Routing Is At Risk.
Let's Secure It Together

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No Day Without an Incident

http://bgpstream.com/
A year in review: 14000 incidents

Statistics of routing incidents generated from BGPStream data

Caveats:

• Sometimes it is impossible to distinguish an attack from a legitimate (or consented) routing change

• CC attribution is based on geolocation MaxMind's GeoLite City data set
The routing system is constantly under attack (2017)

- 13,935 total incidents (either outages or attacks, like route leaks and hijacks)
- Over 10% of all Autonomous Systems on the Internet were affected
- 3,106 Autonomous Systems were a victim of at least one routing incident
- 1,546 networks were responsible for 5304 routing incidents

Source: [https://www.bgpstream.com/](https://www.bgpstream.com/)
The routing system is constantly under attack (2017 → 2018)

- 13,935 total incidents (either outages or attacks, like route leaks and hijacks)
- Over 10% of all Autonomous Systems on the Internet were affected
- 3,106 Autonomous Systems were a victim of at least one routing incident
- **1,546 networks were responsible for 5304 routing incidents**
- **547 networks were responsible for 1576 routing incidents**

Source: https://www.bgpstream.com/
Outages 2017

Outages per country

- BR: 2853
- US: 111
- IR: 300
- IN: 303
- ID: 312
- RU: 406
- UA: 651
- AR: 890
- NG: 303
- BD: 273

# of networks affected by an outage

- BR: 394
- US: 25
- IR: 59
- IN: 51
- ID: 97
- RU: 51
- UA: 82
- AR: 49
- NG: 12
- BD: 25

Source: https://www.bgpstream.com/
Outages 2017

% of networks affected by an outage

Source: https://www.bgpstream.com/
Outages 2017 → 2018

% of networks affected by an outage

- BR: 10.82%
- US: 8.83%
- IR: 8.82%
- IN: 7.96%
- ID: 5.75%
- RU: 5.58%
- AR: 4.90%
- UA: 1.77%
- NG: 1.94%
- BD: 2.87%

Source: https://www.bgpstream.com/
Potential victims

Incidents with a victim in a country, Top 10, 2017

Source: https://www.bgpstream.com/
Potential culprits 2017

Number of AS's in a country responsible for a routing incident (a route leak or hijack)

- BR: 324
- US: 39
- RU: 35
- GB: 32
- IN: 22
- HK: 19
- DE: 17
- ID: 15
- IR: 10
- NL: 8

Percent of AS's in a country responsible for a routing incident (a route leak or hijack)

- BR: 6.55%
- US: 3.76%
- RU: 2.10%
- GB: 7.73%
- IN: 3.50%
- HK: 3.02%
- DE: 4.27%
- ID: 2.33%
- IR: 1.18%
- NL: 9.40%

Source: [https://www.bgpstream.com/](https://www.bgpstream.com/)
## Routing Incidents Cause Real World Problems

<table>
<thead>
<tr>
<th>Event</th>
<th>Explanation</th>
<th>Repercussions</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefix/Route Hijacking</td>
<td>A network operator or attacker impersonates another network operator, pretending that a server or network is their client.</td>
<td>Packets are forwarded to the wrong place, and can cause Denial of Service (DoS) attacks or traffic interception.</td>
<td>The 2008 YouTube hijack April 2018 Amazon Route 53 hijack</td>
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<tr>
<td>Route Leak</td>
<td>A network operator with multiple upstream providers (often due to accidental misconfiguration) announces to one upstream provider that it has a route to a destination through the other upstream provider.</td>
<td>Can be used for a MITM, including traffic inspection, modification and reconnaissance.</td>
<td>September 2014. VolumeDrive began announcing to Atrato nearly all the BGP routes it learned from Cogent causing disruptions to traffic in places as far-flung from the USA as Pakistan and Bulgaria.</td>
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<tr>
<td>IP Address Spoofing</td>
<td>Someone creates IP packets with a false source IP address to hide the identity of the sender or to impersonate another computing system.</td>
<td>The root cause of reflection DDoS attacks</td>
<td>March 1, 2018. Memcached 1.3Tb/s reflection-amplification attack reported by Akamai</td>
</tr>
</tbody>
</table>
Tools to Help

- Prefix and AS-PATH filtering
- RPKI validator, IRR toolset, IRRPT, BGPQ3
- BGPSEC is standardized

But...

- Not enough deployment
- Lack of reliable data

We need a systemic approach to improving routing security
Network operators have a responsibility to ensure a globally robust and secure routing infrastructure.

