# Measurements on Intra-Domain Routing Instability

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# Overview

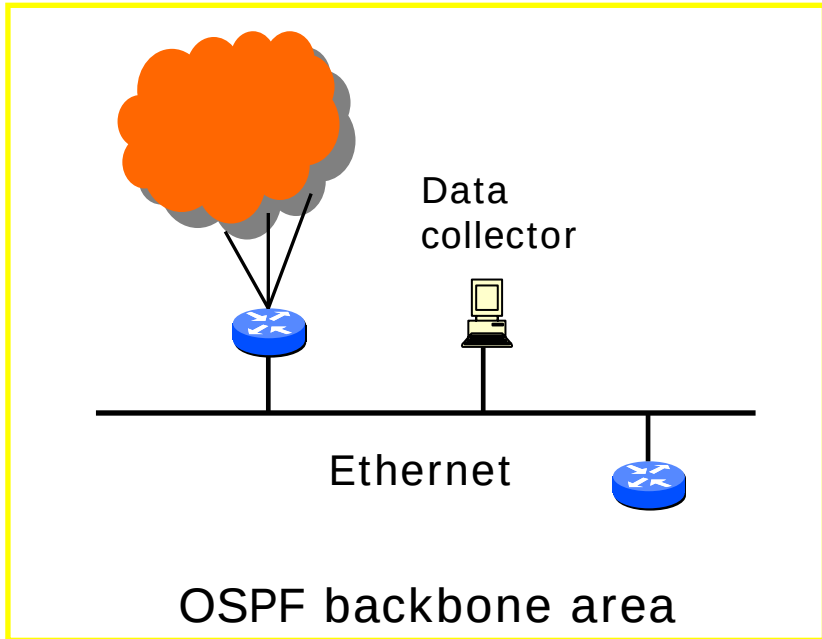
- Intra-domain routing instability
- Measurements on intra-domain routing instability
  - WIDE Internet and APAN-JP network
- Rtanaly
  - An system to detect and visualize intra-domain routing changes
- Summary

# Intra-Domain Routing Instability

- Intra-domain routing instability
  - Unexpected routing changes within an IGP routing domain
  - Causes packet loss, increased router load, and wasted bandwidth
- Why focus on intra-domain routing?
  - Although intra-domain routing is just as important as inter-domain routing, research on IGP behaviors is still poor
  - Help operators better understand intra-domain routing instability

