

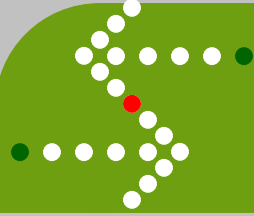
Improvement of Consistency among AS Policies on IRR Database

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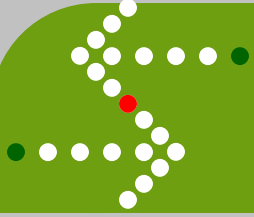
Nara Institute of Science and Technology (NAIST)

Japan



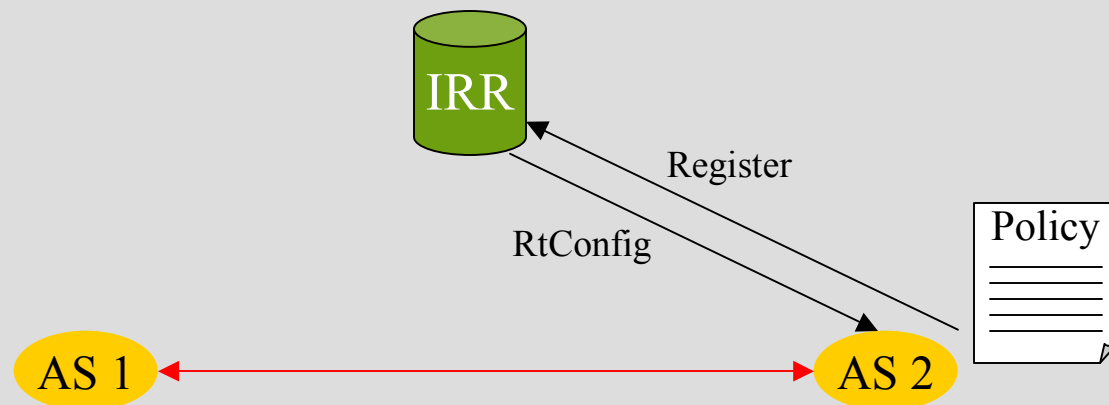
BGP is crucial to reliability of the Internet

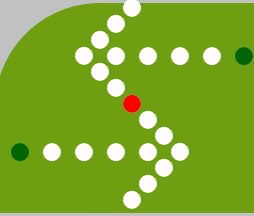
- Autonomous System (AS)
- Border Gateway Protocol (BGP)
- faults in BGP disrupt large regions of the Internet
e.g.
 - AS7007 (April, 1997)
 - AS3561 (April, 2001)



Internet Routing Registry (IRR)

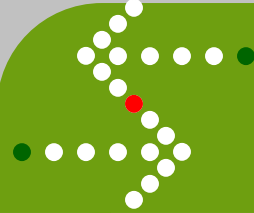
- Global Internet resource database storing routing policy e.g. Route Object, Aut-num Object, Maintainer Object, etc..
- Routing policies are written in “Routing Policy Specification Language (RPSL)”
- generate router configuration with “RtConfig”



