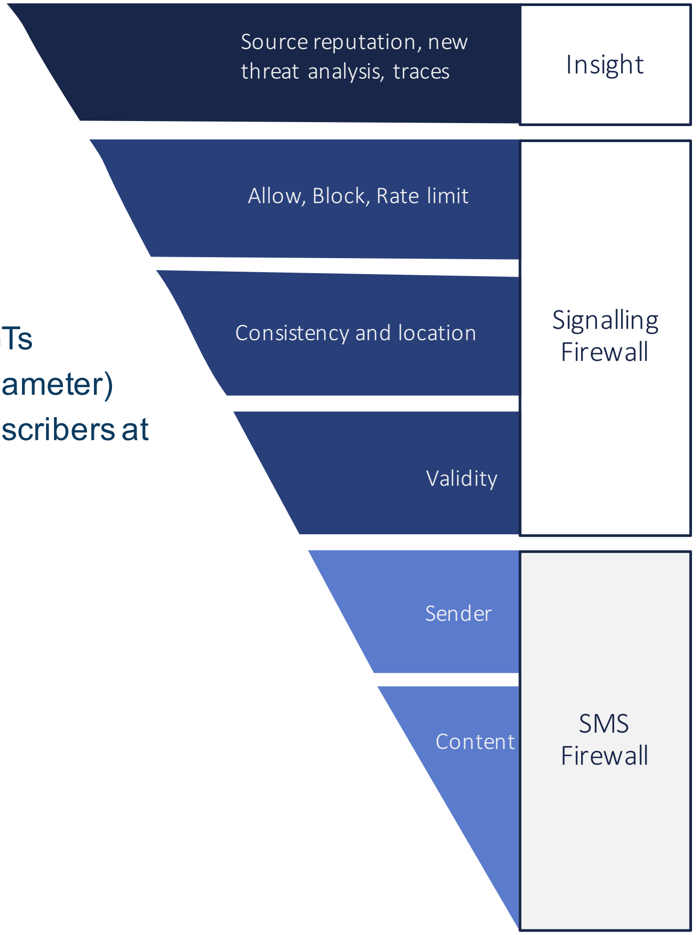
Signalling Firewall

- Blocking suspicious opcodes/command codes, parameters and GTs
- Covers all threats identified by GSMA in FS11 (SS7) and FS19 (Diameter)
- Blocks category 1,2,3 threats (plus rate limiting, anti-spoofing, subscribers at home, configurable actions)
- Flexible blacklist, and whitelisting for real-world signalling
- Powerful UI with underlying rules engine

SMS Firewall

- Blocking suspicious SMS (content, senders)
- Detect and protect the bypass of the correct routes for A2P messaging and SMS spam

Signalling Firewall Screening Layers



History and analysis:
- Unusual error patterns
- Evidence of scanning
- Unusual message ratios
- Mismatch in/out

