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FIRST/AfricaCERT

Routing Security for better Internet Security

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Background

The Internet is a large network of interconnected networks. There are ~73,000 networks on the Internet, each using a unique Autonomous System Number (ASN) to identify itself

Routers use Border Gateway Protocol (BGP) to exchange "reachability information" – to know the best route/shortest path to other networks

The Border Gateway Protocol (BGP) used by the Internet routing system is based entirely on *unverified trust* between networks

- No built-in validation that updates are legitimate
- Any network can announce any ASN or IP prefix
- Any network can claim to be another network

Routing Incidents Cause Real World Problems

Event	Explanation	Repercussions	Example
Route Leak	A network operator with multiple upstream providers (often due to accidental misconfiguration) announces to one upstream provider that is has a route to a destination through the other upstream provider.	Can be used for a MITM, including traffic inspection, modification and reconnaissance.	*June 2019. Verizon accepted incorrect routes from DQE Communications that diverted traffic destined for Cloudflare, Facebook & Amazon.*
Prefix/Route Hijacking	A network operator or attacker impersonates another network operator, pretending that a server or network is their client.	Packets are forwarded to the wrong place and can cause Denial of Service (DoS) attacks or traffic interception.	*The 2008 YouTube hijack* *April 2018 Amazon Route 53 hijack*
IP Address Spoofing	Someone creates IP packets with a false source IP address to hide the identity of the sender or to impersonate another computing system.	The root cause of reflection DDoS attacks	*March 1, 2018. Memcached 1.3Tb/s reflection-amplification attack reported by Akamai*

Routing security – impact on online privacy

- **Man in the Middle (MITM) attacks** - Online traffic inspection, modification and or reconnaissance without consent

- **Traffic Hijacks -** Data being sent to the wrong destination by a malicious actor who hijacks network traffic.

- **Impersonation -** via spoofing where a malicious actor impersonates a genuine online resource thereby facilitating the collection of user data from unsuspecting users.

MANRS improves the security and reliability of the global Internet routing system, based on collaboration among participants and shared responsibility for the Internet infrastructure.

MANRS sets a new norm for routing security.

Currently: 4 MANRS Programs

Network Operators (2014)

765 members about 950 ASNs

Internet Exchange Points (2018)

108 members

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

23 members

Network Equipment Vendors (2021)

6 members

Summary of the MANRS actions

Filtering

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

Anti-Spoofing

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

Coordination

Maintain globally accessible up-to-date contact information

Global Validation

Publish your data, so others can validate routing information on a global scale

Tools

Provide monitoring and debugging tools to help others

Promotion

Actively encourage MANRS adoption among peers, customers, and partners

MANRS

MANRS Actions – Network Operators Programme

Launched November 2014. Actions 1, 3 and 4 are mandatory. Action 2 is optional.

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

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

Coordination

Facilitate global operational communication and coordination between network operators

Maintain globally accessible up-to-date contact information in relevant RIR database and/or PeeringDB

Global Validation

Facilitate validation of routing information on a global scale

Publish your routing data, so others can validate

Registering number resources in an IRR and/or creating ROAs for them

MANRS – What is new?

MANRS Observatory – https://observatory.manrs.org

A lot of work to improve the MANRS Observatory:

- MANRS Observatory collates data from third-party data sources BGPStream, GRIP, CIDR Report, RIR databases, PeeringDB, and CAIDA Spoofer
- BGPStream is no longer actively maintained
- Started to use GRIP (Global Routing Intelligence Platform) but this tends to generate false positives so needs improvements to tune and improve accuracy
- More automated processing of MANRS applications to improve response times

MANRS Observatory (Preview)

OVERVIEW HISTORY COMPARISON ABOUT

MONTH (PARTIAL) October 2020

Overview

State of Routing Security

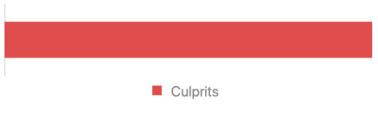
Number of incidents, networks involved and quality of published routing information in the IRR and RPKI in the selected region and time period

