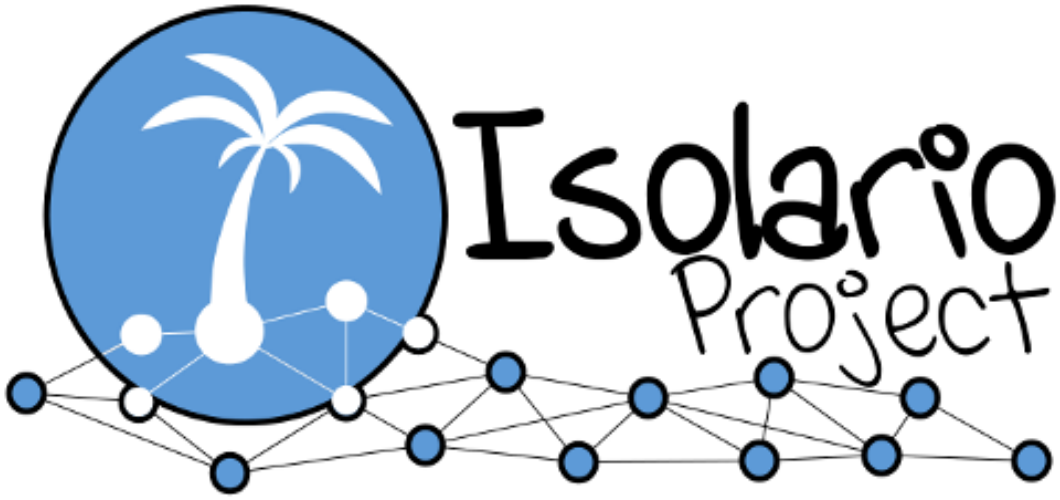


# the **real-time** Internet routing observatory

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ENOG
June 7-8, 2016 | Moscow, Russia

# Unveiling the Internet structure with BGP data

## BGP route collectors

BGP data collected up to date has been unvaluable to reveal the Internet inter-domain characteristics, but it is known to be largely *incomplete*




## How much incomplete? (March 2016)

It was possible to discover the **full** connectivity of:

- 833 out of 8683 ASes (9.59%) which transit traffic for other ASes
- 104 out of 892 ASes (11.65%) of those operating in Russia

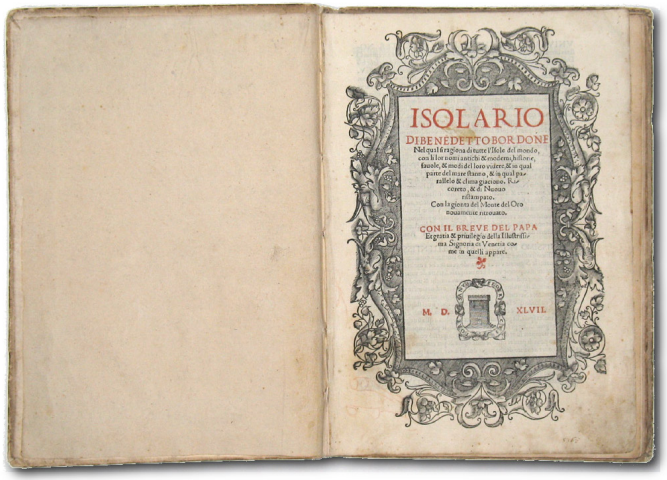
## Main cause: small number of small ASes connected

Do AS administrators see any direct outcome in sharing their routing information?

# Isolario project

## Objective: push more ASes to join

The more the ASes, the more the completeness of public BGP data




Isolario - The Book of Islands

*"where we discuss about all islands of the world, with their ancient and modern names, histories, tales and way of living..."*

Benedetto Bordone
(Italian cartographer)

## Approach: Do-ut-des

- Participants open a BGP session with Isolario providing the BGP full routing table and its evolution over time
- In change, Isolario offers **real-time** and **historic** analysis applications based on the aggregation of every routing information collected

# Data we plan to provide to research community

## MRT data (same format as RIPE RIS, Route Views, · · · )

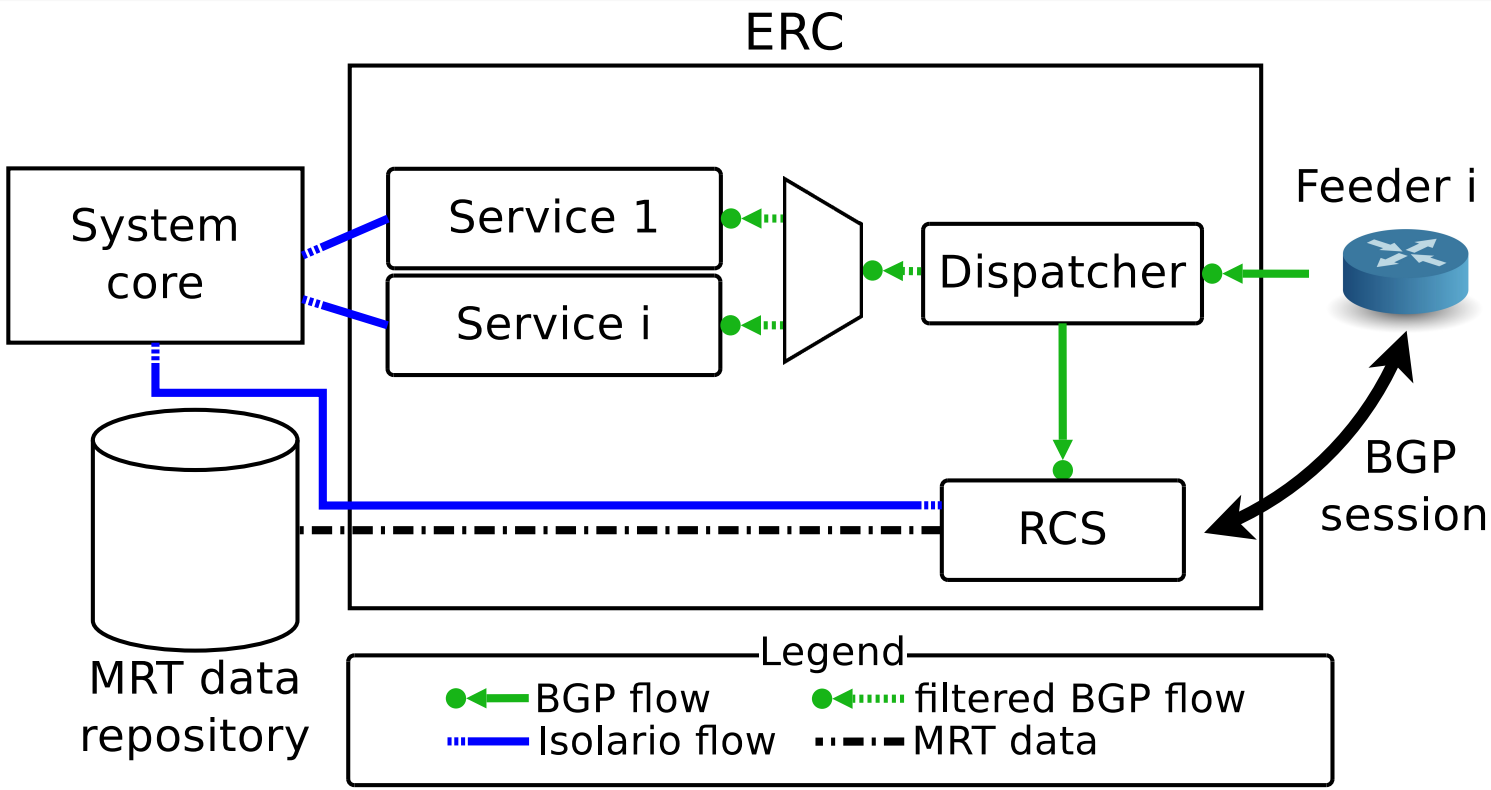
1. RIB feeder snapshots every 2 hours
2. UPDATE collections every 5 minutes