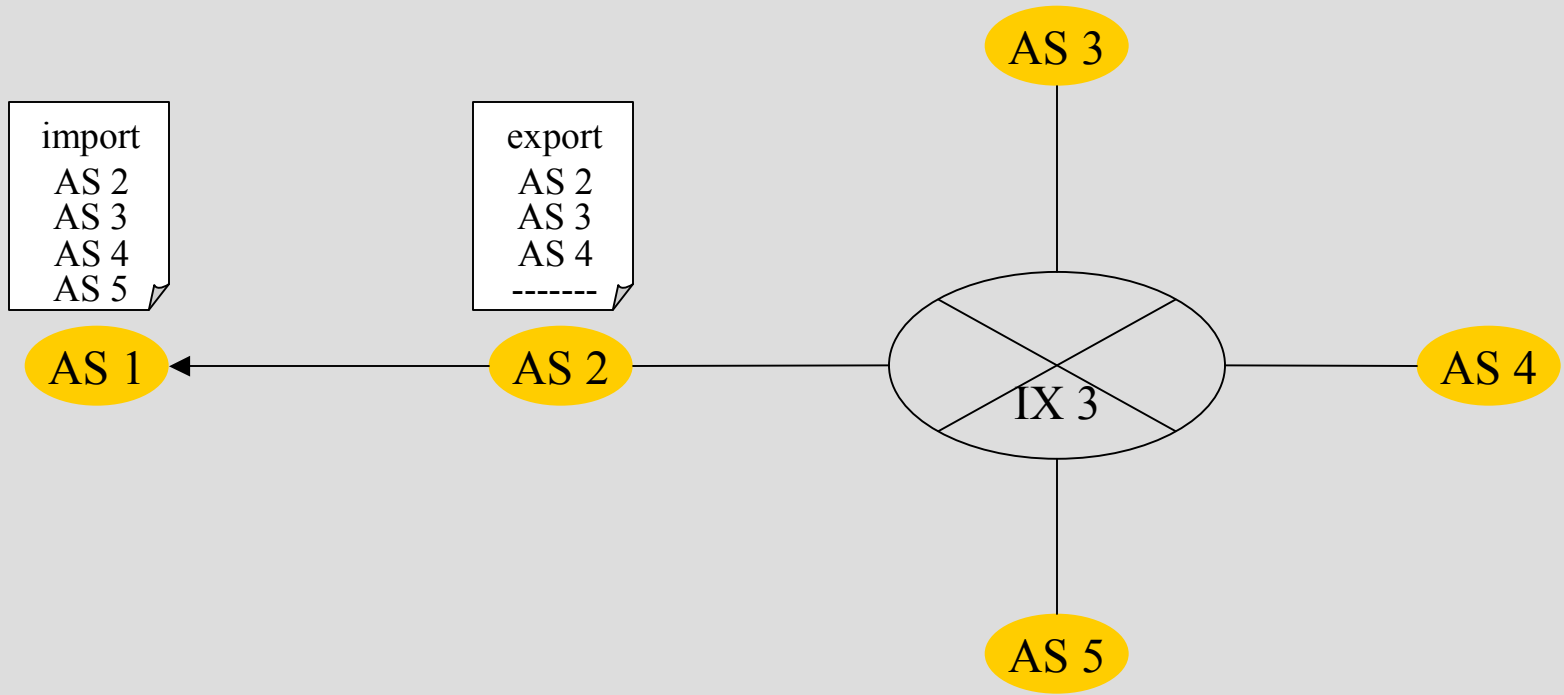


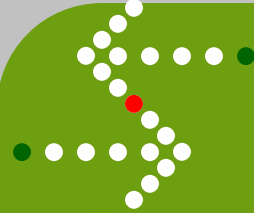
Problem of IRR

- Usage IRR isn't spreading due to lack of consistency.
 - inconsistency we defined is
 - inconsistency between the peering contract and its RPSL description given to IRR (mistakes on interpretations)
 - as a result
 - When we generate the router configurations from IRR database, the connectivity between peering ASes will be lost.
- to find out the inconsistency systematically, we check
- Inconsistency in routing information imported from other peers
 - Inconsistency in routing information exported to its own peers