Incidents

Total		
1'016	*Route misoriginations*	178
	Route leaks	91
	Bogon announcements	747

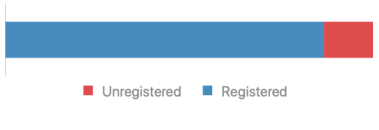
Culprits

Total		
822	*Culprits*	822



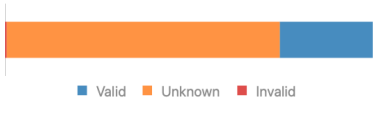
Routing completeness (IRR)

Total		
100%	*Unregistered*	14%
	Registered	86%



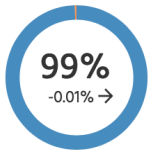
Routing completeness (RPKI)

Total		
100%	*Valid*	25%
	Unknown	74%
	Invalid	1%

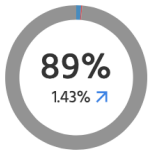


MANRS Readiness

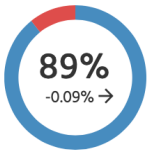
Filtering



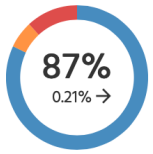
Anti-spoofing



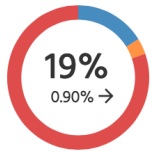
Coordination



Global Validation IRR



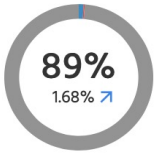
Global Validation RPKI



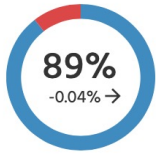
Ready Aspiring Lagging No Data Available

Filtering

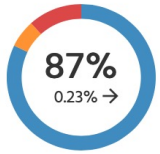
Anti-spoofing



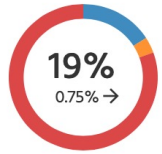
Coordination



Global Validation IRR



Global Validation RPKI



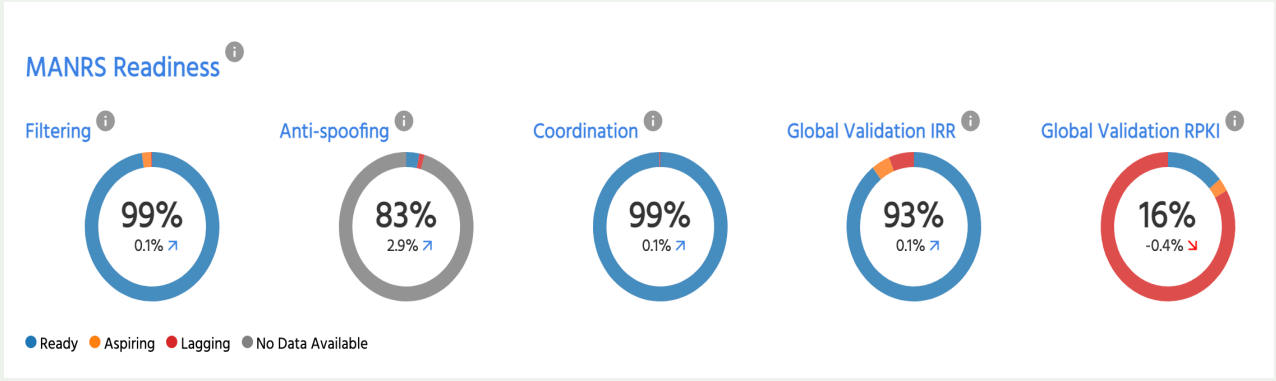
● Ready ● Aspiring ● Lagging ● No Data Available