## Periodic analyses (daily, weekly, monthly, · · · )


1. AS-level Topologies (Global and Geographic)
2. AS characteristics
3. Feeder contribution
4. Total coverage of RCs

# Enhanced BGP Route Collector

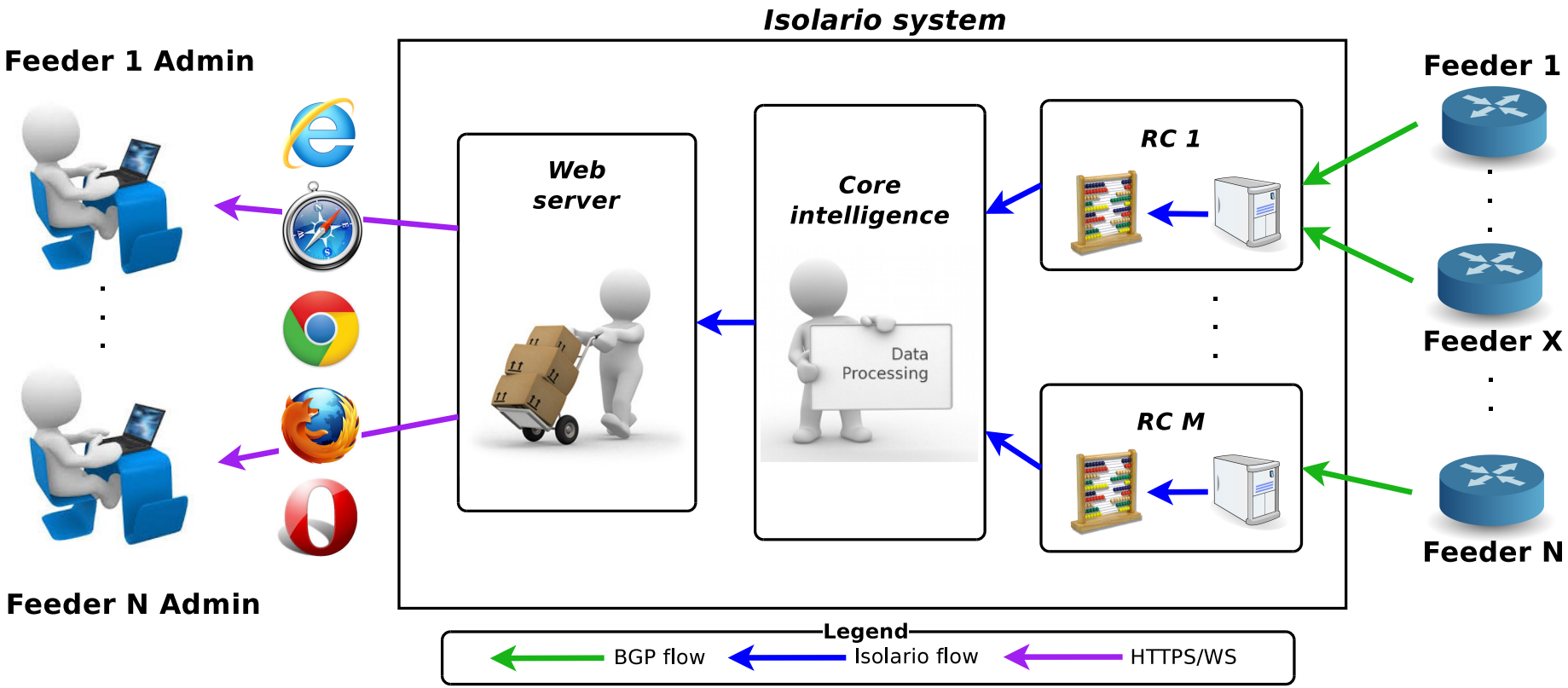
Incoming flows are duplicated as soon as they arrive and feed both the Route Collecting Software (RCS) and service modules




As usual, RCs only collect routing information and **not** user traffic

# Isolario system overview

Incoming BGP flows are used as **real-time streams** for services dedicated to participants




Results are provided to users via WebSockets

# Isolario free services for feeders

Every feeder has **free** access to a set of services tailored to monitor and analyse BGP data coming into Isolario system

## Real-time services

- BGP flow viewer
- Routing table viewer
- Route flap detector
- Website reachability
- Subnet reachability

