AFRINIC
The Internet Numbers Registry for Africa

Internet Routing Registry Tutorial

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Objectives

- Whois Database Refresher
- Overview of the AFRINIC IRR
- Outline the benefits of the AFRINIC IRR
- Discuss the RIPE NCC NWI-5 Implementation
- Upcoming changes to the AFRINIC IRR
- How to create Route objects
- How to replicate objects from RIPE

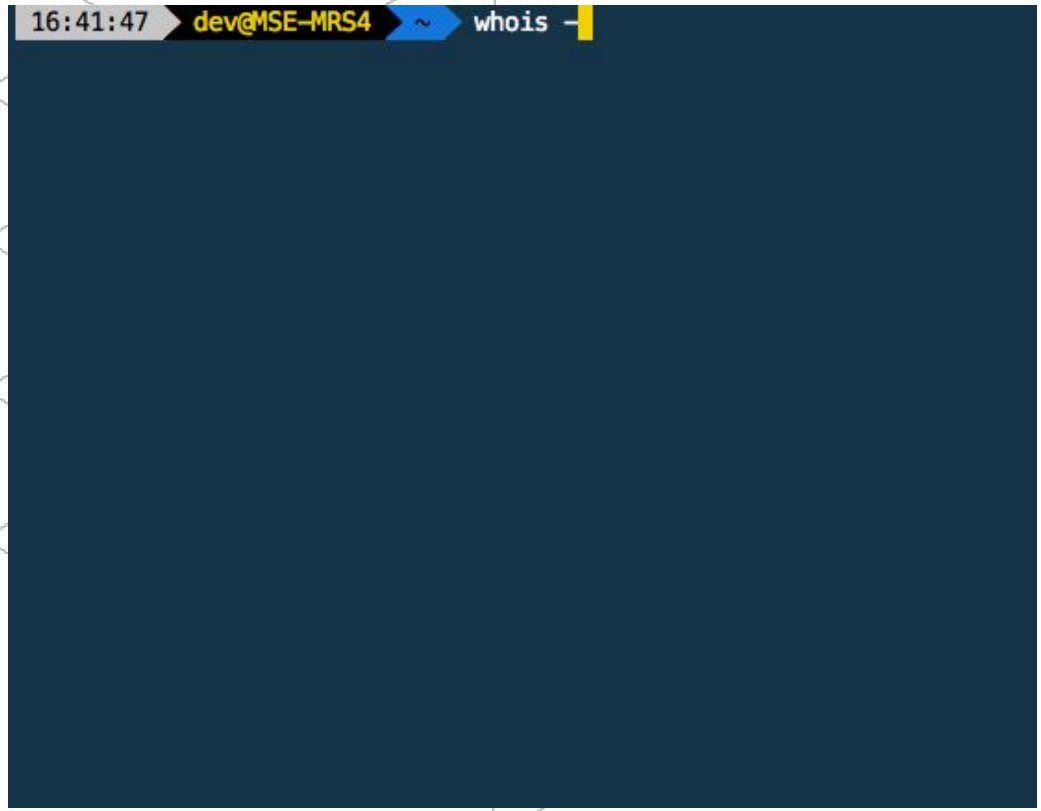
WHOIS DB - Database Objects

An object is a set of attributes and values

- Each attribute of an object...
  - Has a value
  - Has a specific syntax
  - Is mandatory or optional
  - Is single- or multi-valued
- Some attributes ...
  - Are primary (unique) keys
  - Are lookup keys for queries
  - Are inverse keys for queries

Object “templates” illustrate this structure

WHOIS DB - Inetnum Object Example



WHOIS DB - Database Queries

Two ways to query the AFRINIC whois database:

- The Whois Web Interface accessible at:
  https://whois.afrinic.net

- The Whois CLI client which can be downloaded at:
  http://ftp.afrinic.net/db/

  $ whois ***-h whois.afrinic.net*** *-rB 196.1.0.0/24*

WHOIS DB - Object Protection

Objects on the whois database are protected by a maintainer(mntner) via the ‘mnt-by’ attribute. The maintainer is itself an object on the AFRINIC whois database.

Each maintainer object has a password or PGP key linked to it which will be required when creating or updating other objects which are protected by the maintainer.

Overview of the AFRINIC IRR

What is a Routing Registry?

- Distributed databases with public routing policy information, mirroring each other: AFRINIC, RIPE, APNIC, RADB, Level3, etc...
  - BGP does not provide a mechanism to publish/communicate the policies themselves
  - The routing registry provides this functionality

- Routing policy information can be published in a series of objects
  - Stability and consistency of routing
  - Network operators share information

Why do we need a routing registry?

The IRR contains announced routes and routing policy in a common format that network operators can use to configure their backbone routers.

- Document routing policy
- Required by some Transit Providers & IXPs
  - they use it for prefix-based filtering
- Allows for automated generation of prefix filters and router configuration commands, based on the RR using tools such as bgpq3 or IRRtoolset. Prefix filtering based on IRR registered routes prevents accidental route leaks and prefix hijacking

The AFRINIC IRR

AFRINIC's Internet Routing Registry(IRR) was launched during its AFRINIC-18 meeting(17th June 2013).

Previously, AFRINIC members were asked by AFRINIC to add route(6) objects on the RIPE NCC's IRR. Some members also had routing policy information displayed in 'remarks' fields in the AFRINIC WHOIS itself.

How was it possible to create route objects on the RIPE Database?

- Using a well-known maintainer(RIPE-NCC-RPSL-MNT) which had a 'public' password
- Possible to create any new AUT-NUM or ROUTE(6) objects for non-RIPE managed resources

AFRINIC IRR Features

- **Open** to AFRINIC Resource members and Legacy Resource Holders in AFRINIC service region.
- The AFRINIC IRR is a **free** service
- AFRINIC IRR is **mirrored** by the other IRRs such as APNIC, RIPE NCC, NTTCOM, AMS-IX, Work Online(SA), Moscow IXP and RADB.
- **Stable** source of routing information.
- **Secure:** the mnt-by, mnt-lower authentication attributes in inetnum objects are checked to ensure the member has control over routing objects that specify their resources.
- AFRINIC is the **single point of contact** for both Internet Resource Management and Routing Registry

AFRINIC IRR Roadmap June 2013 - Sept 2018

June 2013: Deployment of AFRINIC IRR

2013 to 2018: Various AFRINIC initiatives to increase IRR adoption and member education on how to to use the AFRINIC IRR (bootcamps, documentation on website, tutorials during outreach, assistance during face to face consultations, migration tool)

Enhancements to Business Rules in **May 2016**, to address some issues experienced by the AFRINIC membership

September 2018: RIPE NCC implemented NWI-5(Numbered Work Items - 5) on their IRR database

RIPE NWI-5 Changes in a nutshell..