Signalling message filtering:
- Opcode
- GT
- IMSI
- Rate limiting

Consistency and location .
- SMSC address, MSISDN and SCCP address consistency

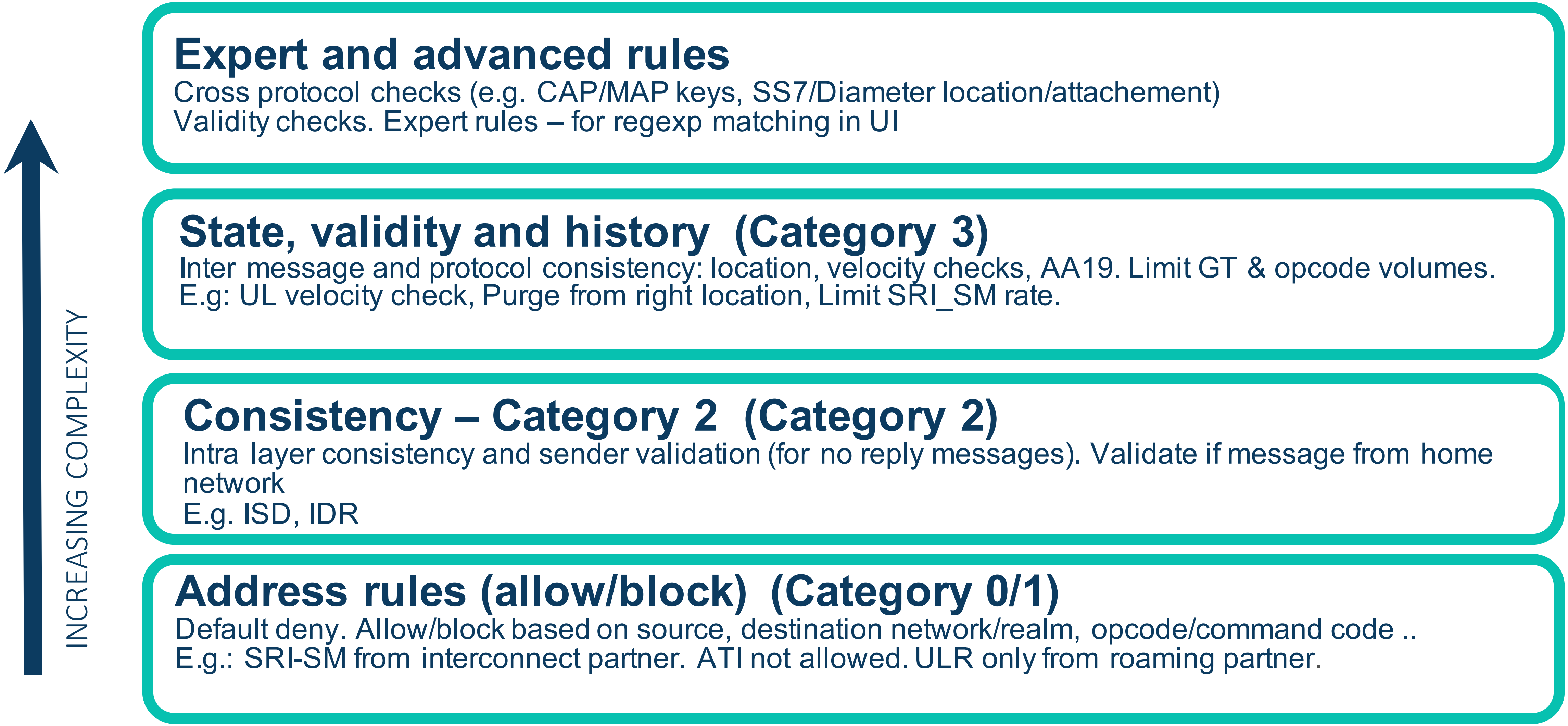
Validity checks including:
- Spoofing checks
- SMS handshake
- AA19

SMS Sender checks:
- Alphanumeric sender
- Shortcodes
- SRI and FSM CaPA match
- MO spoofing checks

SMS content checks
- Pattern matching content
- Repeated similar content

Firewall rules (Full support for FS11/19)

Quarterly updates for GSMA identified threats and from customer sharing (reciprocity)



Expert and advanced rules

Cross protocol checks (e.g. CAP/MAP keys, SS7/Diameter location/attachement)
Validity checks. Expert rules – for regexp matching in UI

State, validity and history (Category 3)

Inter message and protocol consistency: location, velocity checks, AA19. Limit GT & opcode volumes.
E.g: UL velocity check, Purge from right location, Limit SRI_SM rate.