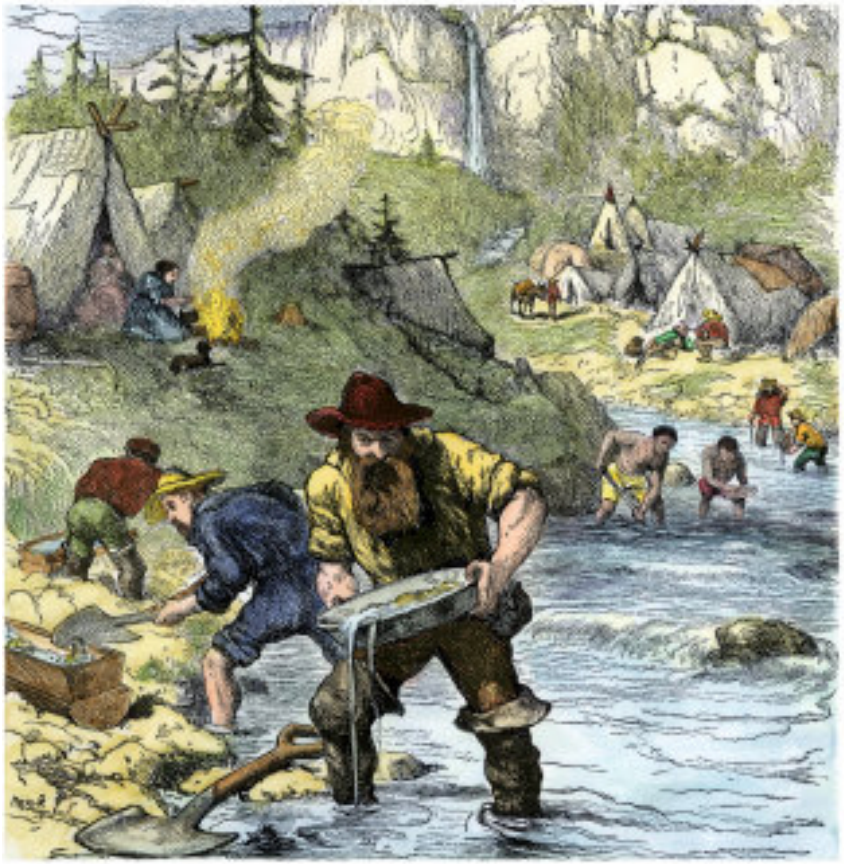
## Historic services


- Routing table viewer
- Subnet reachability

## Diagnostic services

- Alerting system
- Daily report

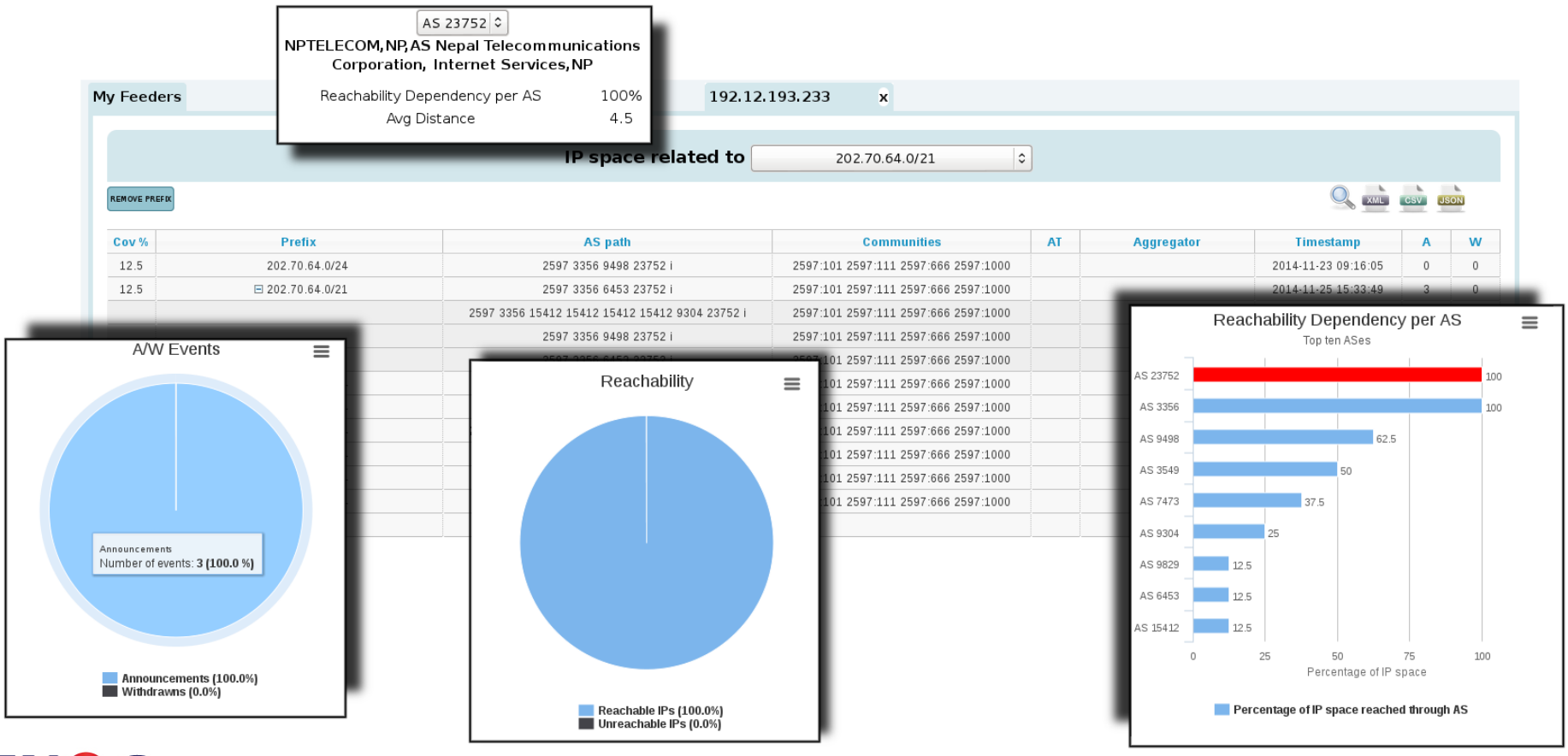
# Real-time services



Real-time services allow to monitor BGP data flowing into Isolario system

