

Measuring routing (in)security

Unpacking the MANRS Observatory

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What are the Mutually Agreed Norms for Routing Security (MANRS, www.manrs.org) ?

A collaborative approach to routing security:

An undisputed minimum security baseline – the norm.

- Defined through MANRS Actions

Demonstrated commitment by the participants

- Measured by the Observatory and published on <https://www.manrs.org>



MANRS Programs



Network
Operators (2014)



Internet Exchange Points (2018)



Content Delivery Networks (CDNs)
and Cloud Providers (2020)



Network Equipment Vendors (2021)



MANRS Actions for Network Operators

Action 1

Filtering

Prevent propagation of incorrect routing information

Ensure the correctness of your own announcements and announcements from your customers to adjacent networks with prefix and AS-path granularity

Action 2

Anti-spoofing

Prevent traffic with spoofed source IP addresses

Enable source address validation for at least single-homed stub customer networks, their own end-users, and infrastructure

Action 3

Coordination

Facilitate global operational communication and coordination between network operators

Maintain globally accessible, up-to-date contact information in common routing databases

Action 4

Routing Information

Facilitate validation of routing announcements on a global scale

Publish your data so others can validate



MANRS Observatory

Provides a factual state of routing hygiene of the Internet routing system and individual networks, and tracks it over time

Measurements are:

- **Transparent** – using publicly accessible data
- **Passive** – no cooperation from networks required
- **Evolving** – MANRS community decide what gets measured and how



Overview

State of Routing Security

Number of incidents, networks involved and quality of published routing information in the IRR and RPKI in the selected region and time period

Incidents ⁱ

Route misoriginations	262
Route leaks	0
Bogon announcements	123
Total	385



Culprits ⁱ

Culprits	295
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Routing Information (IRR) ⁱ

Unregistered	114,311	9.4%
Registered	1,104,864	90.6%



Routing Information (RPKI) ⁱ

Valid	632,645	51.9%
Unknown	580,388	47.6%
Invalid	6,142	0.5%



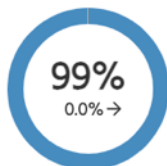
Route Origin Validation ⁱ

ROV-based Filtering Rate (%)	6.2%
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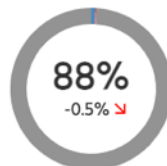