Consistency – Category 2 (Category 2)

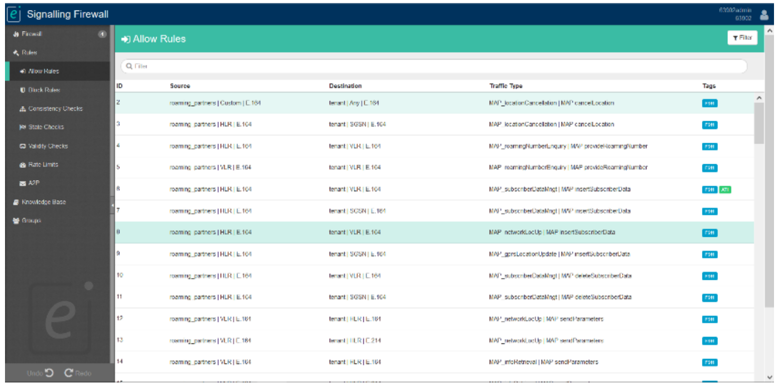
Intra layer consistency and sender validation (for no reply messages). Validate if message from home network
E.g. ISD, IDR

Address rules (allow/block) (Category 0/1)

Default deny. Allow/block based on source, destination network/realm, opcode/command code ..
E.g.: SRI-SM from interconnect partner. ATI not allowed. ULR only from roaming partner.

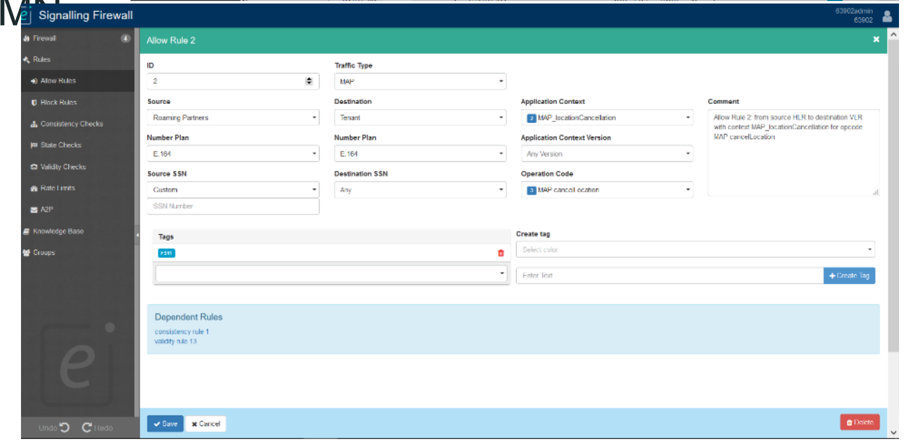
Rich, powerful and easy to use functionality

- Extensive protocol support
  - MTP, SCCP, TCAP, MAP, CAP, Diameter
- Powerful configurable rules:
  - Configurable data items for rules
  - Whitelists and blacklist message, source, destination and parameters/AVP
  - Consistency checks – across signalling layers and against subscriber HPLMN
  - Validity checks – against e.g. AA19, active IMSI
  - History and state checks: Last location, velocity check
  - Message rate limits per opcode/command code, source, subscriber
  - Block on SMS source/text (SMS firewall rules)
  - Watch, whitelist, blacklist on subscriber/VIPs
- Rich set of parameters for rules
  - Opcode/command code
  - Parameters/AVPs – e.g. SSN/node, application context
  - Subscriber/IMSI/hostname
  - Source/destination – i.e. GT or host/realm
- Configurable actions on rule