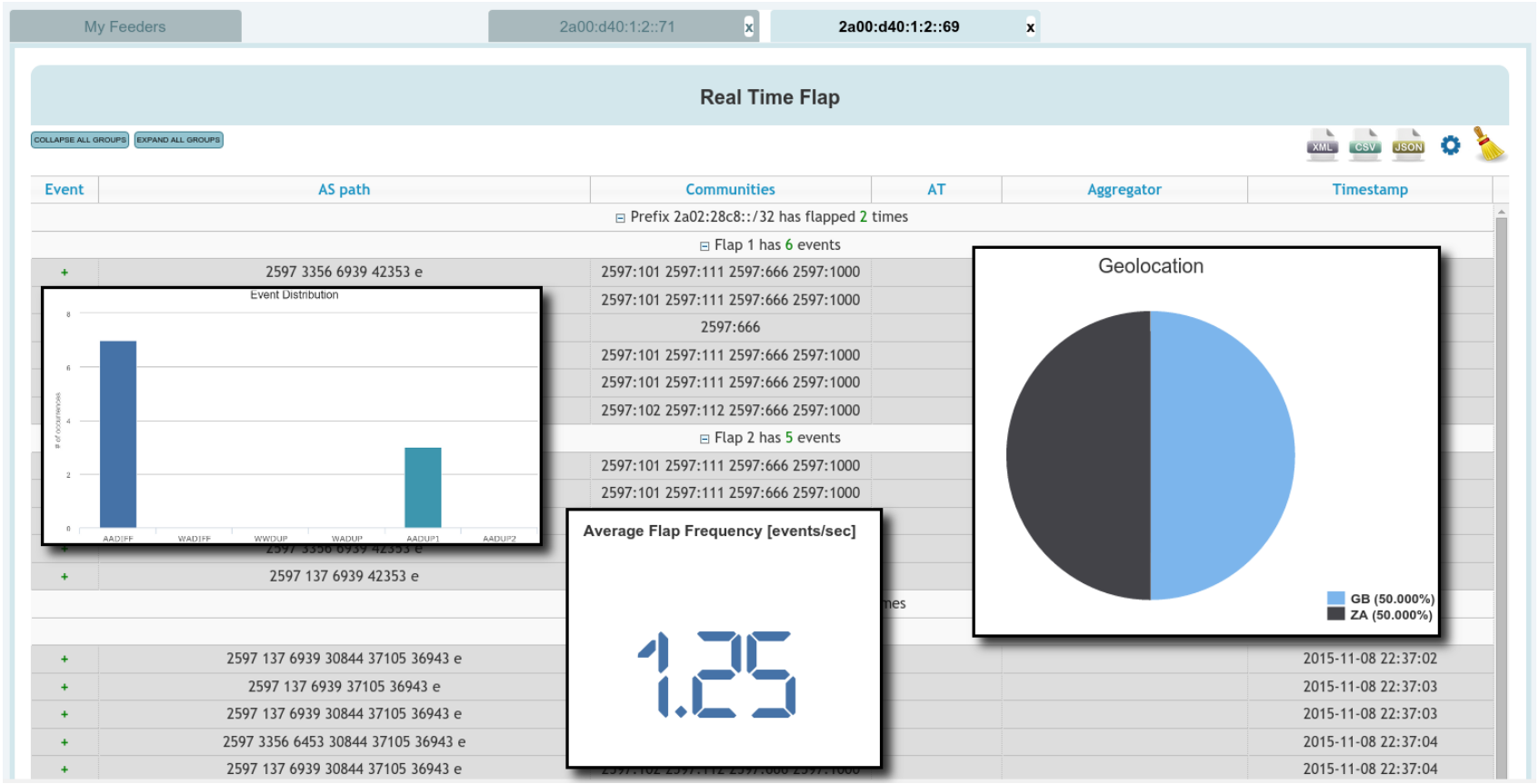
# Routing table viewer

Allows to analyse in real-time the routes that a feeder is currently announcing to Isolario to reach a portion of the IP space



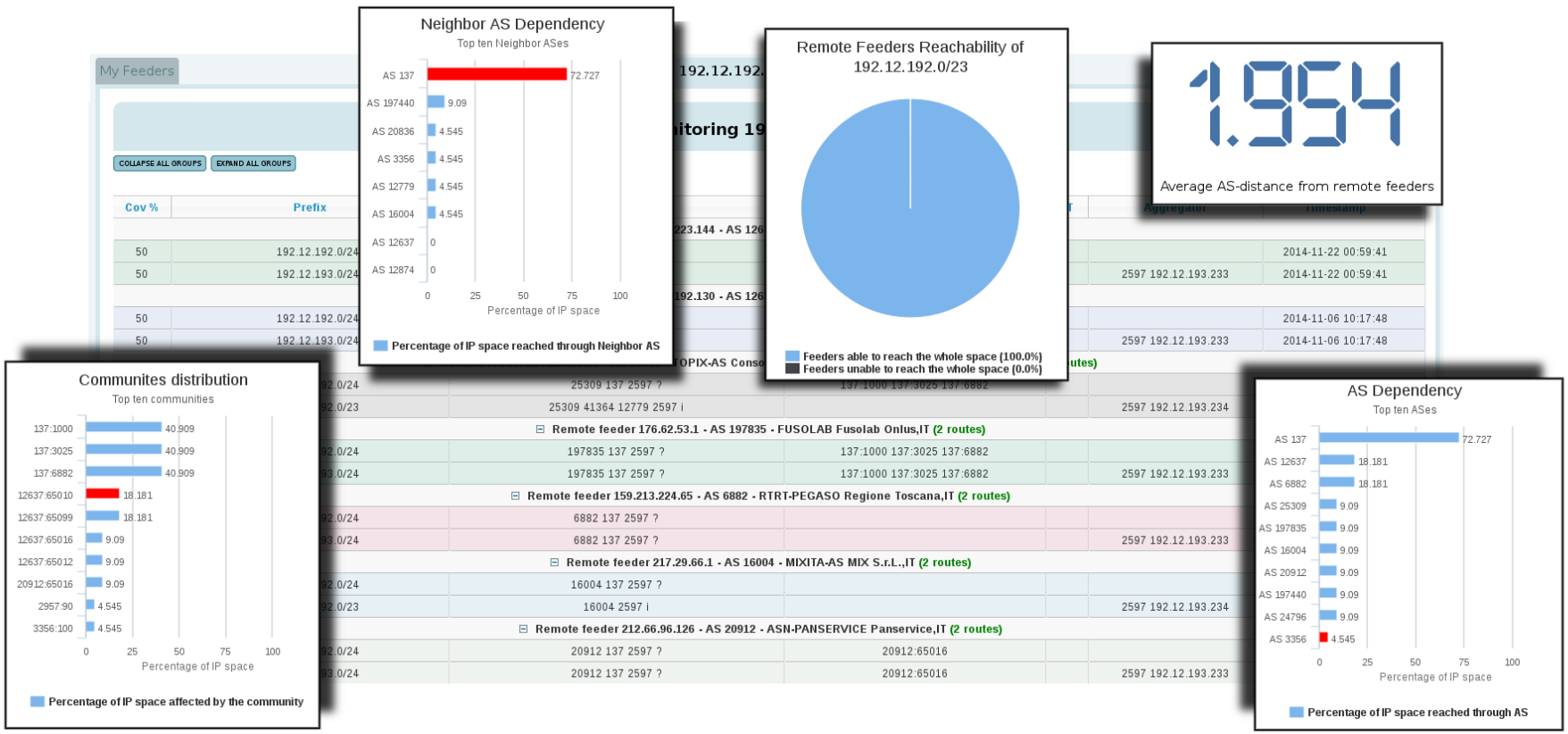
# Flap detector

Allows to detect and analyse in real-time the routes that are experiencing flap events