MANRS Readiness ⁱ

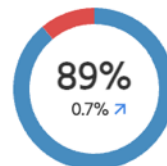
Filtering ⁱ



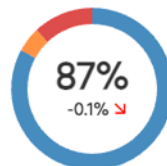
Anti-spoofing ⁱ



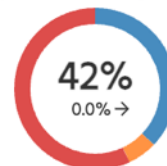
Coordination ⁱ



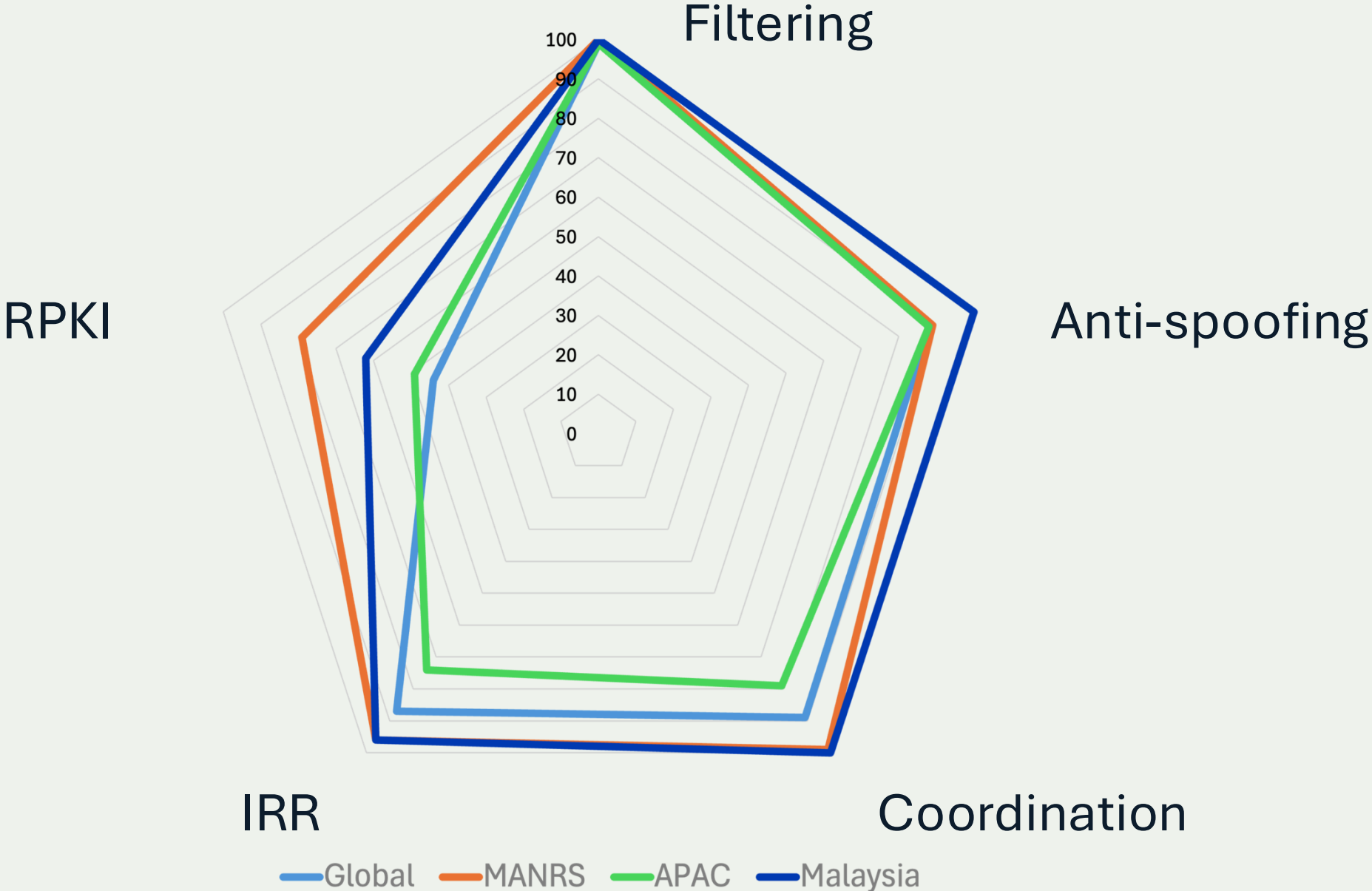
Routing Information (IRR) ⁱ



Routing Information (RPKI) ⁱ



MANRS Readiness scores



A more detailed overview

MONTH (PARTIAL)

February 2025

RIR REGIONS

APNIC

Details

Download data

Severity: All Ready Aspiring Lagging No Data Available

Scope: All Filtering Anti-spoofing Coordination Routing Information (IRR) Routing Information (RPKI)