Allow Rules

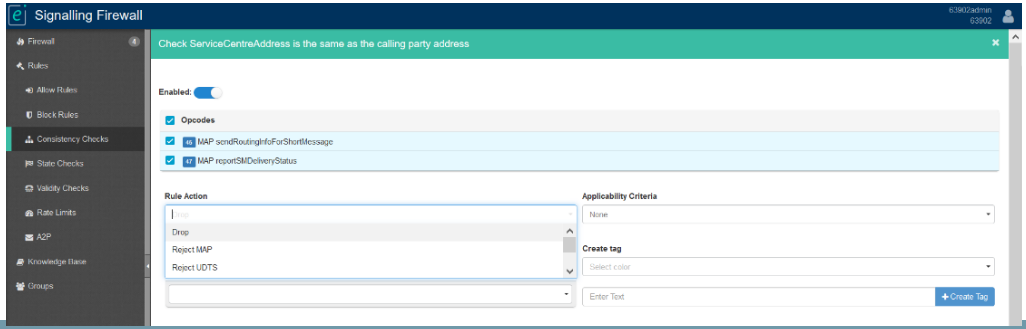
ID	Source	Destination	Traffic Type	Tags
2	roaming_partners | Custom | E.164	tenant | Any | E.164	MAP_locationCancellation | MAP cancelLocation	FS11
3	roaming_partners | HLR | E.164	tenant | SGSN | E.164	MAP_locationCancellation | MAP cancelLocation	FS11
4	roaming_partners | HLR | E.164	tenant | VLR | E.164	MAP_roamingNumberEnquiry | MAP provideRoamingNumber	FS11
5	roaming_partners | VLR | E.164	tenant | VLR | E.164	MAP_roamingNumberEnquiry | MAP provideRoamingNumber	FS11
6	roaming_partners | HLR | E.164	tenant | VLR | E.164	MAP_subscriberDataMngt | MAP insertSubscriberData	FS11 ATI
7	roaming_partners | HLR | E.164	tenant | SGSN | E.164	MAP_subscriberDataMngt | MAP insertSubscriberData	FS11
8	roaming_partners | HLR | E.164	tenant | VLR | E.164	MAP_networkLocUp | MAP insertSubscriberData	FS11
9	roaming_partners | HLR | E.164	tenant | SGSN | E.164	MAP_gprsLocationUpdate | MAP insertSubscriberData	FS11
10	roaming_partners | HLR | E.164	tenant | VLR | E.164	MAP_subscriberDataMngt | MAP deleteSubscriberData	FS11
11	roaming_partners | HLR | E.164	tenant | SGSN | E.164	MAP_subscriberDataMngt | MAP deleteSubscriberData	FS11
12	roaming_partners | VLR | E.164	tenant | HLR | E.164	MAP_networkLocUp | MAP sendParameters	FS11
13	roaming_partners | VLR | E.164	tenant | HLR | E.214	MAP_networkLocUp | MAP sendParameters	FS11
14	roaming_partners | VLR | E.164	tenant | HLR | E.164	MAP_infoRetrieval | MAP sendParameters	FS11



Allow Rule 2

ID: 2
Traffic Type: MAP
Source: Roaming Partners
Destination: Tenant
Application Context: 2 MAP_locationCancellation
Comment: Allow Rule 2: from source HLR to destination VLR with context MAP_locationCancellation for opcode MAP cancelLocation
Number Plan: E.164
Number Plan: E.164
Application Context Version: Any Version
Source SSN: Custom
SSN Number
Destination SSN: Any
Operation Code: 3 MAP cancelLocation
Tags: FS11
Create tag: Select color
Enter Text

Dependent Rules
consistency rule 1
validity rule 13



Check ServiceCentreAddress is the same as the calling party address

Enabled: ●

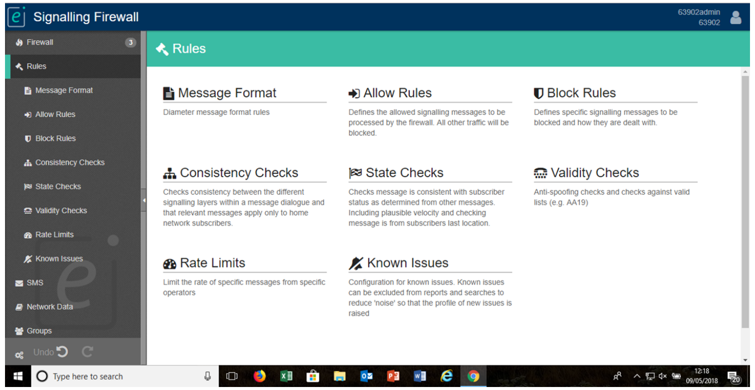
☑ Opcodes
☑ 46 MAP sendRoutingInfoForShortMessage
☑ 47 MAP reportSMDeliveryStatus