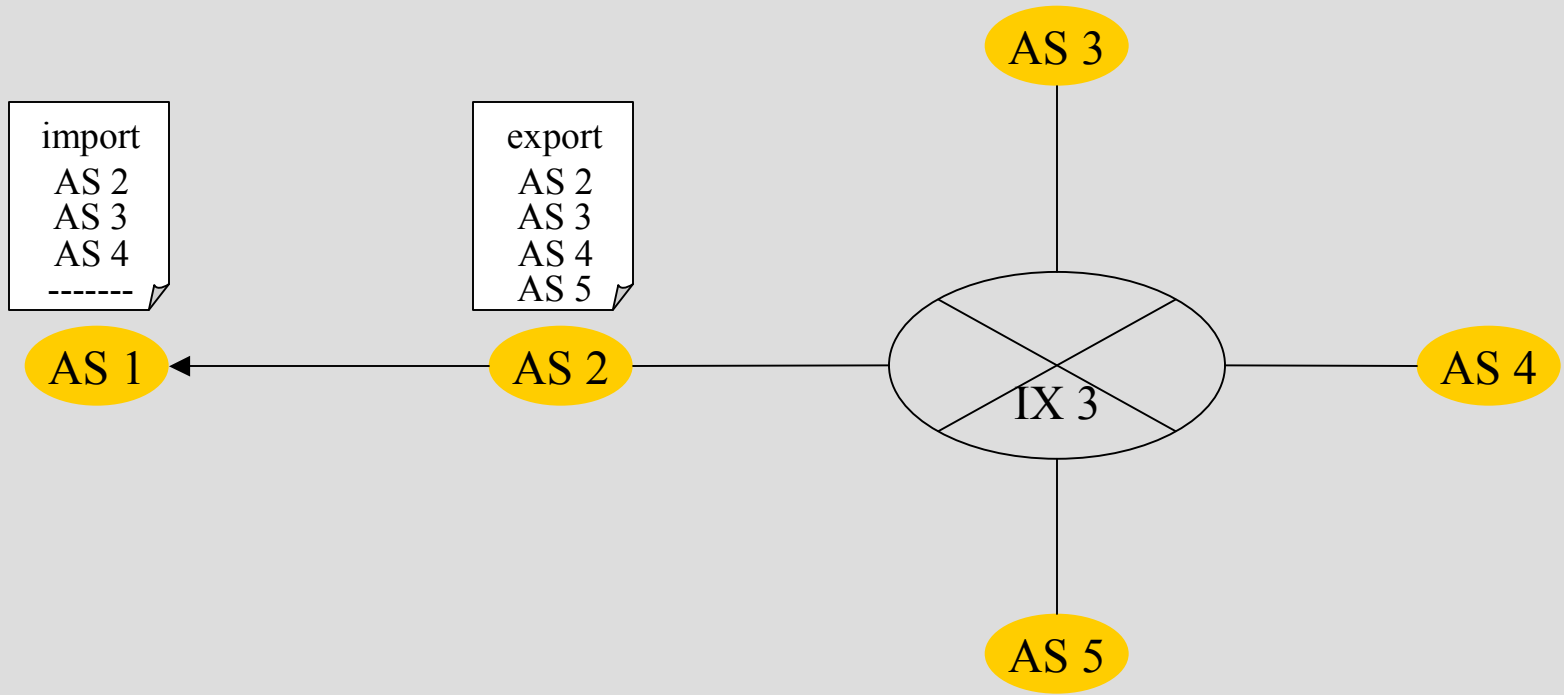


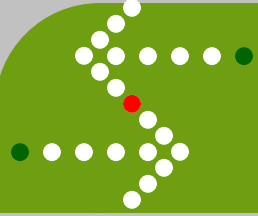
Inconsistency in routing information import





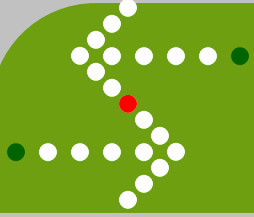
Inconsistency in routing information export





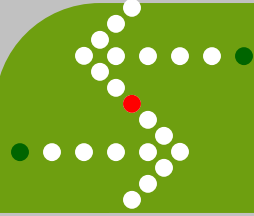
Our Approach

- We have examined how many inconsistencies exist on whole IRR databases in the world.
- We propose a system to prevent increase of inconsistency.
 - Policy Check Server
- We evaluate this system.



Policy Check Server

- DBGenerator
 - constructs a common database called “Unified IRR Database” which includes whole IRR databases in the world.
- Database Checker
 - inspects how many inconsistencies exist on Unified IRR database.
- Policy Checker
 - inspects whether the policy which the operator of AS is about to register is consistent with the policies of peering Ases.

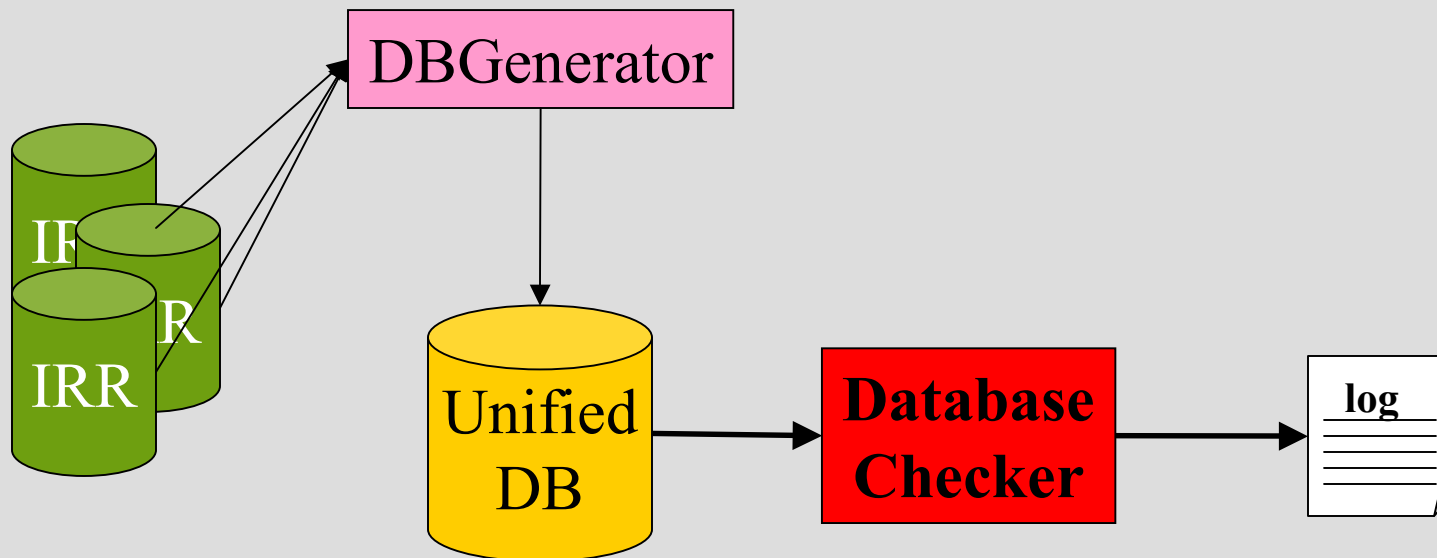


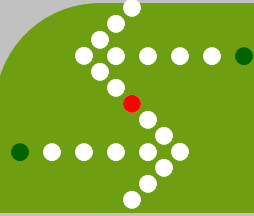
Implementation – Environment

OS	Vine Linux 2.5
DBMS	PostgreSQL 7.2
Programming Language	Java
IDE	J2SDK 1.4.1
WWW Server	Apache 1.3.24
Web Application Server	Tomcat 4.1.18

Database Checker

- Database Checker investigates consistency of AS policies in the Unified IRR database.
- Then output the results as a log file.