# Subnet reachability

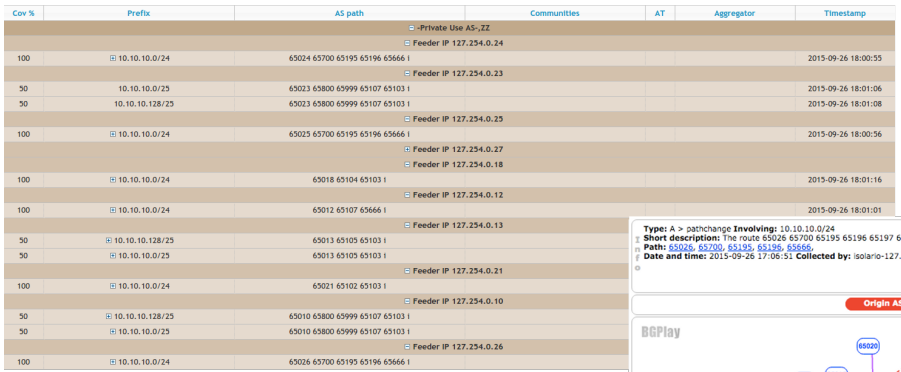
Allows to analyse in real-time the routes that every Isolario feeder is announcing to Isolario to reach a portion of the IP space



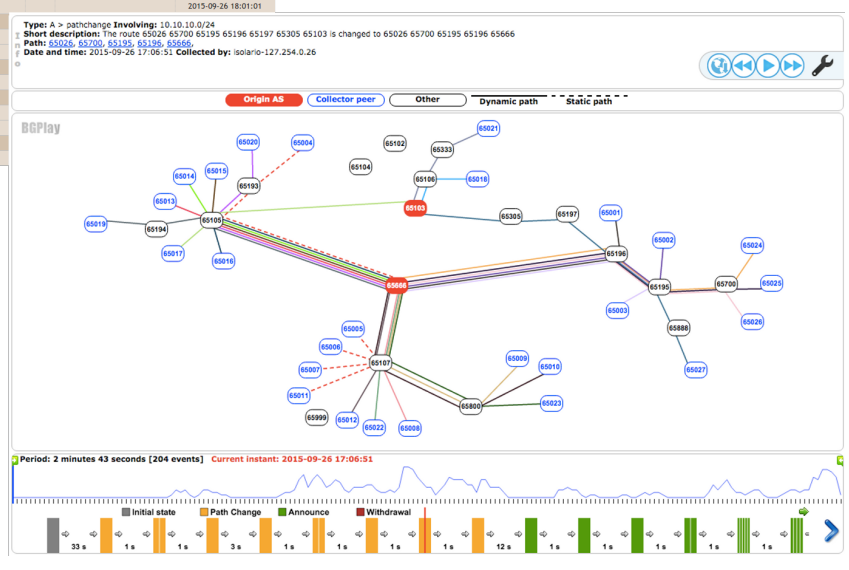

The more the feeders, the more SR is useful!

# Isolario real-time visualisation with BGPlay

- BGPlay is an **open-source** tool for the visualisation of BGP routing
- Thanks to the close collaboration with Massimo Candela (RIPE NCC) we integrated in Isolario the BGPlay **real-time version** (**http://bgplay.massimocandela.com**)