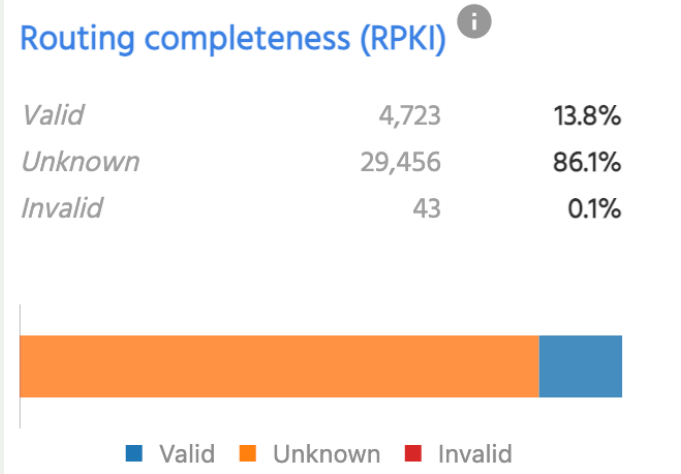
Global view

Size: **Count** | Incidents | Culprits Region: **Country** | UN Regions | UN Sub-Regions | RIR Regions

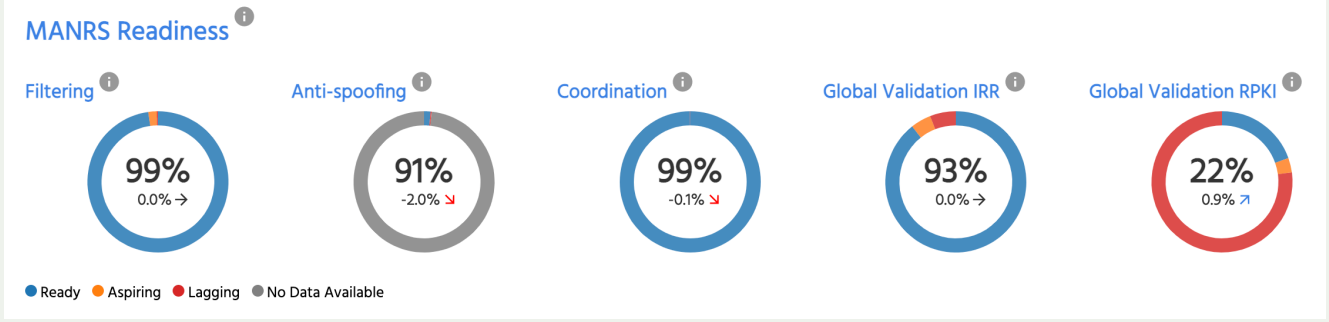
RPKI– AFRINIC region Observatory data

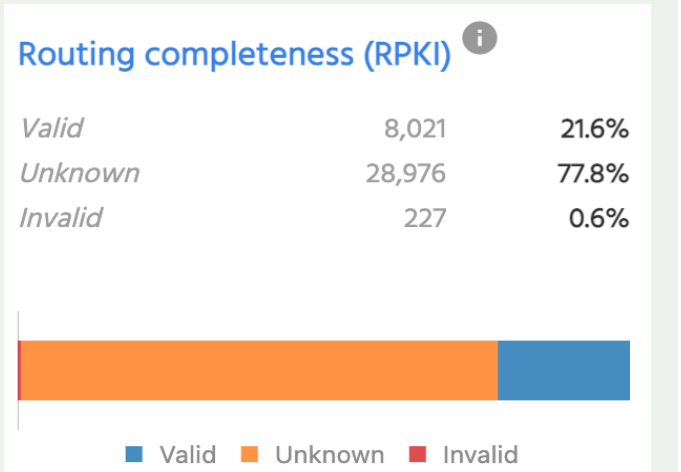
January 2022





January 2023





MANRS Observatory – API

API access is available to the MANRS Observatory. This will enable everyone to view and use this data for research or to make sense of the state of routing on the Internet.