- The RIPE-NCC-RPSL-MNT maintainer was deleted
- Creation of out-of-region aut-num(ASN) is no longer possible
- The RIPE RR no longer supports the creation of out-of-region route(6) objects
- Existing non-RIPE-managed route(6) objects have been moved under the source: “RIPE-NONAUTH”
- The existing out-of-region objects may eventually be deleted after further discussion by the RIPE Database Working Group

RIPE NWI-5: Implications for AFRINIC members

- Operators can opt to lookup object with "source: RIPE" only, else their scripts or automation tools may filter out-of-region route(6) objects (as their authorisation is questionable) or treat them with a lower preference. Your legitimate route announcement may be filtered and this will eventually result in network outages.

- The changes may not be affecting you at the moment if your upstream does not filter route(6) objects based on the “source”. However, the RIPE DBWG is yet to decide to delete the out-of-region objects or not.

- No longer able to create route(6) objects in the RIPE IRR DB using IP resources from AFRINIC.

RIPE NWI-5: Migrate to AFRINIC IRR

If you have IP prefixes delegated by AFRINIC, we highly recommend using the AFRINIC IRR to publish your routing policy.

The AFRINIC & RIPE IRR Similarities:

- RPSL
- Quasi similar object attributes
- Authentication against maintainers
- RIPE mirrors the AFRINIC IRR
- Use WHOIS web-client
- Use Email updates

AFRINIC IRR - Previous Business Rules

- The route(6) object creation were possible for the following scenario:
  - Both ASN and IPv4/IPv6 prefix(es) were issued to your organisation
    - Authentication for **IPv6/IPv6 and ASN in route(6) object is required**
  - IPv4/IPv6 was issued to one ORG and ASN to another ORG.
    - Both ASN and IPv4/IPv6 prefixes were registered in AFRINIC WHOIS
    - Dual Authentication of **IPv4/IPv6 & ASN holders is required**

AFRINIC IRR - Previous Business Rules

- **Out Of Region (OOR) ASN** (ASN not registered in AFRINIC WHOIS but registered as delegated in other RIRs whois db)
  - OOR ASN Registered under member's org details in another RIR's whois db.

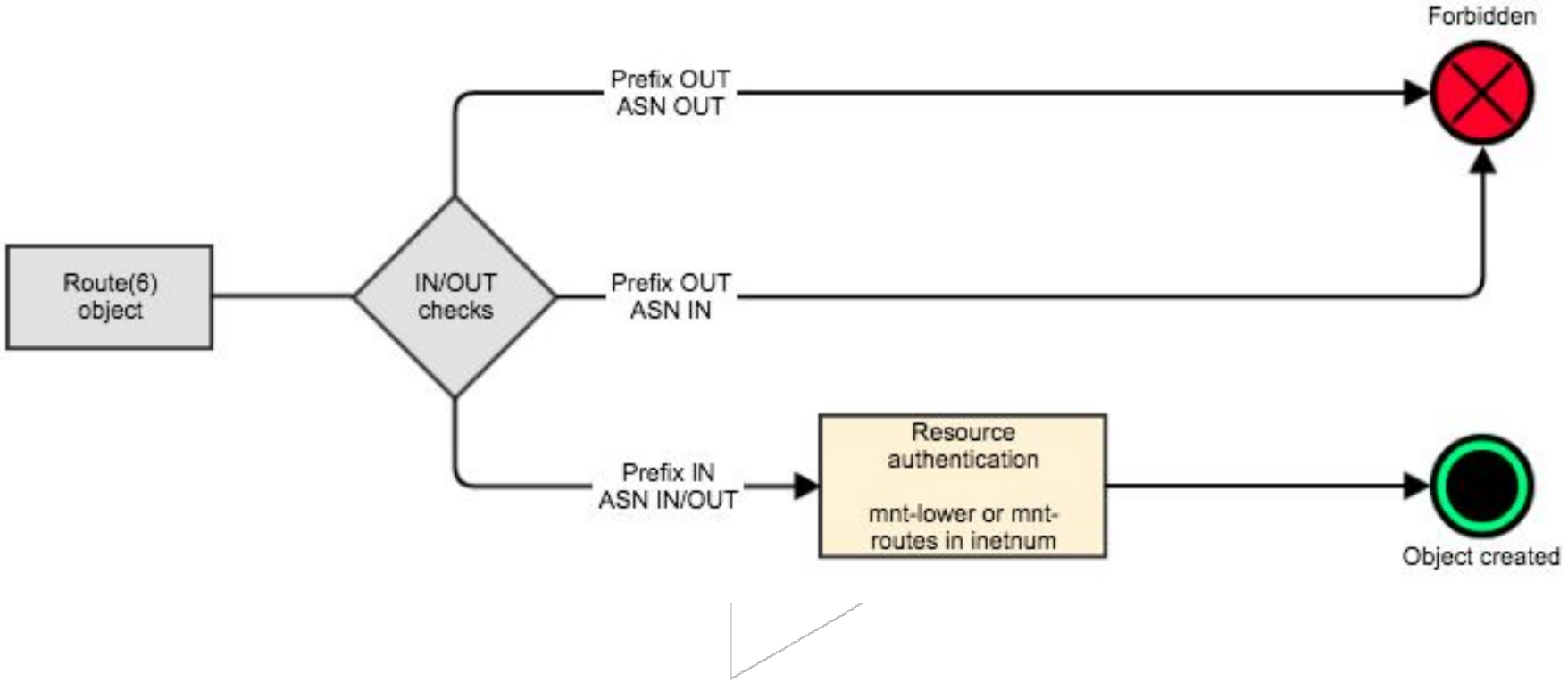
    Manual Hostmaster intervention was required

    Hostmasters create the route object after validation.
  - Not supported: OOR ASN not delegated to member as per organisation details

AFRINIC IRR - Current Business Rule

- On the 27th September 2018, AFRINIC implemented the new rules for the route(6) object creation, the following shall then be possible:
  - No ASN authorisation requirement for ROUTE(6) object creation
  - Autonomously create route objects where the IPv4 or IPv6 is from the AFRINIC service region
    - Only authentication required against IP prefix's maintainer
    - Regardless of where the ASN is domiciled or who is the holder of the ASN
    - No hostmaster intervention required for route(6) creation where the ASN is not issued by AFRINIC

AFRINIC IRR - New Creation Workflow



AFRINIC IRR - Create route(6) objects

Route(6) Creation in 4 steps:

- The IP prefix must be an AFRINIC managed IP resource and an inet(6)num object must exist on the AFRINIC whois.
- Ensure that there is an mnt-lower or mnt-routes in the inet(6)num
- Get the route(6) object template and fill in all the mandatory attributes
- Submit the route(6) object for creation by authenticating against the maintainers in the inet(6)num

The `mntner` object

- mntner is an abbreviation of maintainer
- Identifies accounts in the registry
- Specifies authentication mechanism in the “auth” attribute. Either:
  - PGP-KEY - PGP/GPG based auth
  - (B)CRYPT-PW / MD5-PW - password auth
  - MAIL-FROM - email based auth