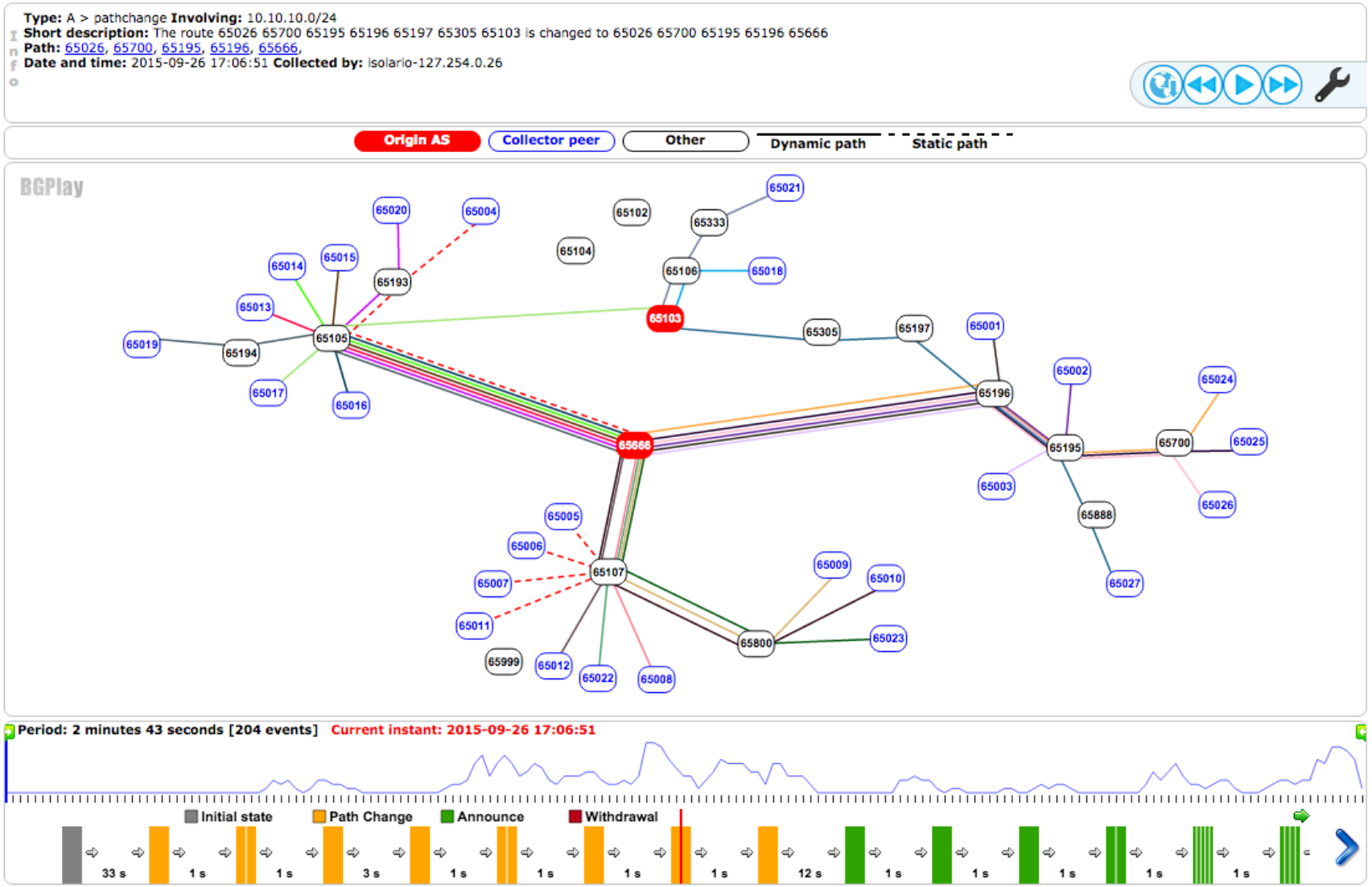


| Cov % | Prefix | AS path | Communities | AT | Aggregator | Timestamp |
|---|---|---|---|---|---|---|
| | | Private Use AS-,ZZ | | | | |
| | | Feeder IP 127.254.0.24 | | | | |
| 100 | 10.10.10.0/24 | 65024 65700 65195 65196 65666 I | | | | 2015-09-26 18:00:55 |
| | | Feeder IP 127.254.0.23 | | | | |
| 50 | 10.10.10.0/25 | 65023 65800 65999 65107 65103 I | | | | 2015-09-26 18:01:06 |
| 50 | 10.10.10.128/25 | 65023 65800 65999 65107 65103 I | | | | 2015-09-26 18:01:08 |
| | | Feeder IP 127.254.0.25 | | | | |
| 100 | 10.10.10.0/24 | 65025 65700 65195 65196 65666 I | | | | 2015-09-26 18:00:56 |
| | | Feeder IP 127.254.0.27 | | | | |
| | | Feeder IP 127.254.0.18 | | | | |
| 100 | 10.10.10.0/24 | 65018 65104 65103 I | | | | 2015-09-26 18:01:16 |
| | | Feeder IP 127.254.0.12 | | | | |
| 100 | 10.10.10.0/24 | 65012 65107 65666 I | | | | 2015-09-26 18:01:01 |
| | | Feeder IP 127.254.0.13 | | | | |
| 50 | 10.10.10.128/25 | 65013 65105 65103 I | | | | |
| 50 | 10.10.10.0/25 | 65013 65105 65103 I | | | | |
| | | Feeder IP 127.254.0.21 | | | | |
| 100 | 10.10.10.0/24 | 65021 65102 65103 I | | | | |
| | | Feeder IP 127.254.0.10 | | | | |
| 50 | 10.10.10.128/25 | 65010 65800 65999 65107 65103 I | | | | |
| 50 | 10.10.10.0/25 | 65010 65800 65999 65107 65103 I | | | | |
| | | Feeder IP 127.254.0.26 | | | | |
| 100 | 10.10.10.0/24 | 65026 65700 65195 65196 65666 I | | | | |




BGPlay is currently integrated in SR

# BGPlay real-time

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**http://bgplay.massimocandela.com**

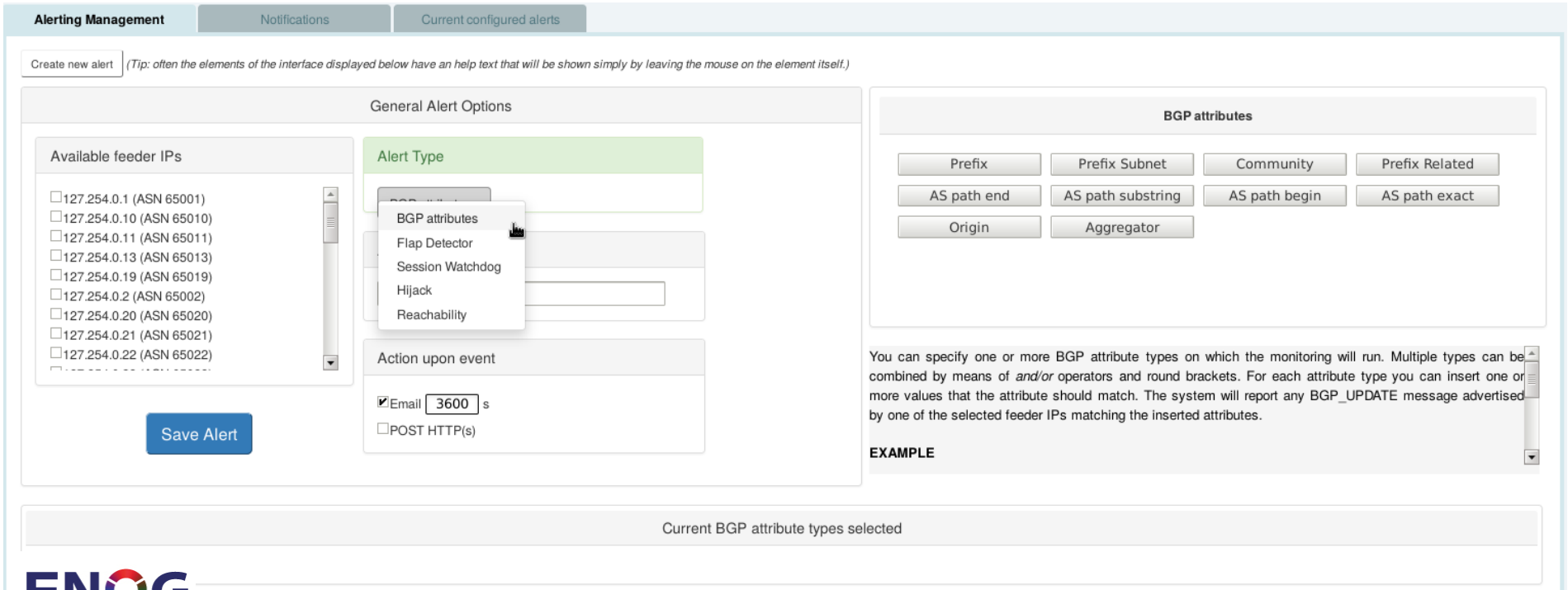
# Diagnostic services


Diagnostic services exploit incoming BGP flows and/or historic data to report anomalies of the inter-domain routing status