Your network’s safety depends on a routing infrastructure that weeds out bad actors and accidental misconfigurations that wreak havoc on the Internet.

The more network operators work together, the fewer incidents there will be, and the less damage they can do.
Mutually Agreed Norms for Routing Security (MANRS)

Provides crucial fixes to reduce the most common routing threats
Mutually Agreed Norms for Routing Security

MANRS defines four simple but concrete actions that network operators must implement to improve Internet security and reliability.

- The first two operational improvements eliminate the root causes of common routing issues and attacks, while the second two procedural steps improve mitigation and decrease the likelihood of future incidents.

MANRS builds a visible community of security minded network operators and IXPs.
## MANRS Actions

<table>
<thead>
<tr>
<th>Filtering</th>
<th>Anti-spoofing</th>
<th>Coordination</th>
<th>Global Validation</th>
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<tbody>
<tr>
<td>Prevent propagation of incorrect routing information</td>
<td>Prevent traffic with spoofed source IP addresses</td>
<td>Facilitate global operational communication and coordination between network operators</td>
<td>Facilitate validation of routing information on a global scale</td>
</tr>
<tr>
<td>Ensure the correctness of your own announcements and announcements from your customers to adjacent networks with prefix and AS-path granularity</td>
<td>Enable source address validation for at least single-homed stub customer networks, their own end-users, and infrastructure</td>
<td>Maintain globally accessible up-to-date contact information in common routing databases</td>
<td>Publish your data, so others can validate</td>
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MANRS is an Important Step

Security is a process, not a state. MANRS provides a structure and a consistent approach to solving security issues facing the Internet.

MANRS is the minimum an operator should consider, with low risk and cost-effective actions.

MANRS is not a one-stop solution to all of the Internet’s routing woes, but it is an important step toward a globally robust and secure routing infrastructure.
The Business Case for MANRS and Routing Security

Engaged 451 Research to better understand the attitudes and perceptions of Internet service providers and the broader enterprise community around the project.
What We Learned from the Study

Security is Vital to Enterprises

- MANRS knowledge is low, but the desire for security is high
- Enterprises are willing to require MANRS compliance of their service providers

MANRS Adds Value for Service Providers

- Security can help service providers differentiate from their competitors; Identifiable value in a vague market
- Service providers may be able to add additional revenue streams based on information security feeds and other add-on services
Enterprise Security Concerns

• Widely varying concerns across a range of issues, with traffic hijacking leading the list

• Security focus is aligned with types of issues MANRS is looking to address

• Confidence that MANRS can help long-term routing security

![Internet Security Concerns](chart.png)
Implementing MANRS Actions:

**Signals** an organization’s security-forward posture and can eliminate SLA violations that reduce profitability or cost customer relationships.

**Heads off** routing incidents, helping networks readily identify and address problems with customers or peers.

**Improves** a network’s operational efficiency by establishing better and cleaner peering communication pathways, while also providing granular insight for troubleshooting.

**Addresses** many concerns of security-focused enterprises and other customers.
MANRS – increasing adoption
MANRS IXP Programme

There is synergy between MANRS and IXPs

• IXPs form a community with a common operational objective
• MANRS is a reference point with a global presence – useful for building a “safe neighborhood”

How can IXPs contribute?

• Implement a set of Actions that demonstrate the IXP commitment and also bring significant improvement to the resilience and security of the routing system
MANRS IXP Program – launched on April 23!

IXP Participants

IXPs are important partners in the MANRS community.

IXPs can be a collaborative focal point to discuss and promote the importance of routing security. To address the unique needs and concerns of IXPs, the community created a related but separate set of MANRS actions for IXP members.

Click Here to Join!

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MANRS Implementation Guide

A resource to help Operators implement MANRS Actions.

• Based on Best Current Operational Practices deployed by network operators around the world

• https://www.manrs.org/bcop/

• Has received recognition from the RIPE community by being published as RIPE-706
6 training tutorials based on information in the Implementation Guide. A test at the end of each tutorial.
https://www.manrs.org/tutorials
About to begin training moderators for online classes (43 applications received!)
The prototype lab is ready, finalizing the production version.
MANRS Member Report and MANRS Observatory
Why join MANRS?

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

Visit https://www.manrs.org

• Fill out the sign up form with as much detail as possible.
• We may ask questions and run tests

Get Involved in the Community

• Members support the initiative and implement the actions in their own networks
• Members maintain and improve the document and promote MANRS objectives
manrs.org

#ProtectTheCore

MANRS Video:
https://www.youtube.com/embed/nJINk5p-HEE