Rule Action: Drop
Drop
Reject MAP
Reject UDTS

Applicability Criteria: None
Create tag: Select color
Enter Text

Managing firewalls in real life

- Configured (and tagged) for FS11 and FS19 standard rules
  - Reciprocity agreement – share real threats across customers and from our threat intelligence
- Experience of “wild” signalling.
  - Maintaining accurate number analysis
  - Roaming hubs, Late ISD, Pooled VLR, shared HLR
  - Configured “out of the box” to avoid issues – but easy to edit with exceptions
- Screens to configure standard rules, data easily via UI
  - Eg: Simple to add roaming partner
  - E.g: Simple to add/block new routes
  - E.g. Block, allow, monitor specific IMSI or GT
- Controlled rule introduction. No downtime (for rules or software upgrades)
  - Eg: warn initially
  - E.g. Rule versioning – save / revert / export
  - E.g. Set of rules to implement together
  - Eg: Rule dependencies displayed automatically, conflicts flagged etc
- Known issues can be filtered to find new sources
- Privacy / GDPR support
- Alerts (inbox/SIEM) on active attack source or IMSI attacked from multiple sources



Rules

Message Format

Diameter message format rules

Allow Rules

Defines the allowed signalling messages to be processed by the firewall. All other traffic will be blocked.

Block Rules

Defines specific signalling messages to be blocked and how they are dealt with.

Consistency Checks

Checks consistency between the different signalling layers within a message dialogue and that relevant messages apply only to home network subscribers.

State Checks

Checks message is consistent with subscriber status as determined from other messages. Including plausible velocity and checking message is from subscribers last location.

Validity Checks

Anti-spoofing checks and checks against valid lists (e.g. AA19)