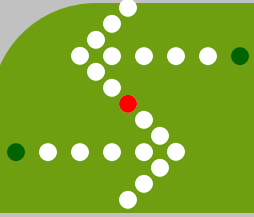




Algorithm of inspection (1)

1. Specify peering AS

```
extract import, export sentences from input AS object ;  
if (the peering AS (or AS-SET) exists on database) {  
    create Autnum object as a peering AS ;  
} else {  
    inconsistency ;  
}
```



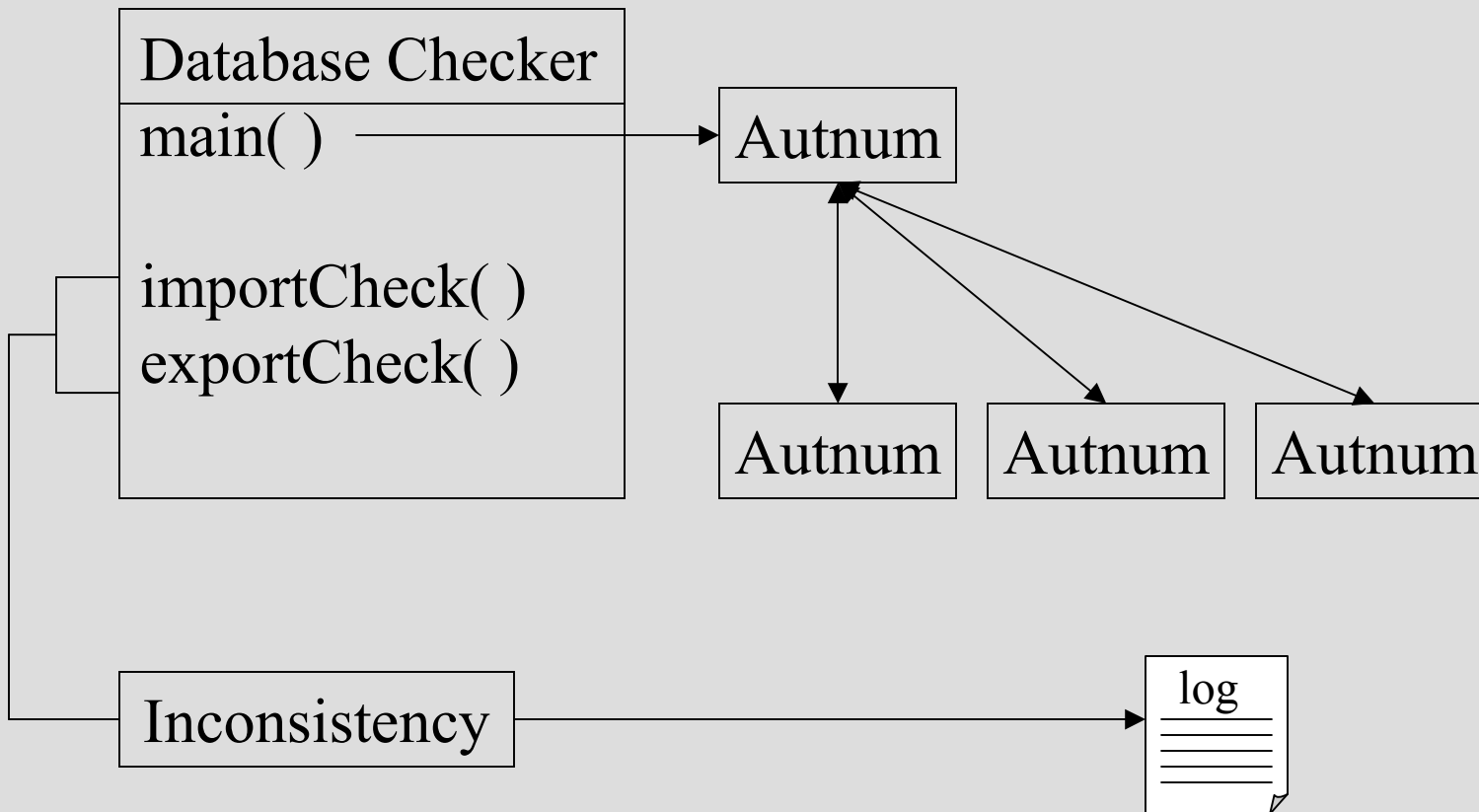
Algorithm of inspection (2)