# Alerting system

## Alerting system

- **BGP attributes:** BGP UPDATEs matching attributes of interest
- **Flap events:** a prefix UPDATE rate is larger than a threshold
- **Hijack attempts:** BGP UPDATEs hijacking a feeder subnet
- **Prefix reachability:** (un)reachability of prefixes of interest



# Daily report

Summary about the feeder inter-domain routing status as perceived by the Isolario system

## For example...

**Routing statistics**

- #Announce, #Withdrawn
- Most (un)stable prefixes

**Reachability statistics**

- Inbound reachability

**BGP attributes statistics**

- AS path anomalies

# Daily report: Summary of statistics

## 1 General statistics

Analysis start date: *Thursday 21 May 2015 at 00:00:00*
Analysis end date: *Thursday 21 May 2015 at 23:59:59*

Number of non overlapping IPv4 space covered[1]: *2739704260 (98.581001 %)*
The remaining 1.418999 % is covered by a default route

Packets received: *227490*
Feeder status at end date: *up*
Downs experienced since start date: *0*

## 2 Route statistics

Subnets: *532099*
Unstable subnets: *57727 (10.848 %)*
Stable subnets: *474372 (89.151001 %)*

Number of reserved subnets: *1* – see Sect. 2.4 for further details

Geolocated subnets[2]: *475610 (89.383003 %)*

## 5 AS statistics

ASes seen: *50241*
Private ASes: *34 (0.067 %)*
Public ASes: *50207 (99.931999 %)*

Public ASes on 16 bits: *42864 (85.316002 %)*
Public ASes on 32 bits: *7343 (14.615 %)*
Number of public ASes at start date: *50089*
Number of public ASes at end date: *50142*
Difference: *+53 ASes (+0.105 %)*

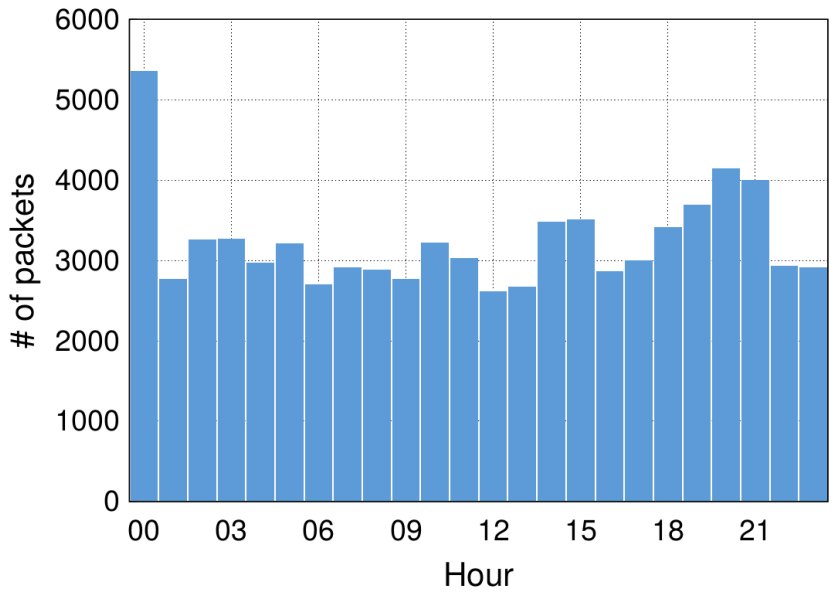
## 7 My subnet statistics

Total number of subnets perceived as proprietary: *1*

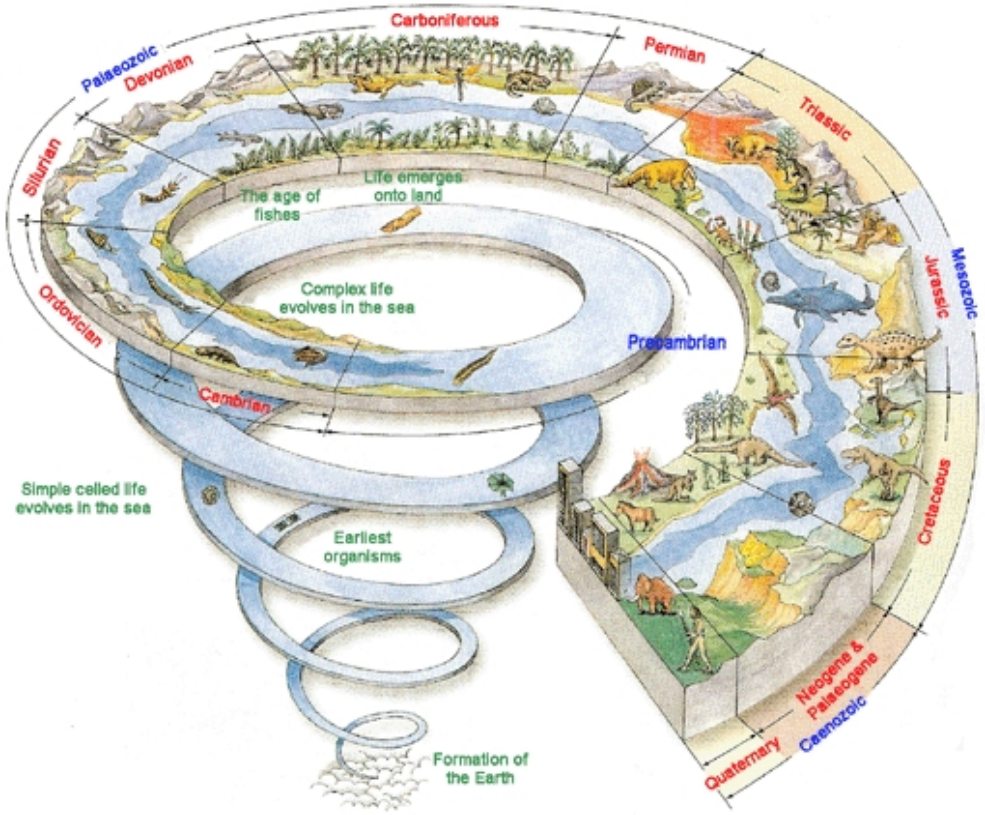
| Subnet |
|---|
| 192.65.131.0/24 |

Number of events related to proprietary subnets: *0*
Number of announcements related to proprietary subnets: *0*
Number of withdrawns related to proprietary subnets: *0*