Rate Limits

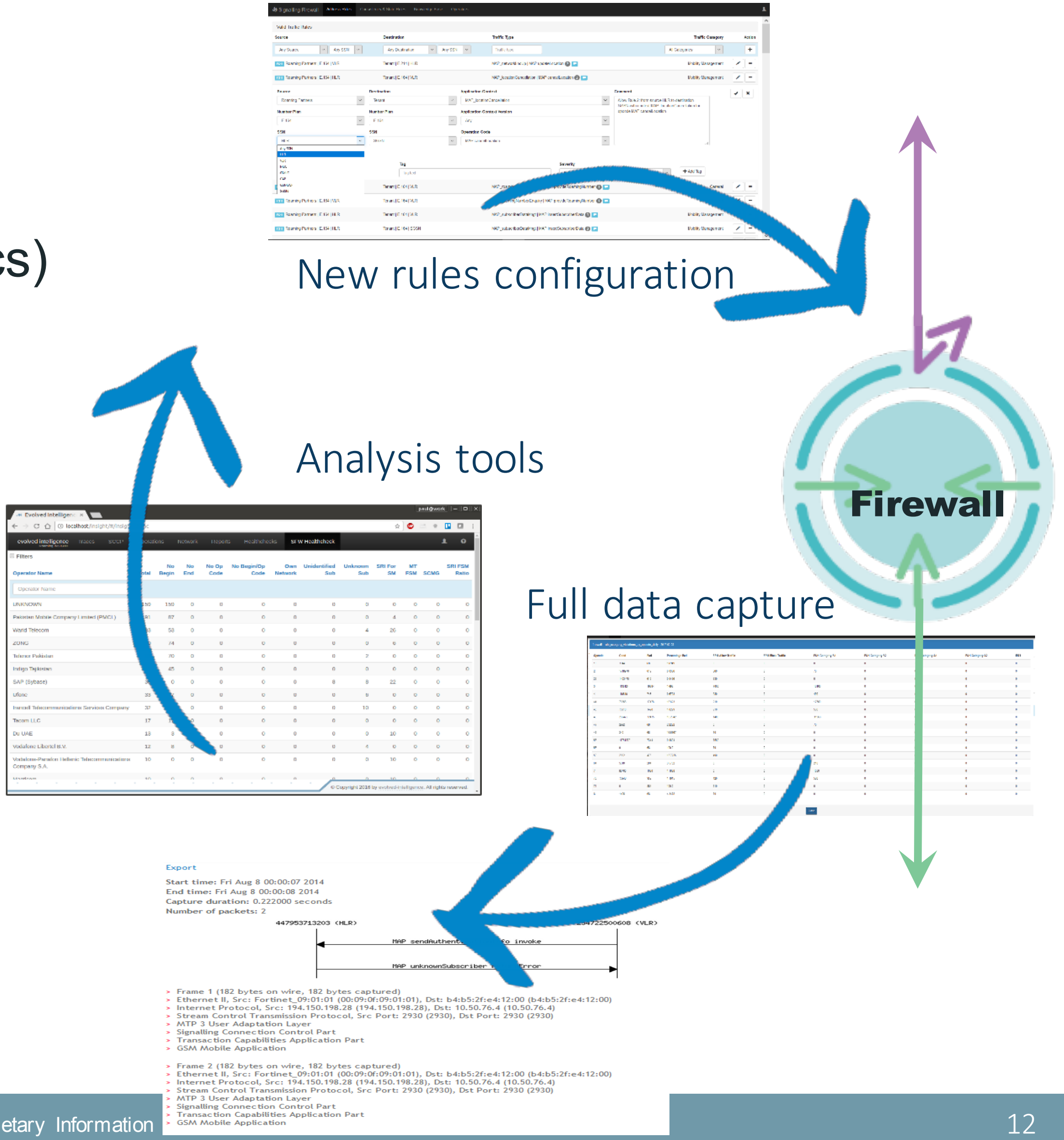
Limit the rate of specific messages from specific operators

Known Issues

Configuration for known issues. Known issues can be excluded from reports and searches to reduce 'noise' so that the profile of new issues is raised