You do not need to be a MANRS participant to get access, but you do need an Observatory account. You can get access by:

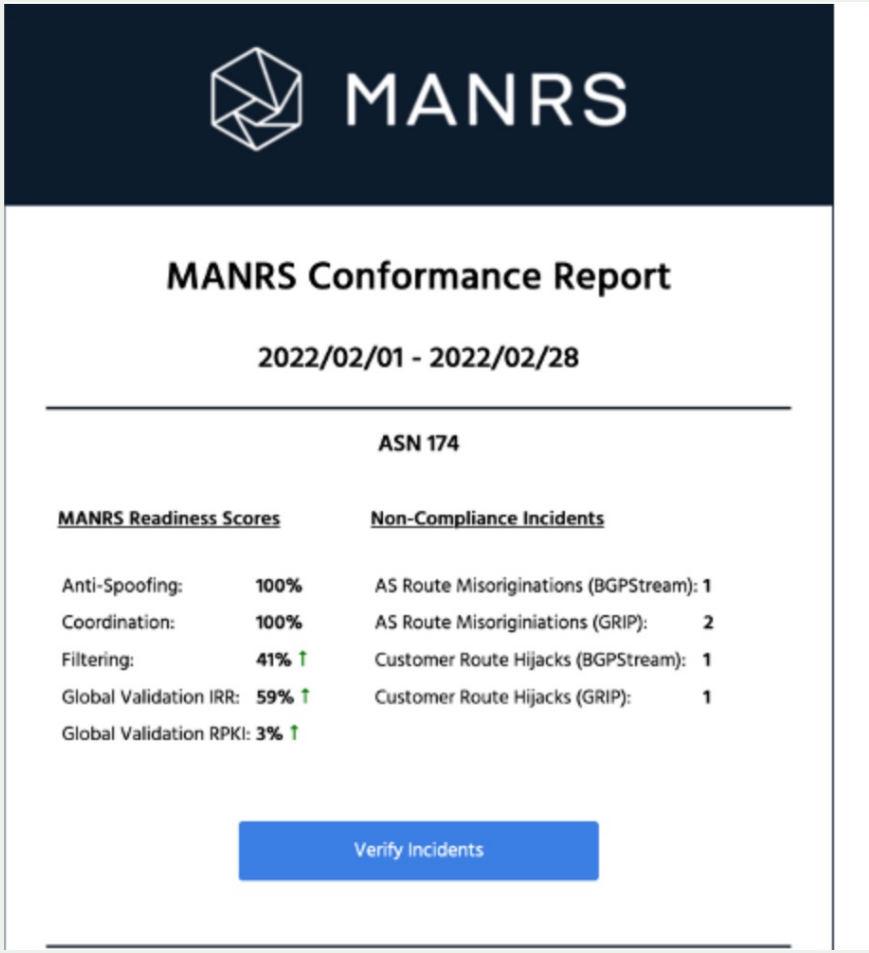
- Being a MANRS participant, you get access to all MANRS scores and detailed information on your ASN(s).
- Applying to be a partner, you get access to a certain selection of ASN(s).
- Registering as an API-only user, you get no access to any non-public part of the Observatory.

MANRS Conformance Reports

Monthly reports on MANRS participant conformance

Opportunity to verify any incidents picked up on the MANRS Observatory that involved your network

May indicate a need to look at your network security controls, especially those that require MANRS conformance.