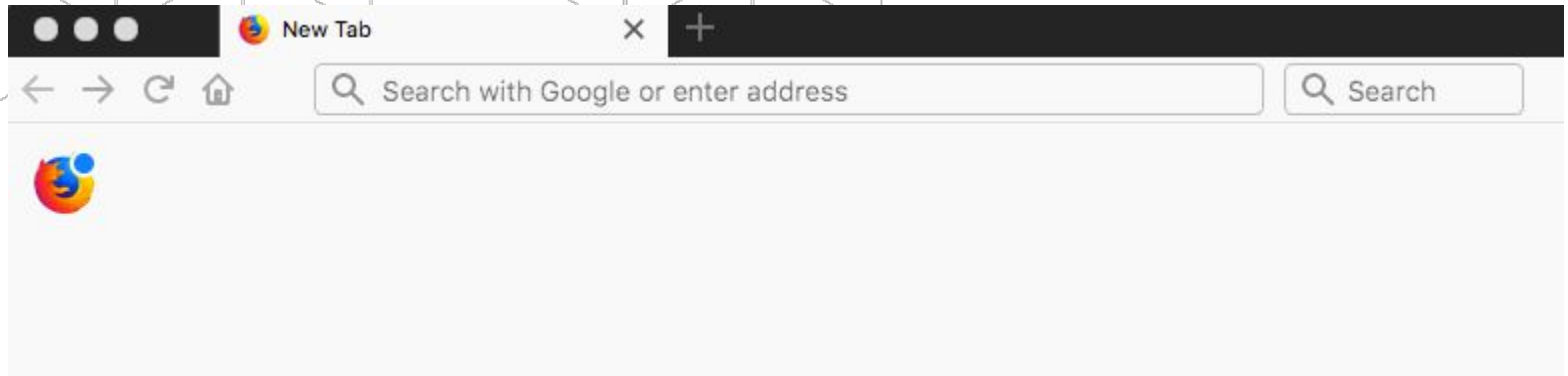
(MD5-PW, CRYPT-PW and MAIL-FROM are now deprecated)

Sample `mntner` object

```
mntner:          [mandatory]  [single]     [primary/look-up key]
descr:           [mandatory]  [multiple]   [ ]
org:             [optional]   [multiple]   [inverse key]
admin-c:         [mandatory]  [multiple]   [inverse key]
tech-c:          [optional]   [multiple]   [inverse key]
upd-to:          [mandatory]  [multiple]   [inverse key]
mnt-nfy:         [optional]   [multiple]   [inverse key]
auth:            [mandatory]  [multiple]   [inverse key]
remarks:         [optional]   [multiple]   [ ]
notify:          [optional]   [multiple]   [inverse key]
abuse-mailbox:   [optional]   [multiple]   [inverse key]
mnt-by:          [mandatory]  [multiple]   [inverse key]
changed:         [mandatory]  [multiple]   [ ]
source:          [mandatory]  [single]     [ ]
```