# Measurement Methodology

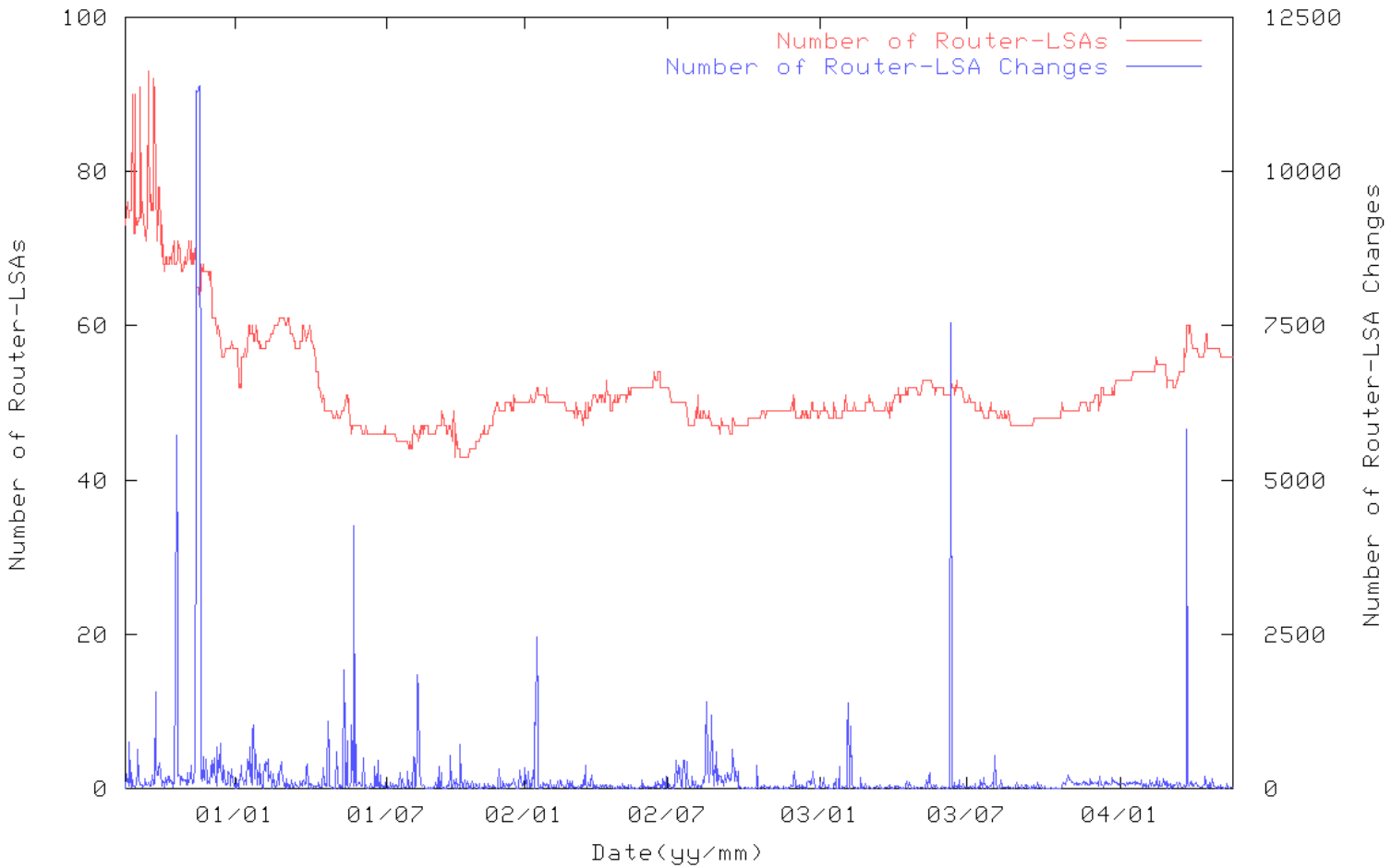
- Data collection
  - Raw OSPF data collected
  - Tcpdump
- Data analysis
  - Counting routing changes
    - Changes in the content of an LSA
    - LSA flush
    - Changes in AS-External LSAs were excluded



# Measured Networks

- WIDE Internet
  - WIDE Project (http://www.wide.ad.jp)
  - Connects hundreds of academic organizations
  - About 50 routers in the OSPF backbone area
- APAN-JP Network
  - Part of the Asia-Pacific Advanced Network (http://www.jp.apan.net)
  - Provides transit service among academic organizations in Asia-Pacific region
  - Relatively small in scale, with no more than 10 routers in the backbone area

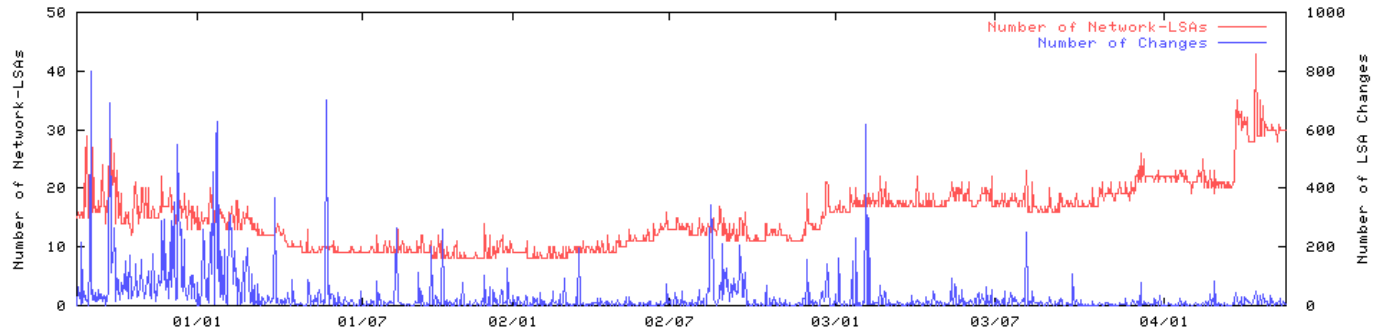
# Measurement of the WIDE Internet (1/2)
# Router-LSA