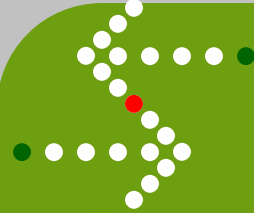
2. inspection of import sentence

```
for (number of import sentence, repeat following processes) {  
  for (number of export sentence, repeat following processes) {  
    If (the export sentence specify input AS as a peer) {  
      if (the sentence doesn't export required routes) {  
        inconsistency ;  
      }  
    } else {  
      inconsistency ;  
    }  
  }  
}
```

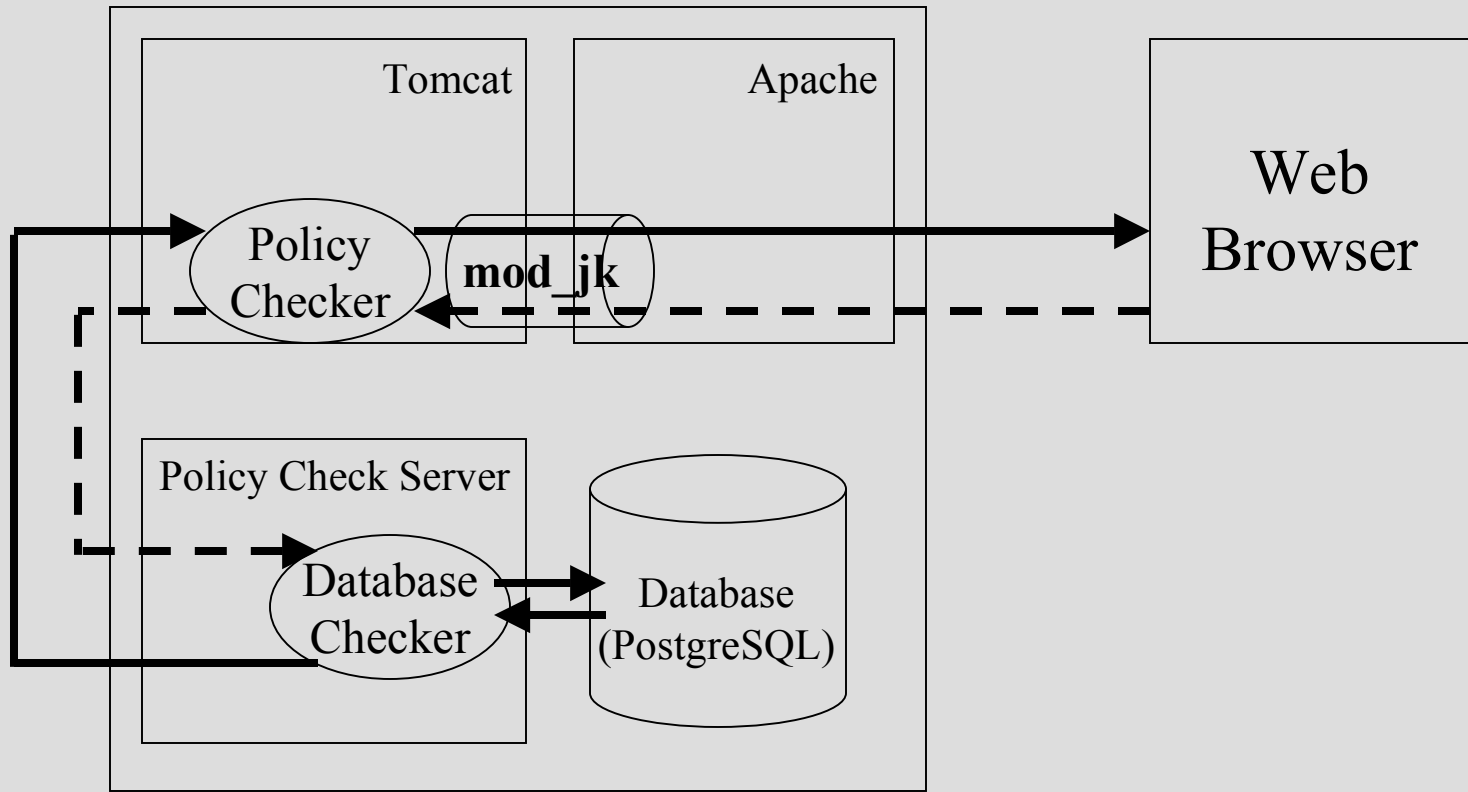
3. inspection of export sentence: same as import sentence