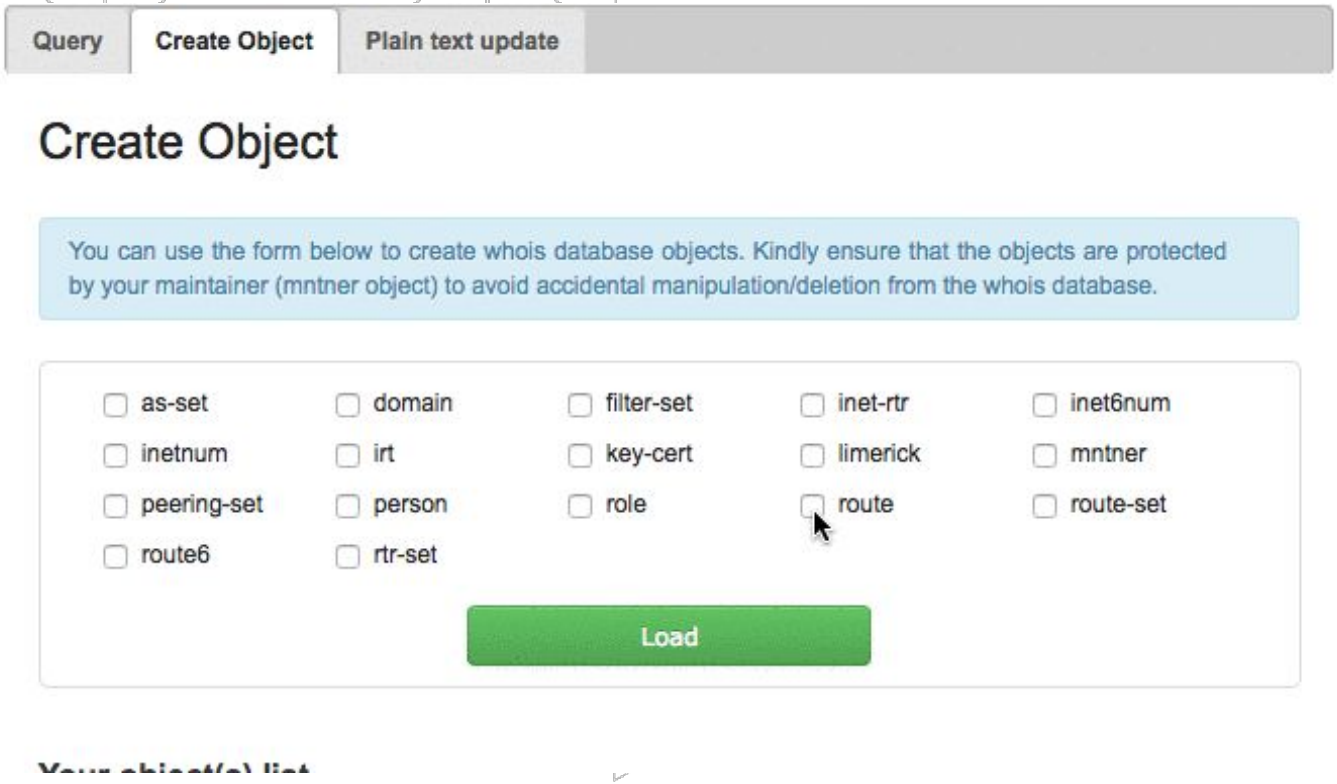
AFRINIC IRR - Using Web Update

To access the AFRINIC Web Interface, go to http://whois.afrinic.net

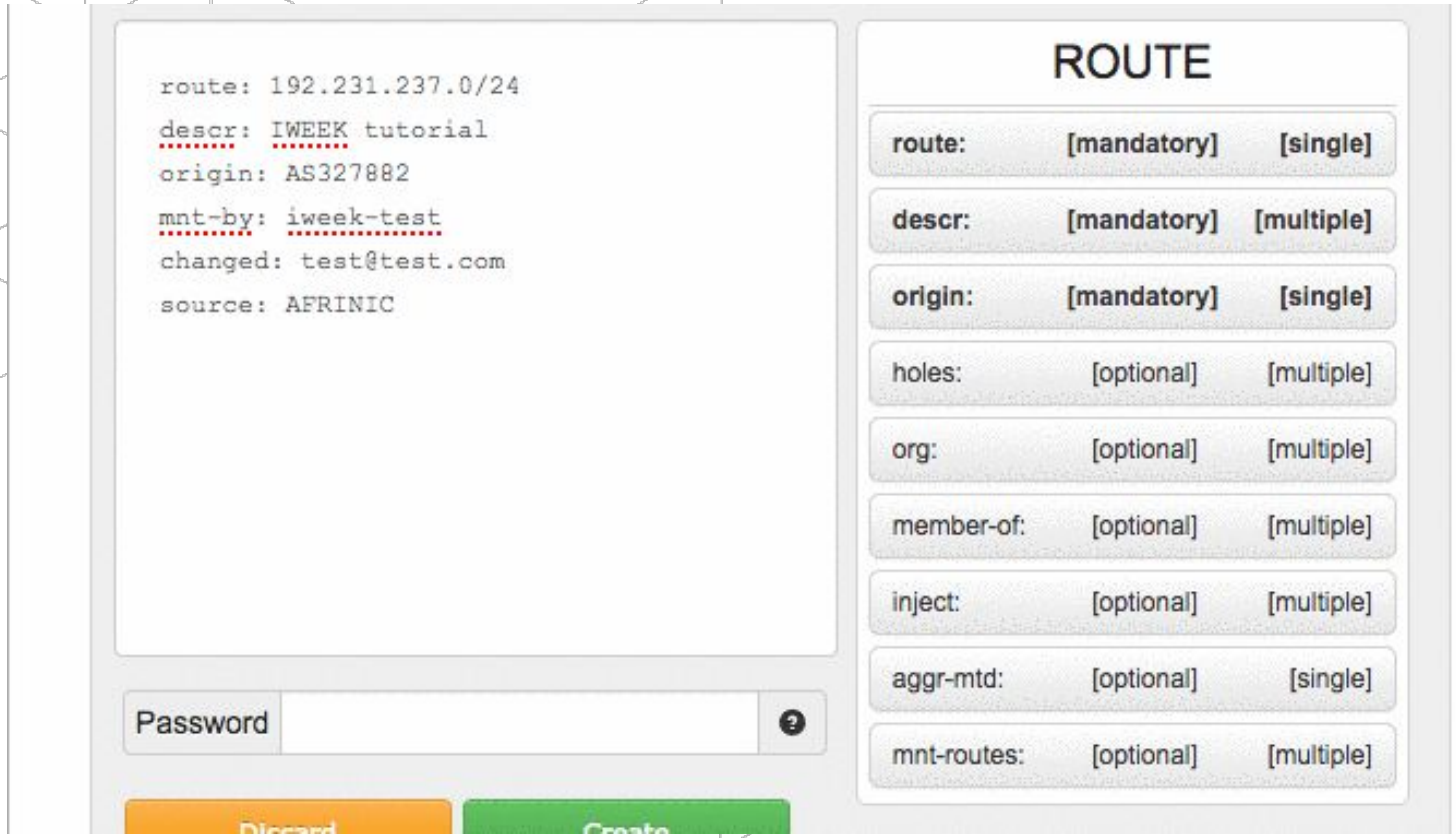


AFRINIC IRR - Using Web Update

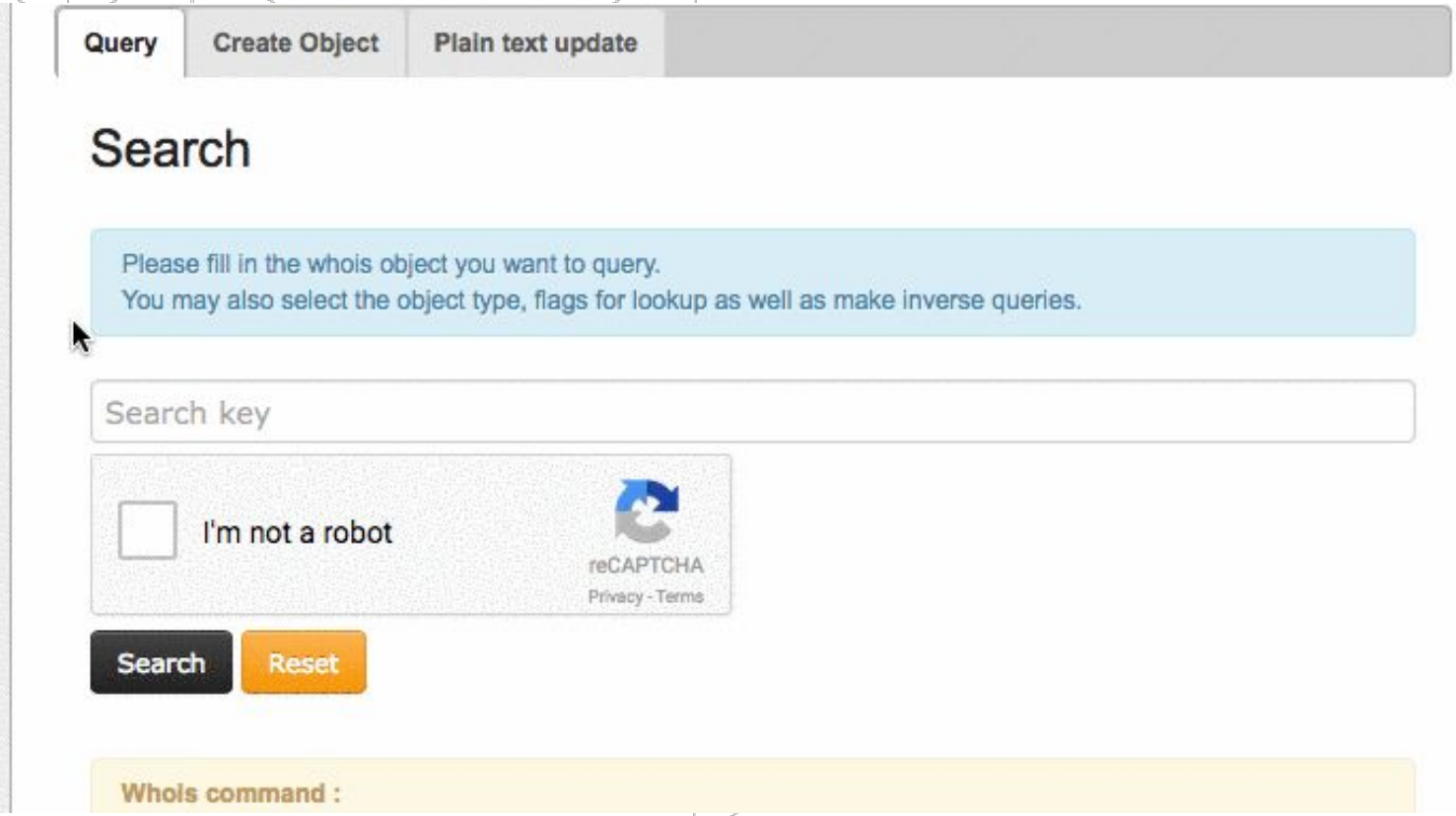
- Get the route(6) object template and fill in all the mandatory attributes