Figure 1: Amount of packets received per hour



# Historic services

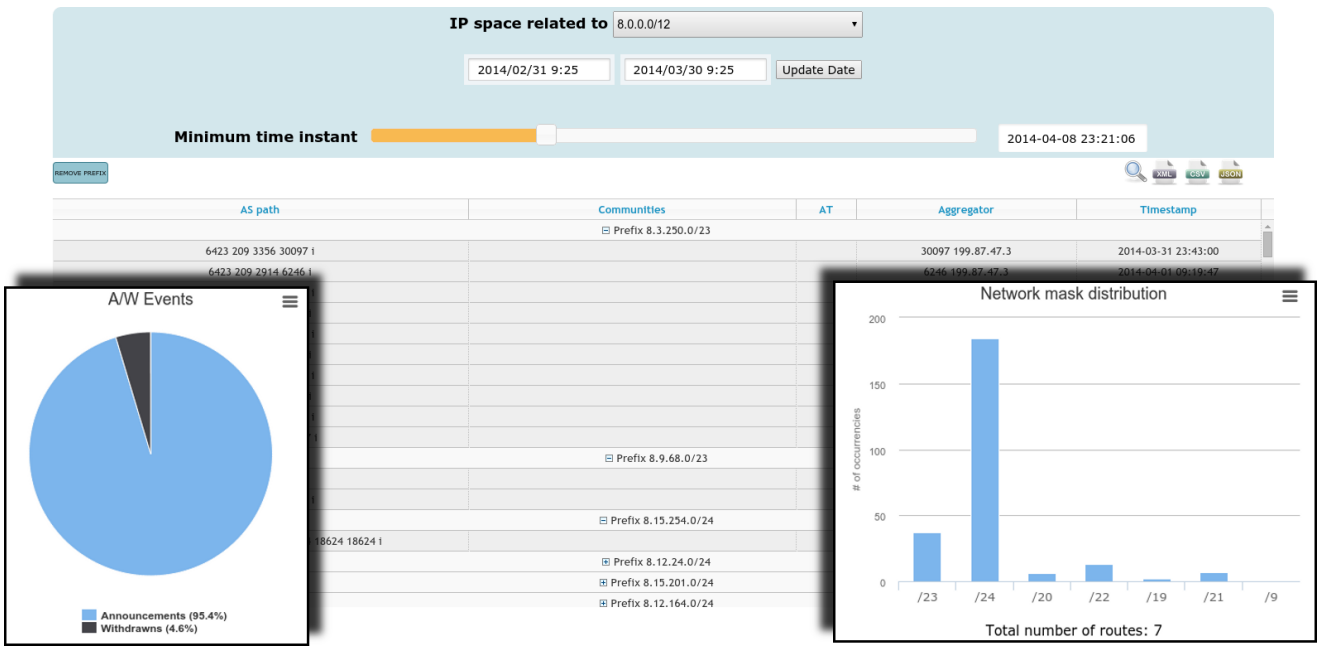



Historic services exploit every BGP data available
(Route Views, RIPE NCC RIS, Isolario)
to show how routes evolved in the past

# Historic services


## Applications

- **Routing table viewer:** Allows to analyse portion(s) of the routing table that each feeder announced to Isolario
- **Subnet reachability:** Allows to analyse the reachability of the IP space portions from every feeder available in the past



# Summary: how to use Isolario?

## Real-time services

**Something is happening**

How is my RIB(s) evolving?

How is my reachability affected?

## Historic services


**Something happened**

How was my RIB(s) evolving?

How was my reachability affected?

## Alerting System

**Something is happening NOW!**

Check real-time services!

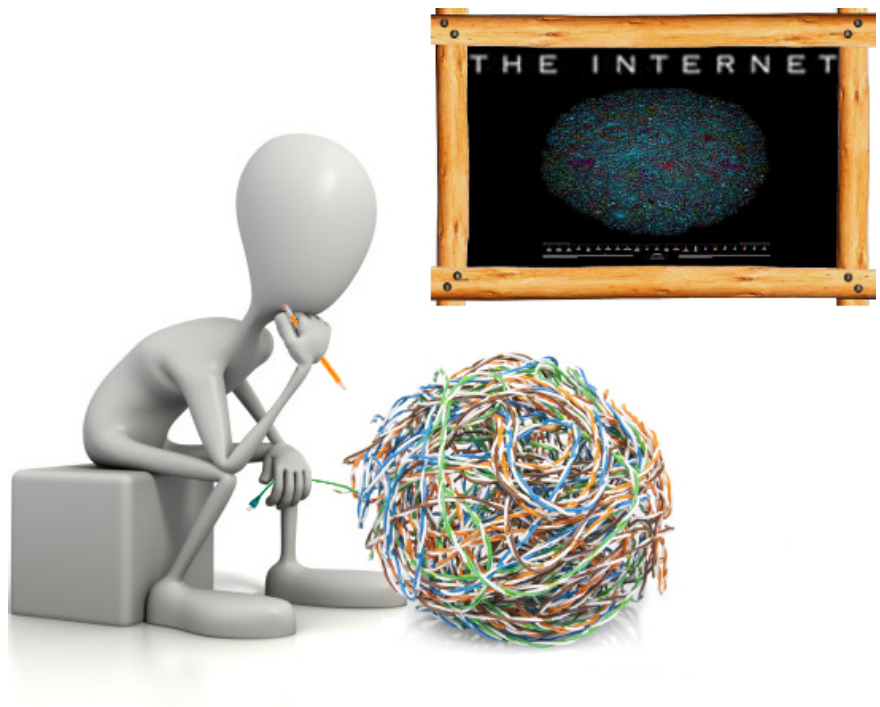
Do something! (if needed)

## Daily report

**Did something happen yesterday?**

Check historic services!

Do something! (if needed)



# Summary: how to use Isolario?

## Real-time services

**Something is happening**

How is my RIB(s) evolving?

How is my reachability affected?

## Historic services


**Something happened**

How was my RIB(s) evolving?

How was my reachability affected?

## Alerting System

**Something is hap**

Check real-tin

Do something!

## Daily rep

**Did something happen yesterday?**

Check historic services!

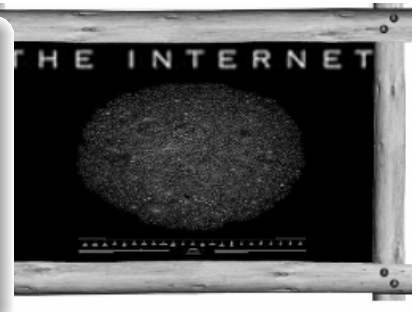
Do something! (if needed)

## Please, try Isolario real-time services!

`https://www.isolario.it`

Username: *guest*

Password: *guest*




# Thank you for your attention

**Join us and help us to unveil the Internet AS-level structure!**

To participate, contact us at:
**info@isolario.it**