Class Object Diagram





Policy Checker



Example - query

The screenshot shows a Microsoft Internet Explorer window titled "check your policy - Microsoft Internet Explorer". The address bar contains "http://163.221.52.143:8080/PolicyCheck/index.html". The main content area displays a query result for AS2500. At the top, there is an input field containing "AS2500" and a button labeled "クエリ送信". Below this is a large text area containing the following BGP policy information:

```
aut-num: AS2500
as-name: WIDE
descr: WIDE Project in Japan
admin-c: JM48-AP
tech-c: AK27-AP

import:
  from AS-NSPIX2 action pref=100; accept AS4126
import:
  from AS2501 action pref=100; accept AS2501 AS7531
import:
  from AS9696 action med=1; accept AS9696
import:
  from AS4777 action pref=100 accept AS4777

export:
  to AS9696 announce AS2500
export:
  to AS2501 announce ANY
export:
  to AS2516 announce AS112 AS2500 AS4717
export:
  to AS4126 announce ANY

notify: two@wide.ad.jp
mnt-by: MAINT-AS2500
changed: kato@wide.ad.jp 20020419
source: RADB
```

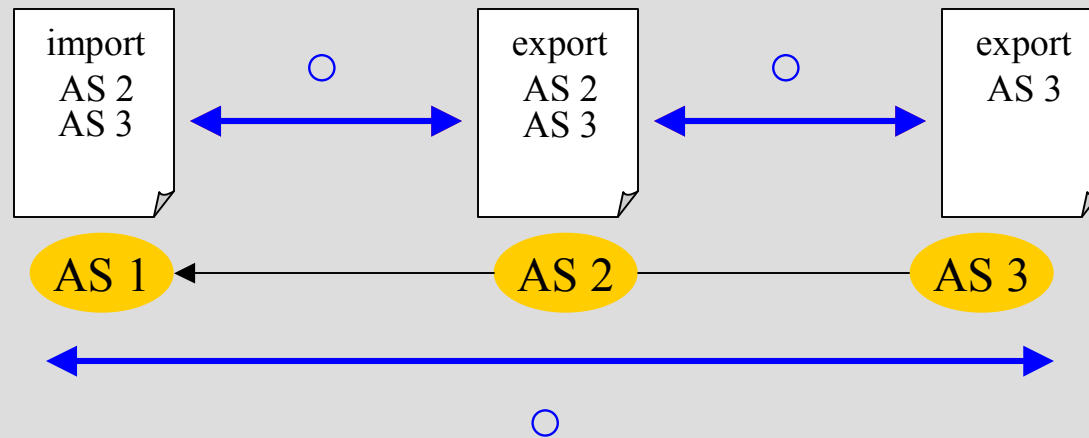
At the bottom of the text area is a button labeled "submit". The status bar at the bottom of the browser window shows "ページが表示されました" and "インターネット".

Example - result

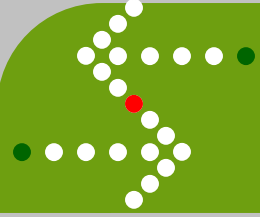
```
Result of inspection : AS2500
import: from AS-NSPIX2 action pref=100 accept AS4126
    peering AS-NSPIX2 does not export route of 'AS4126' to this AS.
import: from AS2501 action pref=100 accept AS2501 AS7531
import: from AS9696 accept AS9696
    peering AS9696 does not export any routes to this AS.
import: from AS4777 action pref=100 accept AS4777
export: to AS9696 announce AS2500
    peering AS9696 does not import any routes from this AS.
export: to AS2501 announce ANY
export: to AS2516 announce AS112 AS2500 AS4717
    peering AS2516 does not import route of 'AS112' from this AS.
    peering AS2516 does not import route of 'AS4717' from this AS.
export: to AS4126 announce ANY
    peering AS 'AS4126' is not found on database.

Time spent for inspection : 13234 (msec)
```