AFRINIC IRR - Using Web Update



AFRINIC IRR - Using Web Update



AFRINIC IRR - How to Bulk Create Route(6) Objects

To bulk create Route(6) Objects:

- Create a text file with all the route(6) objects
- Ensure that you provide the password for the maintainer referenced in the inet(6)num on each object
- Submit the route(6) objects for creation
  - Using the Whois Web Interface
  - Using the Email Update method

AFRINIC IRR - How to Bulk Create Route(6) Objects

- Create a text file with all the route(6) objects
  Example: Bulk create objects for 196.192.48.0/20, 196.192.48.0/21 & 196.192.56.0/21 with AS327800 as the origin

```
1  route:
2  descr:
3  origin:
4  mnt-by:
5  changed:
6  source: AFRINIC
7
```

AFRINIC IRR - How to Bulk Create Route(6) Objects

- Provide the password for the maintainer referenced in the inet(6)num
  In this example, we need to provide the password for Example-1-mnt for each object.

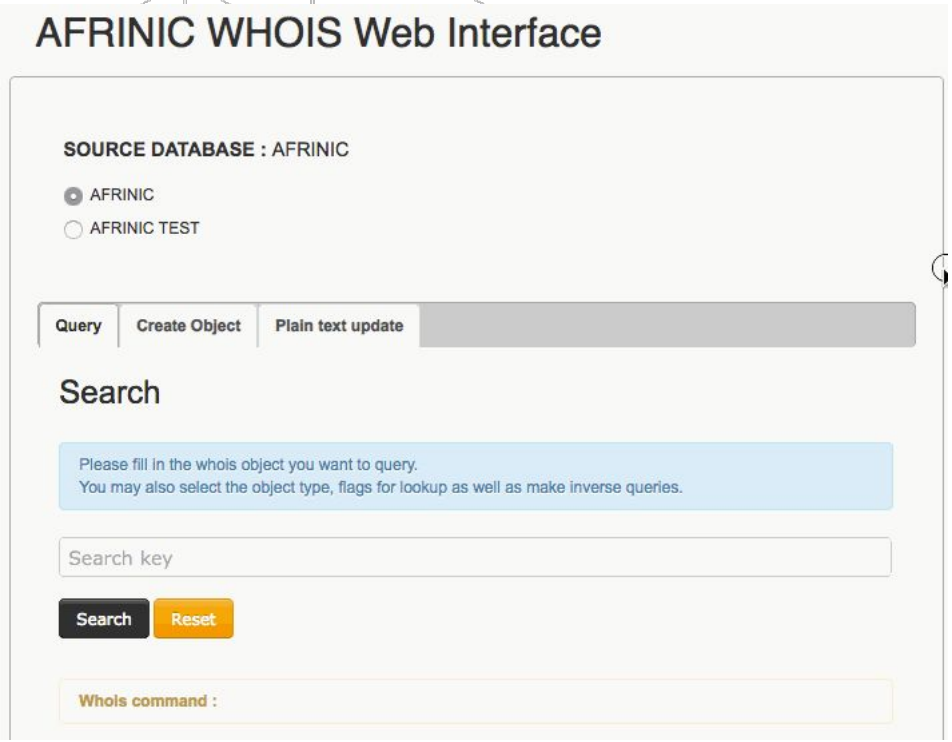
```
route: 196.192.48.0/20
descr: Aggregated Announcement
origin: AS327800
mnt-by: Example-1-mnt
changed: email@example.com
source: AFRINIC

route: 196.192.48.0/21
descr: Announcement to Upstream X
origin: AS327800
mnt-by: Example-1-mnt
changed: email@example.com
source: AFRINIC

route: 196.192.56.0/21
descr: Announcement to Upstream Y
origin: AS327800
mnt-by: Example-1-mnt
```

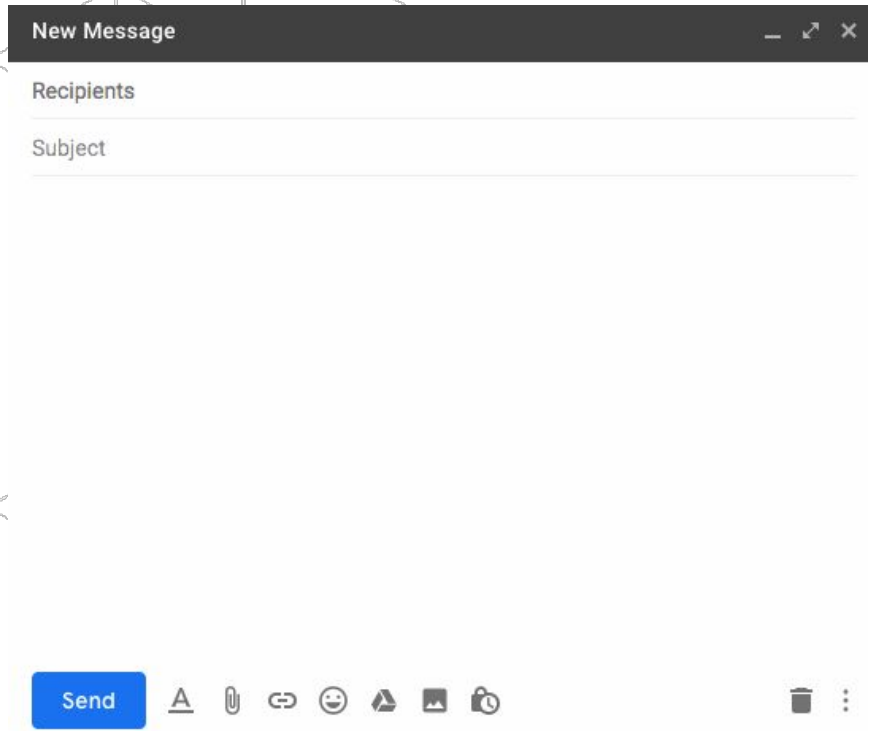
AFRINIC IRR - How to Bulk Create Route(6) Objects

- Submit the route(6) objects for creation
  - Using the Whois Web Interface



AFRINIC IRR - How to Bulk Create Route(6) Objects

- Submit the route(6) objects for creation
  - Using the email update method



Replicate Route(6) Objects

There are multiple ways to replicate route objects to the AFRINIC IRR. The most straightforward steps to bulk create your route objects are summarised below;

- Get the route objects to replicate from other IRR database(s)
- Review the objects and remove obsolete ones
- Ensure that the objects have all mandatory attributes
- Update the “mnt-by” with the “mnt-lower” or “mnt-routes” in the inetnum object.
- Submit the objects for creation