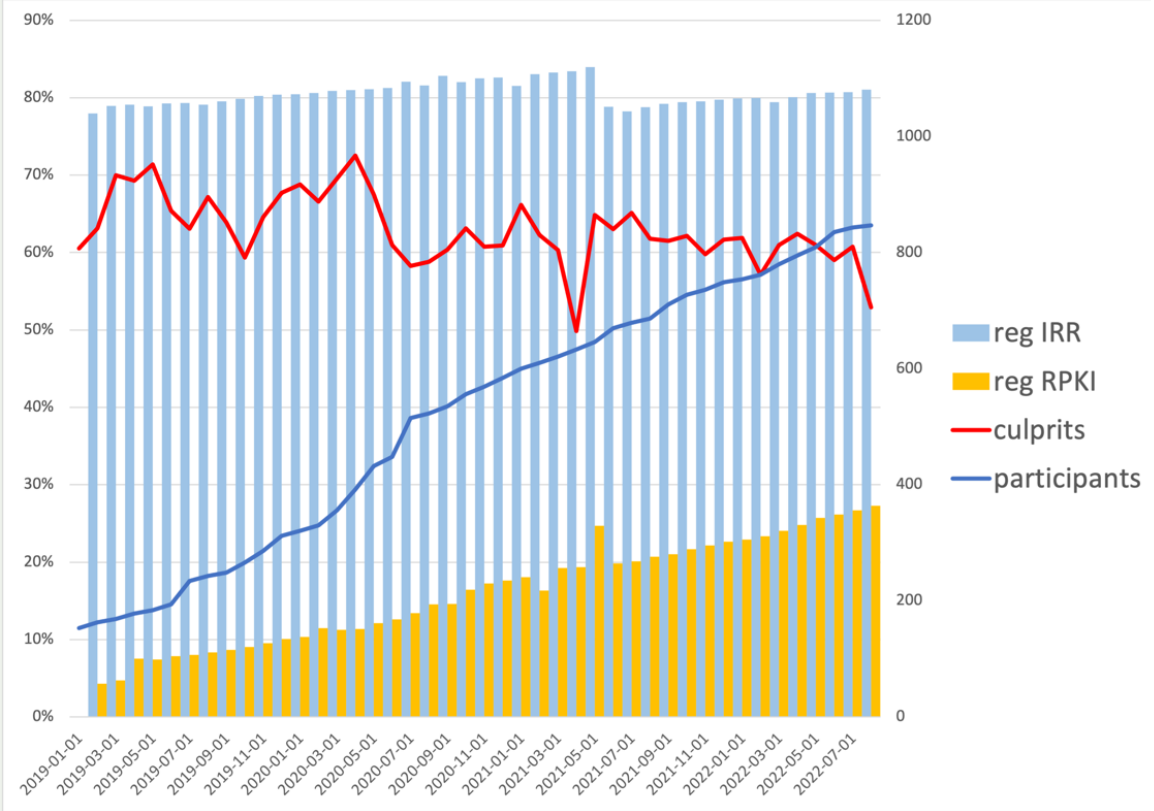


Progress in routing security

81% of all ASNs have their routes registered in the IRR and 27% in RPKI, and these numbers steadily grow.

Number of “culprits” – ASNs implicated in one or more suspicious routing events – declines

Data sources: MANRS Observatory, BGPStream, GRIP.