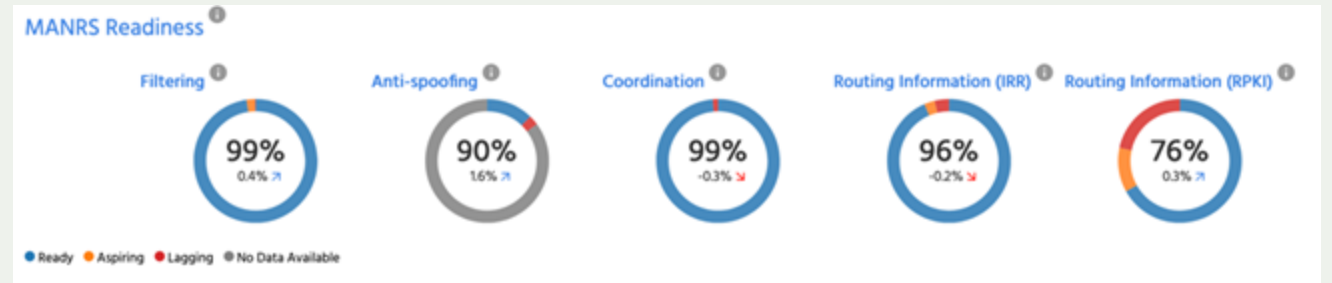
Result Limit: 100 200 500 1000

Total 19,578 Previous 1 2 3 4 5 ... 196 Next

Overview

ASN	Holder	Country	UN Regions	UN Sub-Regions	RIR Regions	Filtering	Anti-spoofing	Coordination	Routing Information (IRR)	Routing Information (RPKI)
1000	ASIA TELECOM	Asia	Asia	Eastern Asia	APNIC	100%	-	100%	100%	100%
1000	ASIA TELECOM	Oceania	Oceania	Australia and Nev	APNIC	100%	-	100%	100%	0%
1000	ASIA TELECOM	Asia	Asia	South-eastern As	APNIC	100%	-	100%	98%	56%
1000	ASIA TELECOM	Asia	Asia	South-eastern As	APNIC	100%	-	100%	100%	0%
1000	ASIA TELECOM	Oceania	Oceania	Australia and Nev	APNIC	67%	-	100%	67%	42%
1000	ASIA TELECOM	Asia	Asia	Eastern Asia	APNIC	100%	-	100%	99%	0%
1000	ASIA TELECOM	Asia	Asia	Eastern Asia	APNIC	100%	-	100%	100%	95%
1000	ASIA TELECOM	Asia	Asia	Eastern Asia	APNIC	100%	-	100%	100%	0%

MANRS Readiness



Organization Name	Date Approved	Areas Served	ASNs	Action 1 Filtering	Action 2 Anti-Spoofing	Action 3 Coordination	Action 4 Routing Information	
							IRR	RPKI
.pt	15th Oct 2018	PT	199993	✓	No data	100%	100%	100%
1-Grid	24th Oct 2023	ZA	36943	✓		100%	100%	100%
10110770 Manitoba O/A Vulpine Networks	19th Jun 2022	CA, US	400442	✓		100%	100%	100%
2012 Limited	26th Apr 2023	HK	4658	✓		100%	100%	94%
3D TELECOMUNICACOES LTDA	20th Nov 2023	SC	52706	✓	100%	100%	100%	100%
3WACCES	31st Mar 2020	BR	269053	✓	49%	100%	100%	100%
76 Telecom Telecomunicações Ltda	7th Jul 2020	BR	262760, 262363	✓		50%	100%	0%

Why to measure?

Inform MANRS participants about their degree of commitment

- Improve reputation and transparency of the effort
- Support participants in fixing issues