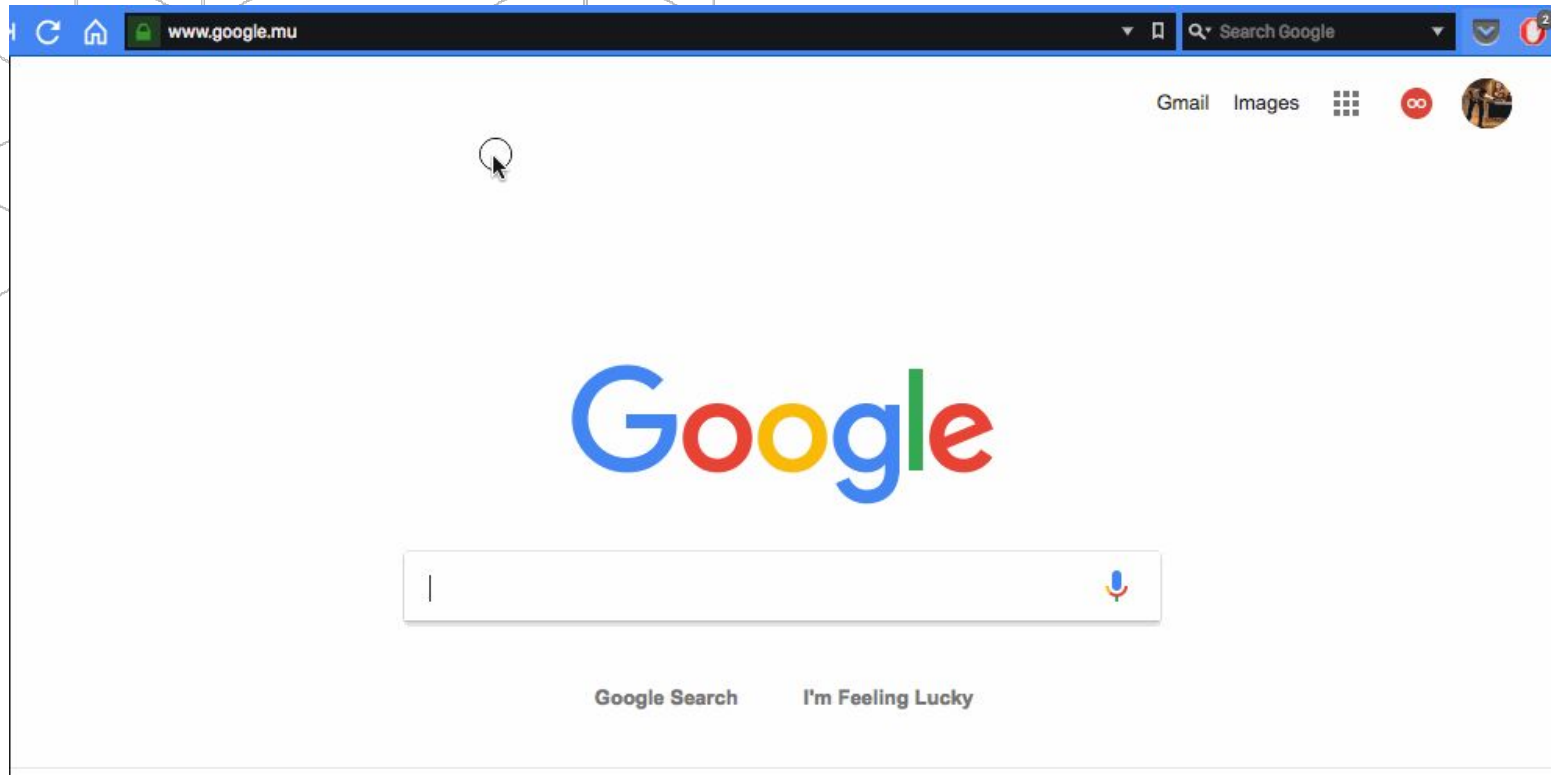
Replicate Route(6) Objects

Step 1 - Get the route objects to be replicated

- Query the IRR DB to retrieve all your route objects. You can use the IRR Explorer in case you are not aware on which IRR DB your route objects are.
- A list of all IRR databases can be found on RADB's website and you may use a whois CLI client or their whois web interface, if available, to query the databases.
- You can get all your existing routes objects in APNIC, RADB, RIPE IRR on the AFRINIC website.

Replicate Route(6) Objects

View all your existing routes objects in APNIC, RADB, RIPE IRR on the AFRINIC website.



Replicate Route(6) Objects

View existing objects in the RIPE DB using the Whois CLI client

Replicate Route(6) Objects

Step 2 - Review the objects to remove any obsolete ones

- It is recommended that you go through the all the route objects and identify any obsolete objects

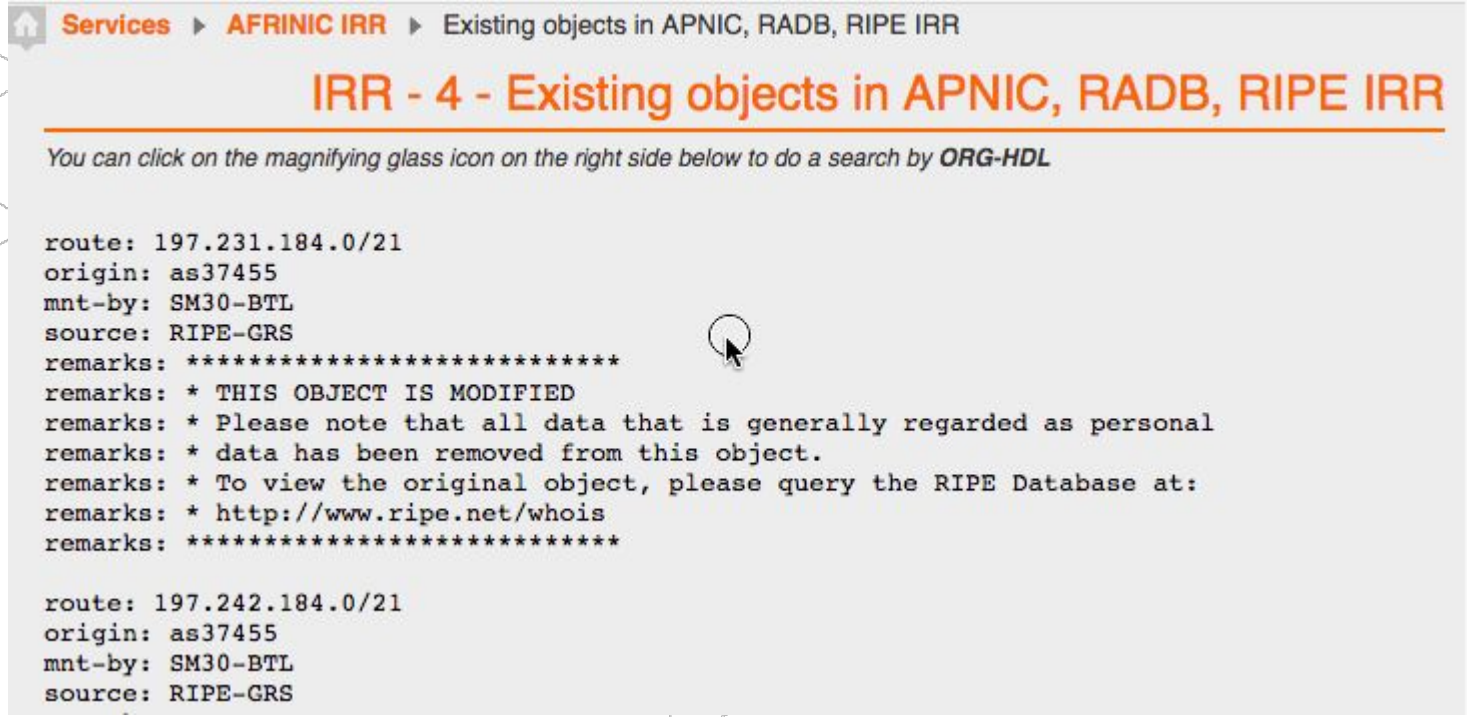
Step 3 - Ensure that the objects have all mandatory attributes