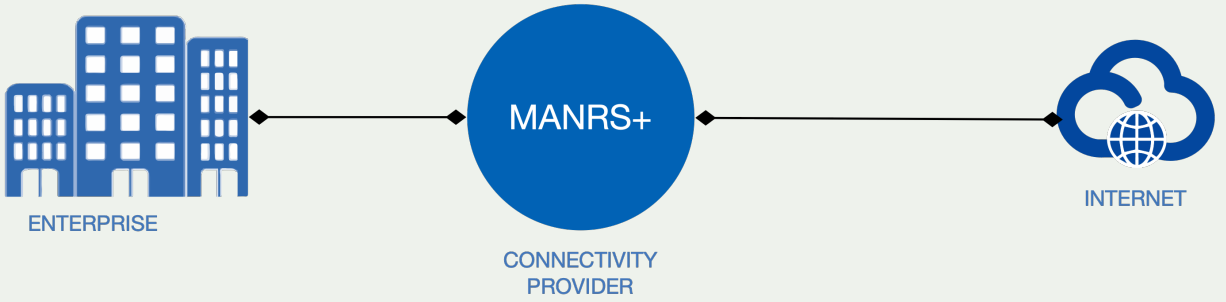
The Future of MANRS

MANRS+ - Elevated tier of MANRS participation

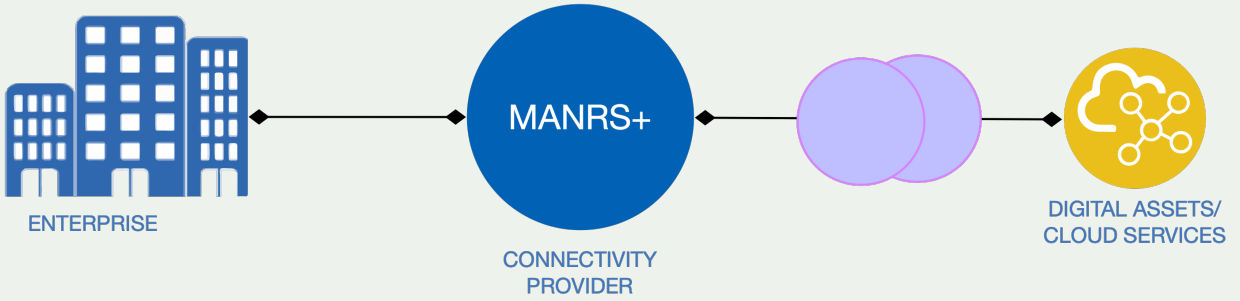
- Established by network operators, service providers and their customers who require higher levels of routing security assurance
- Aims to develop a quality mark, certification, and possibly standards that can be incorporated into procurement recommendations and policies.
- MANRS+ WG is developing set of requirements around path security, DDoS attack protection, anti-spoofing protection, and validated routing information (e.g. ROAs and AS-SETs), plus auditing approaches to assure high levels of conformance
- Network operators (Connectivity Providers) and their customers (Relying Parties) setting the requirements of the future quality mark for traffic security with the goal of eventually incorporating it in procurement policies and recommendations

Use Cases for MANRS+

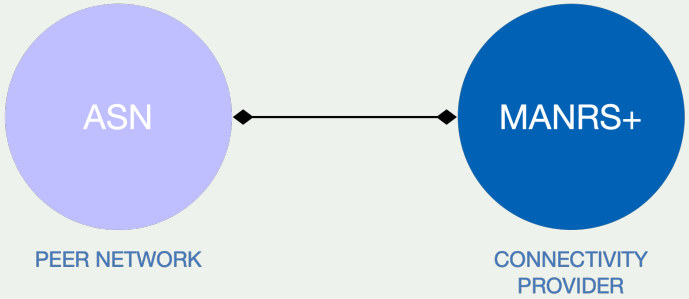
Traffic Security



Value Chain Security



Peering Security



MANRS+ Sample Requirements

- **Path Security** - Connectivity provider has detection capabilities and can mitigate the risk that traffic will be hijacked or detoured as a result of a mistake or an attack.
- **DDoS Attack Protection** - Connectivity provider has detection and mitigating capabilities reducing the risk of a (volumetric) DoS attack.
- **Anti-Spoofing Protection** – Connectivity provider detects and prevents traffic from their direct customers or peers with spoofed source IP addresses
- **Routing Information** - Connectivity provider has accessible complete and up-to-date documentation of the intended routing announcements (e.g. RPKI ROAs) and other information on its routing policy (e.g AS-SET) that is necessary for deploying effective security controls by the Network.

Current status of MANRS+

MANRS+ WG setup

WG landing page: https://www.manrs.org/about/manrs-working-group/

WG calls every two weeks, alternating between 1200UTC and 1700UTC

WG mailinglist: <manrs-plus-wg@elists.manrs.org>

Work focus: MANRS+ Requirements, survey to validate the requirements

2023: Opportunities for CSIRTs in MANRS

How can CSIRTS get involved in MANRS?