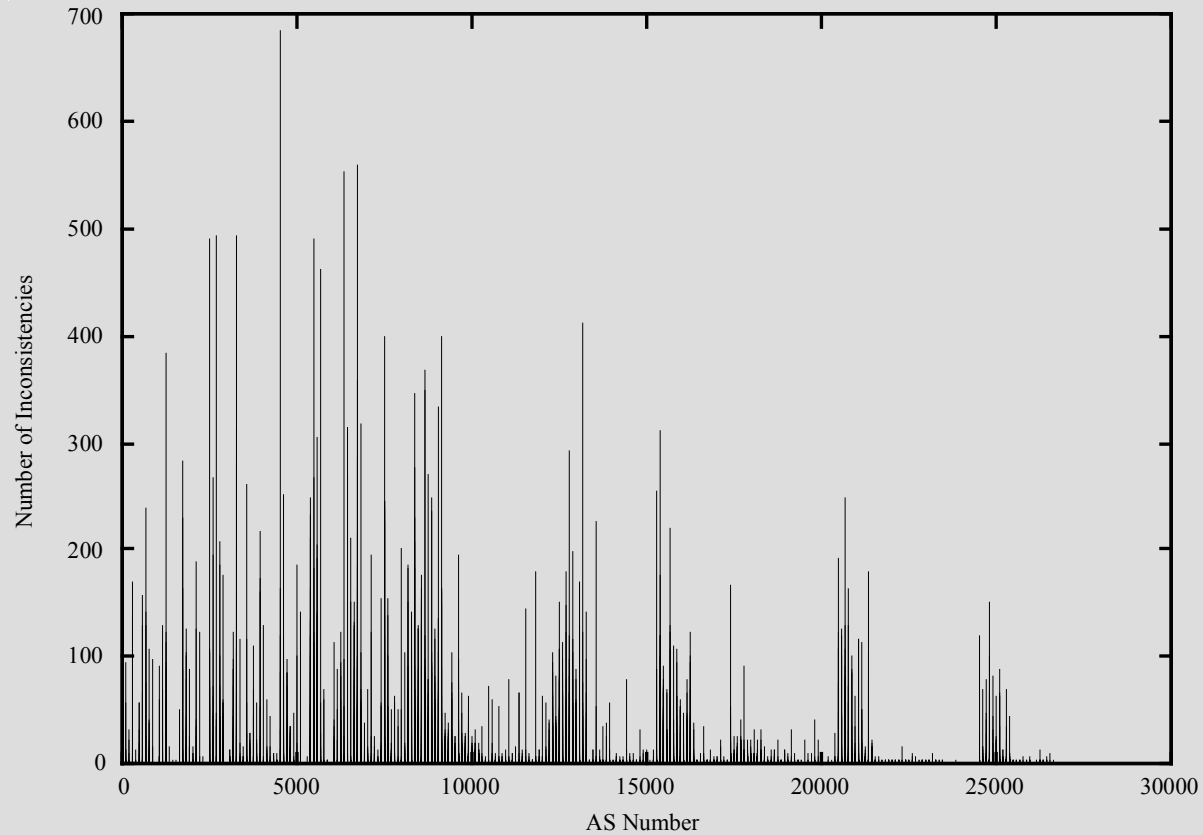

Consistency Chain



- By correcting the inconsistencies between peering ASes, it is possible to exchange route information between ASes that are not directly peering.
→ improve consistency of the whole IRR databases