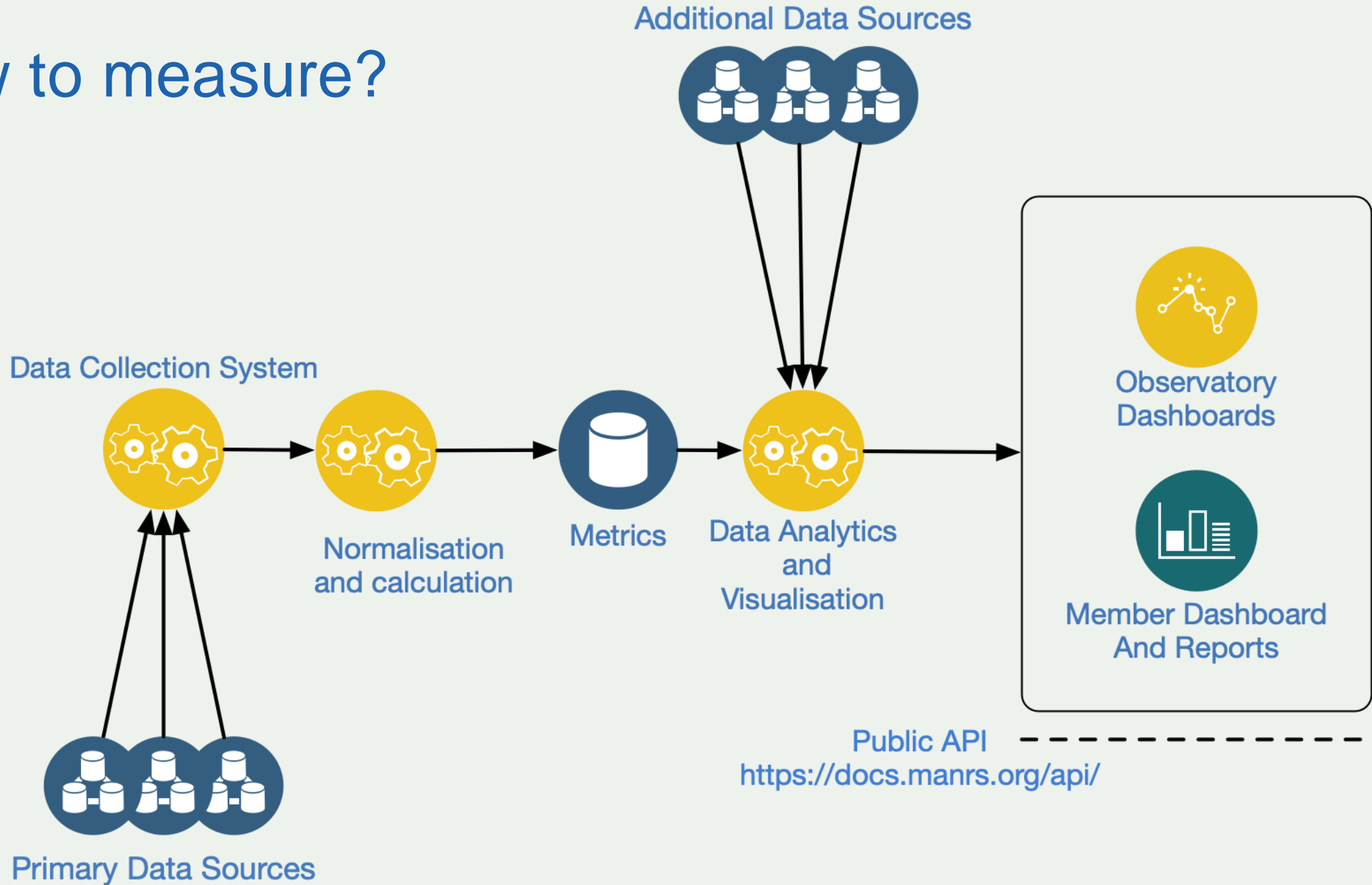
Support the audit process

- Make it more comprehensive and consistent
- Reduce the load
- Allow preparation (self-assessment)

Provide a factual state of routing hygiene as it relates to MANRS

- Support the problem statement with data
- Demonstrate the impact and progress
- Network, country, region, over time

How to measure?