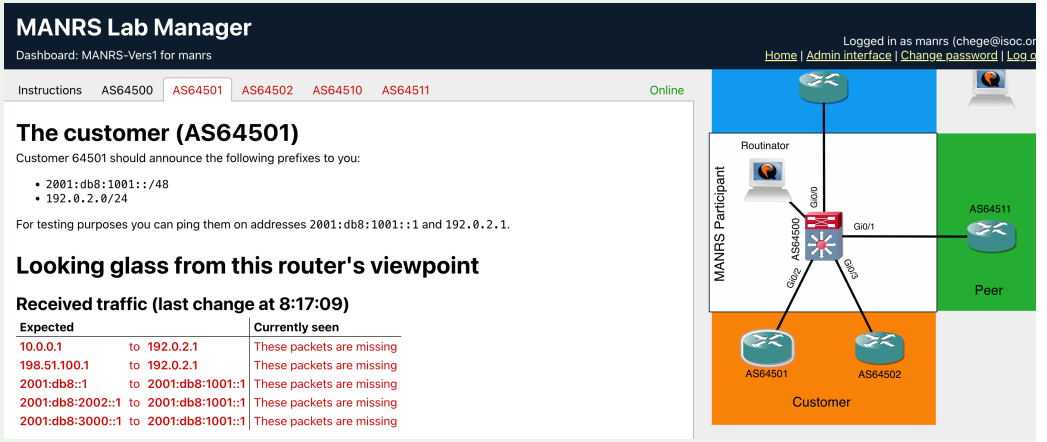
- Raise awareness of routing security in CSIRT and national critical infrastructure activities and utilization of the MANRS Observatory
- Encourage addition routing security incident monitoring and handling to service portfolios
- Help organise practical routing security workshops and/or develop routing security curriculums in the context of training-the-trainers and/or network forensics capacity building programmes

- MANRS CSIRT Primer: https://www.manrs.org/resources/primers/csirts/

MANRS

MANRS Trainings – available to CSIRT community

- Internet Society moderated courses (https://www.isoc.org/learning/manrs/)
- Hands-on workshops (both directly and via our Mentors and Ambassadors Program)
- Training labs for network engineers and administrators to learn how to configure routing security features
- Implementation Guides provide step-by-step instructions to implement MANRS Actions



MANRS

MANRS Mentors & Ambassadors Program 2023

formerly known as MANRS Ambassadors & Fellows Program

Aims to extend outreach and involve the wider Internet community in routing security

- Applications will open on 6 April 2023
- **Mentors** are individuals well established in the MANRS Community who provide mentorship, guidance, and feedback to others in the routing security community
- **Ambassadors** are emerging leaders who can enthusiastically bring knowledge and skills about routing security to their communities
- **Three Tracks:** Training, Research and Policy
- CSIRTS are invited to apply and participate

MANRS

Participation in the MANRS Steering Committee

The Steering Committee is comprised of individuals elected by the MANRS community to coordinate and develop the MANRS initiative. It holds quarterly meetings, and its duties include:

- Reviewing and making recommendations to the MANRS community about the MANRS Actions
- Appointing MANRS Advisors, Ambassadors, and Mentors
- Supervising the auditing process for new applicants
- Making recommendations to the MANRS community on the suspension/termination

Anyone is eligible to serve on the Steering Committee. Nominations are held annually in October.

Participating in the MANRS+ & FIRST NetSec SIG

MANRS+ WG setup

WG landing page: https://www.manrs.org/about/manrs-working-group/

WG calls every two weeks, alternating between 1200UTC and 1700UTC

FIRST NetSec SIG: https://www.first.org/global/sigs/netsec/

Funding and Sustainability

- The MANRS community needs support to continue to grow and strengthen the routing security community
- We are looking for industry sponsors interested in supporting the **MANRS Observatory**, **Mentors and Ambassadors Program**, **Training Program**, and community events including the **Routing Security Summit (later in 2023)**

Why join MANRS?

- **Improve your security posture and reduce the number and impact of routing incidents**
- Improve your privacy posture
- **Meet the expectations of the operator community**
- Join a community of security-minded operators working together to make the Internet better
- **Use MANRS as a competitive differentiator**

Thank You!

Join the MANRS Community

https://www.manrs.org

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