Threat management methodology & requirements

- High functionality firewall delivered to protect against know threats (FS11,19 including protection at home, spoofing, cross protocol attacks etc – co-author of specs)
- Real world exceptions to avoid false positives (e.g. shared networks, hubs)
- Analytics to track, find new and drill down to details
- Operational tools to easily manage firewall (e.g. testing rules, versioning)
- Easy to configure rules (direct from analysis)
- Threat intelligence from supplier and other operators (reciprocity – largest footprint)



```
Export

Start time: Fri Aug 8 00:00:07 2014
End time: Fri Aug 8 00:00:08 2014
Capture duration: 0.222000 seconds
Number of packets: 2

447953713203 (HLR)                                    254722500608 (VLR)
        MAP sendAuthent...fo invoke
        MAP unknownSubscriber ... Error

> Frame 1 (182 bytes on wire, 182 bytes captured)
> Ethernet II, Src: Fortinet_09:01:01 (00:09:0f:09:01:01), Dst: b4:b5:2f:e4:12:00 (b4:b5:2f:e4:12:00)
> Internet Protocol, Src: 194.150.198.28 (194.150.198.28), Dst: 10.50.76.4 (10.50.76.4)
> Stream Control Transmission Protocol, Src Port: 2930 (2930), Dst Port: 2930 (2930)
> MTP 3 User Adaptation Layer
> Signalling Connection Control Part
> Transaction Capabilities Application Part
> GSM Mobile Application

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```
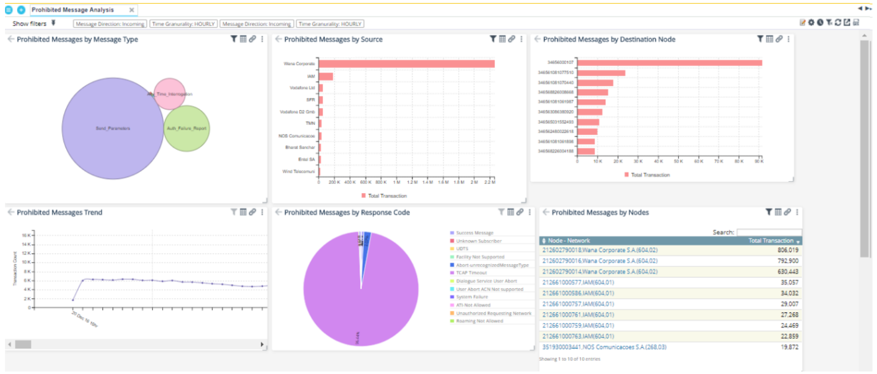

Threat analysis

- Reports on each attack / rule violation
  - Trends, sources etc
  - Link to signalling from each attack / rule
  - Customisable visualisation
- Forensic analysis
  - Reports and trends on sources, IMSIs
  - Drill down to signalling (both directions)
- Scanning analysis
  - Reports on unusual activity (e.g. many unknown sub)
- Suspicious GT analysis (e.g. cluster, SSN analysis)
  - Wisdom as optional add-on. Will be integrated.

(Goal – add MNS graphics)



Prohibited Message Analysis

Show filters | Message Direction: Incoming | Time Granularity: HOURLY | Message Direction: Incoming | Time Granularity: HOURLY

Prohibited Messages by Message Type

Prohibited Messages by Source

Prohibited Messages by Destination Node

Prohibited Messages Trend

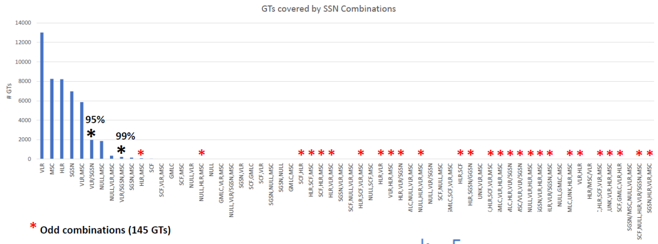
Prohibited Messages by Response Code

Prohibited Messages by Nodes

Search:

Node - Network	Total Transaction
212602790018,Wana Corporate S.A.(604,02)	806,019
212602790016,Wana Corporate S.A.(604,02)	792,900
212602790014,Wana Corporate S.A.(604,02)	630,443
212661000577,IAM(604,01)	35,057
212661000586,IAM(604,01)	34,032
212661000757,IAM(604,01)	29,007
212661000761,IAM(604,01)	27,268
212661000759,IAM(604,01)	24,469
212661000763,IAM(604,01)	22,859
351930003441,NOS Comunicacoes S.A.(268,03)	19,872

Showing 1 to 10 of 10 entries

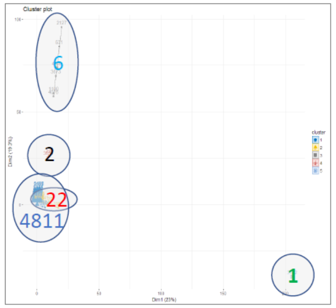


* Odd combinations (145 GTs)

62 unique combinations

1% of GTs = 472

k = 5



Summary

- Leading functionality, SS7 and diameter firewall
- Proven over last 2 years in tier 1 operators
- Full CAP/MAP/Diameter (GTP soon) cross protocol Cat 1,2,3 and more
- Practical and easy to manage for real world environment
- Analytics to track trends, sources and identify new threats

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Thank You