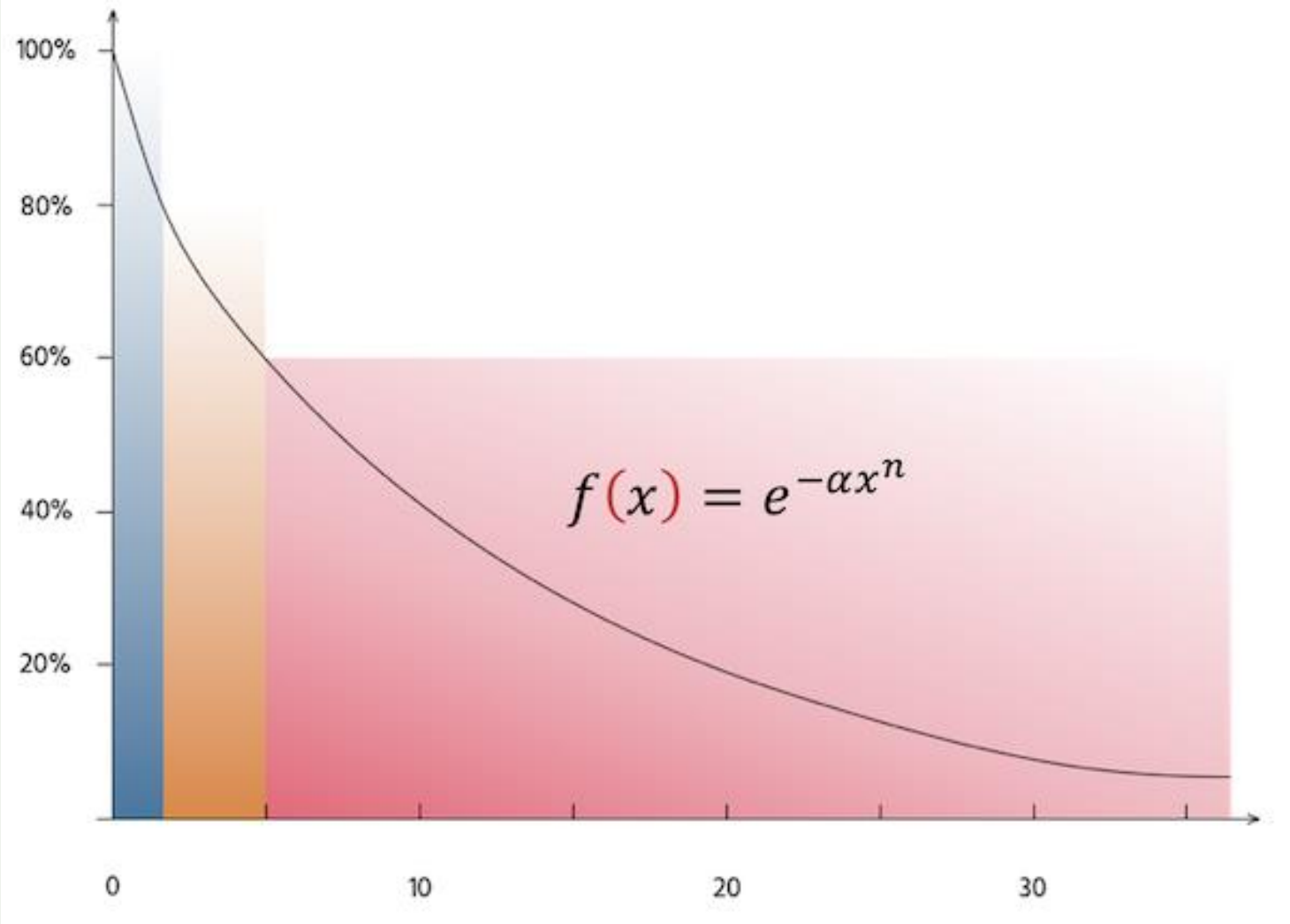


MANRS Actions for Network Operators

Filtering	GRIP, CIDR report, NRO stats
Anti-Spoofing	CAIDA Spoofer
Communication	RIPEStat, PeeringDB
Routing Information	RIPEStat, ROAST

<https://manrs.org/manrs-observatory/measurement-framework/>

Normalisation



<https://manrs.org/manrs-observatory/measurement-framework/>

MANRS Readiness: Ready, Aspiring, Lagging

Metric	Absolute			Normalized		
	Ready	Aspiring	Lagging	Ready	Aspiring	Lagging
Filtering	<1.5	1.5-5	>5	≥80%	60-80%	<60%
Anti-spoofing	0	0.5	≥1	>60%	60%	<60%
Coordination	0	–	1	100%	–	0%
Routing Information IRR	<0.1	0.1-0.5	>0.5	≥90%	50-90%	<50%
Routing Information RPKI	<0.1	0.1-0.5	>0.5	≥90%	50-90%	<50%

Some of the caveats



The measurement framework is focused on conformance



Passive measurement of filtering can only detect non-conformance



The measurement of anti-spoofing is active and require cooperation

Thank you.

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