- Different IRRs may have different set of rules and attributes. In order to create the route objects all the mandatory attributes must be present.

```
route:          [mandatory]
descr:          [mandatory]
origin:         [mandatory]
mnt-by:         [mandatory]
changed:        [mandatory]
source:         [mandatory]
```

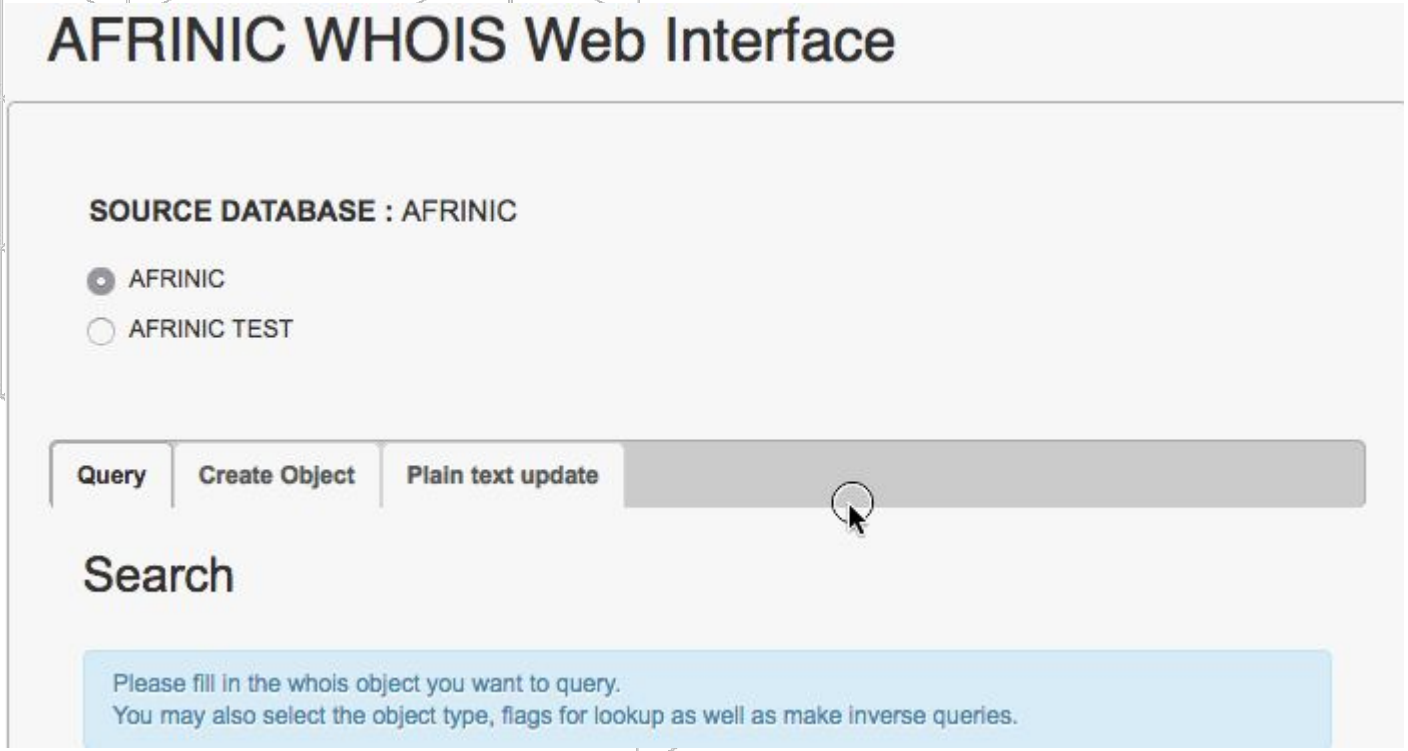
Replicate Route(6) Objects

Ensure that the objects to be replicated have all mandatory attributes



Replicate Route(6) Objects

Update the “mnt-by” with the “mnt-lower” or “mnt-routes” in the inetnum object



Replicate Route(6) Objects

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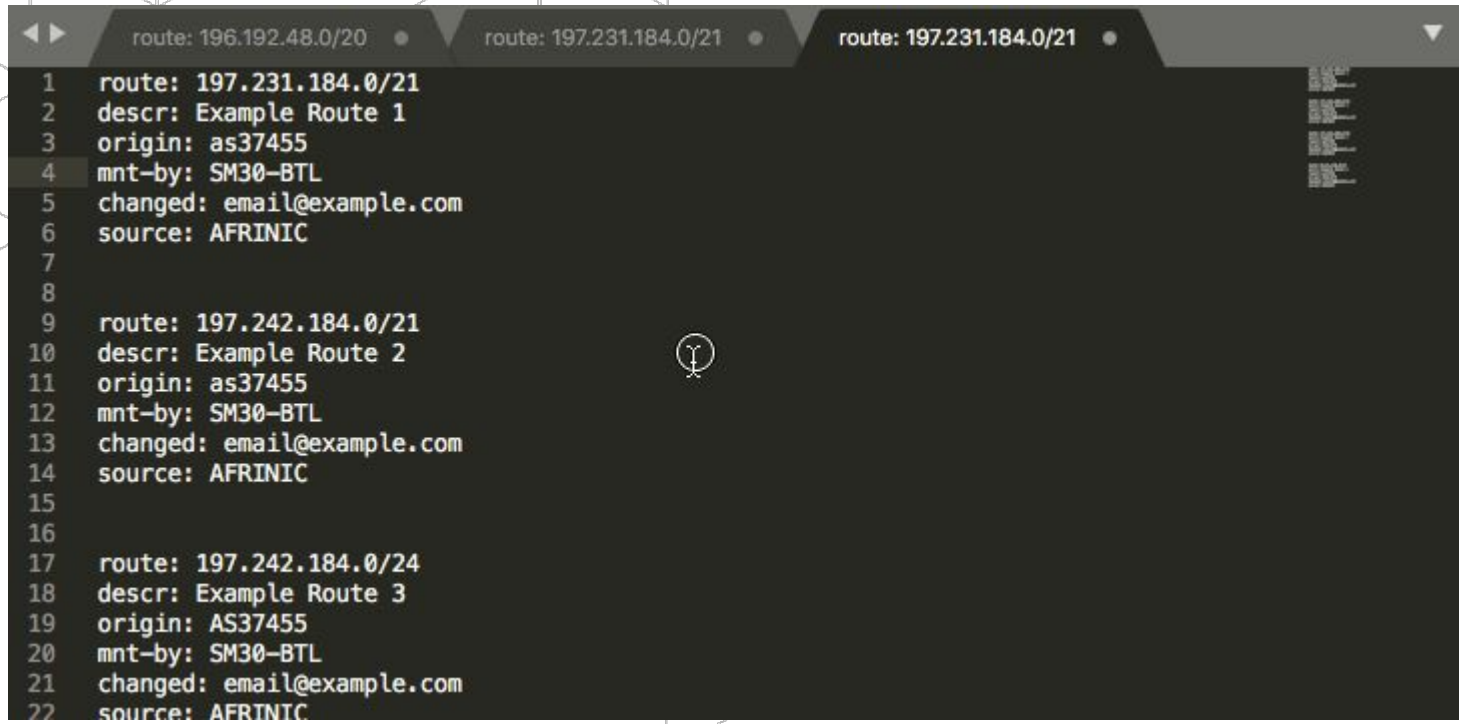
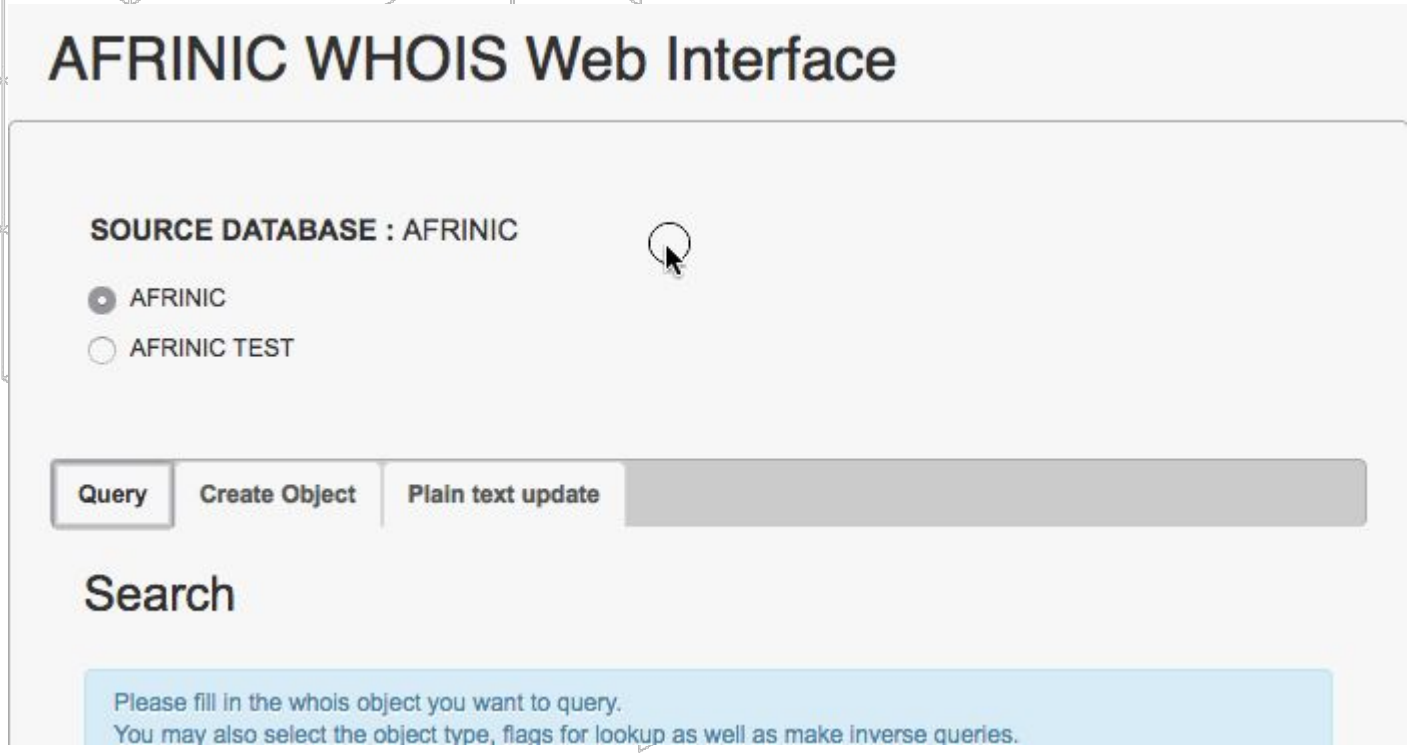


Replicate Route(6) Objects

Submit the objects for creation



Verify Your IRR Object

- Using WHOIS command line tool

Whois -h whois.afrinic.net -rB <YourIPPrefixASN>
Or whois -h whois.afrinic.net -rB <Your IP Prefix>

- Using the whois web interface (whois.afrinic.net)
  - Input search value (IP block)
  - Click flags and select “r” and “B”
  - Click search

Route Filtering with IRR

1. Creates route-map, AS path and ingress/egress filters
2. route filtering using Internet Routing Registry (IRR) no longer an option, it's simply the right thing to do.
3. Avoid filter errors (typos)
4. Filters consistent with documented policy

Recommendations

1. Members read through AFRINIC IRR docs published, to ensure ease of use of the AFRINIC IRR
2. Contact details kept up to date after staff movements.
3. Maintainer passwords are kept up to date
4. If you hold resources from AFRINIC, have your route object registered in the AFRINIC IRR
5. Replicate route objects from other IRRs to AFRINIC to avoid being filtered after housekeeping by the other IRRs
6. Inform AFRINIC in case your upstream provider does not accept routes from the AFRINIC IRR, but insists on you using some other IRR.

Recommendations

If **you are an upstream provider** using IRR to generate your filters and router configs:

1. Ensure your filters have been updated after the RIPE changes with source “RIPE-NONAUTH” to allow objects still on RIPE NCC’s IRR

1. Ensure your filters are updated with the AFRINIC IRR

1. Encourage adoption of AFRINIC IRR by your customers to ensure reliable routing information.

Be heard, Be Engaged!

The AFRINIC Database Working Group is an open mailing list available for knowledge sharing and for proposing new ideas/solutions

Feel free to contribute your ideas on this list

Subscribe to our DBWG via https://lists.afrinic.net/ then “dbwg”

For any further help, contact irr@afrinic.net

Thank you for your Attention

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