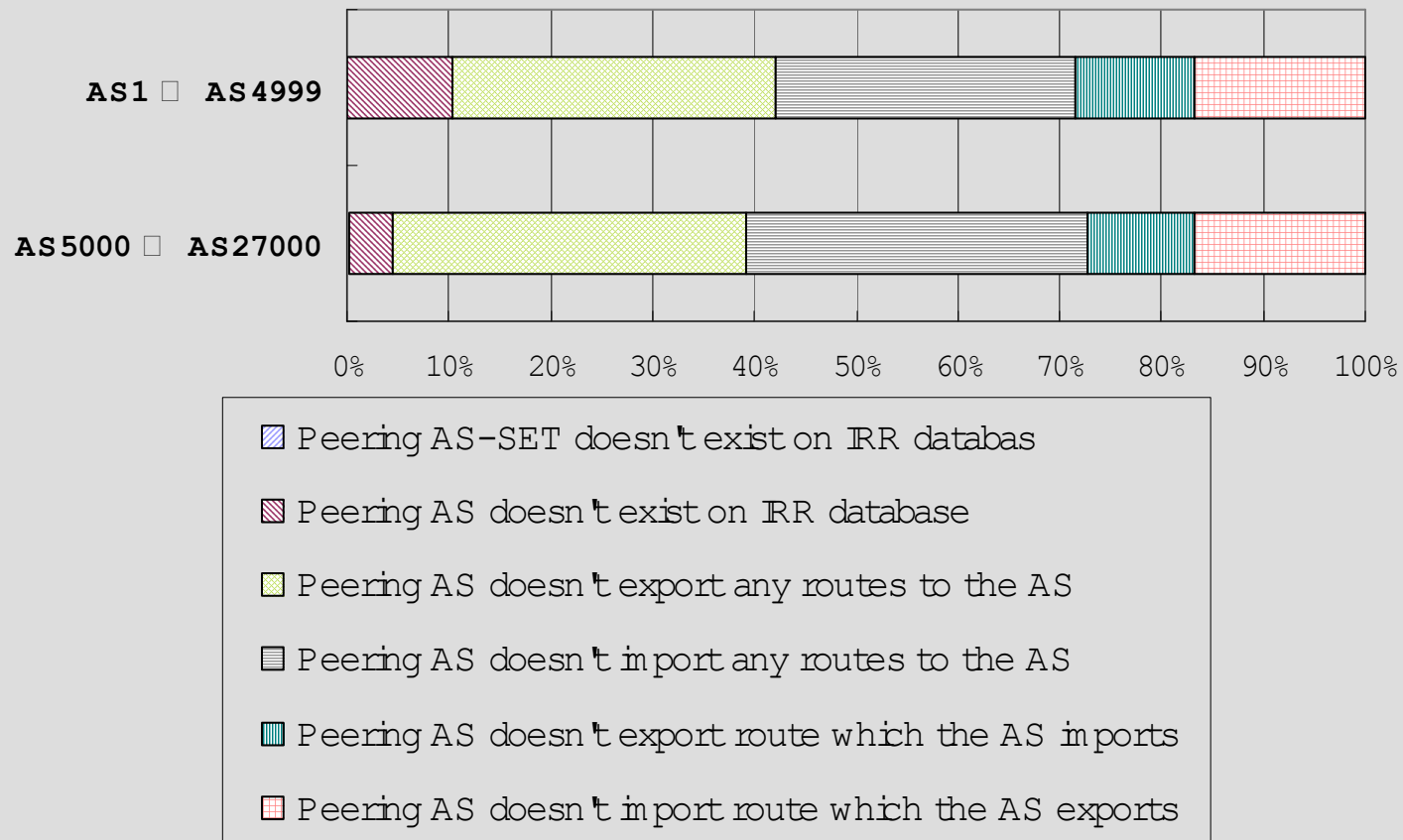


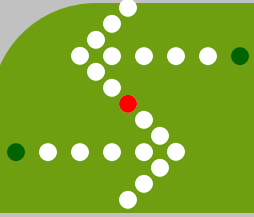
Analysis of inspection result



55.8% of AS has at least one inconsistency

Specification of the inconsistency

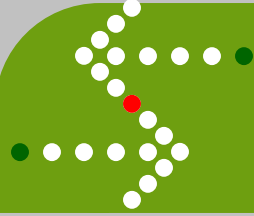




Detail of inconsistencies

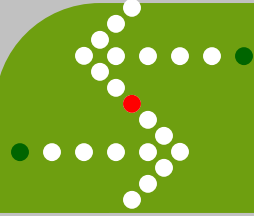
	Classification	Number	Rate
1	Peering AS-SET doesn't exist on IRR database	482	0.2 %
2	Peering AS doesn't exist on IRR database	7,971	4.0 %
3	Peering AS doesn't exist export any routes to the AS	36,333	18.6 %
4	Peering AS doesn't import any routes from the AS	34,710	17.8 %
5	Peering AS doesn't export route which the AS imports	11,436	5.8 %
6	Peering AS doesn't import route which the AS exports	17,753	9.1 %
	Total	108,685	55.8 %

- Rate of each inconsistencies in all 194,820 import and export sentences



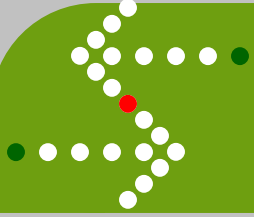
Operations

- JPNIC IRR (JPIRR)
 - JPNIC IRR planning team
 - Operating IRRd
 - We intend to apply Policy Check Server to JPIRR maintained by JPNIC and provide a service to inspect consistency.



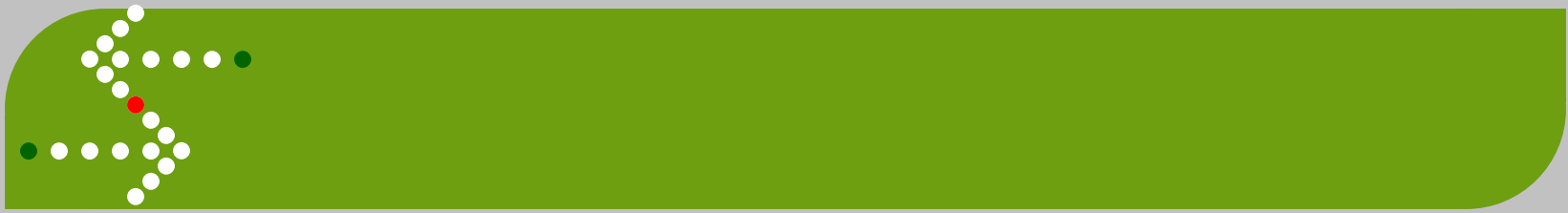
Conclusion

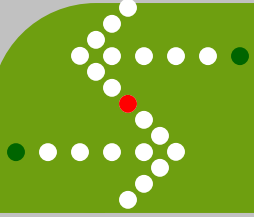
- Policy Check Server
 - Classification of the inconsistency
 - proposed a system to investigate consistency
 - proposed a system to prevent increasing inconsistency
- Analysis of inspection result
 - 55.8% of AS has at least one inconsistency
- Future work
 - Operation on IRR server



Question?

- in slow and easy English please ..





Classification of Inconsistencies

Inconsistencies in routing information import	Peering AS-SET doesn't exist on IRR database
	Peering AS doesn't exist on IRR database
	Peering AS doesn't export any routes to the AS
	Peering AS doesn't export route which the AS imports
Inconsistencies in routing information export	Peering AS-SET doesn't exist on IRR database
	Peering AS doesn't exist on IRR database
	Peering AS doesn't import any routes from the AS
	Peering AS doesn't import route which the AS exports