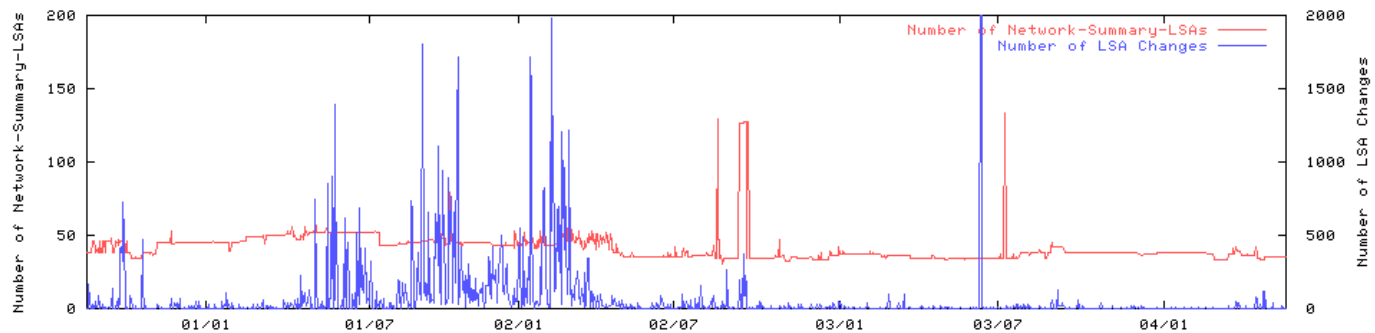

Period: August 2000 – May 2004

# Measurement of the WIDE Internet (2/2)

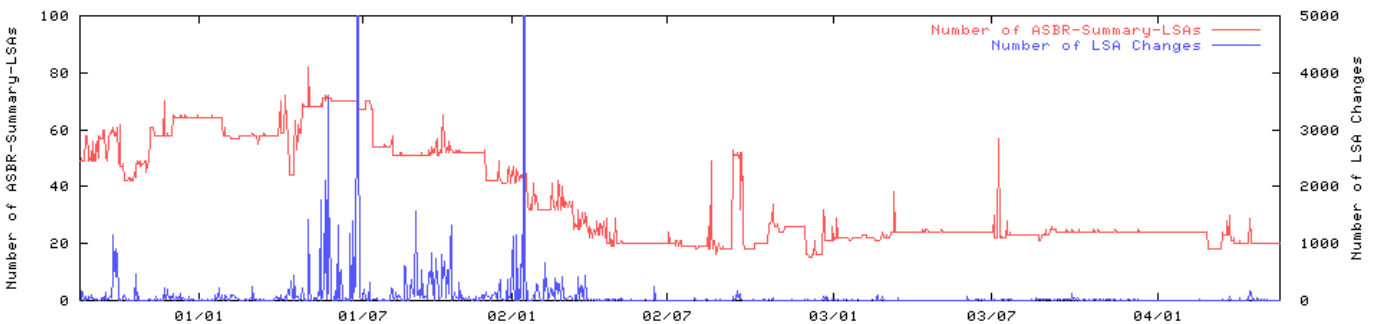
Network-LSA




Network-Summary-LSA



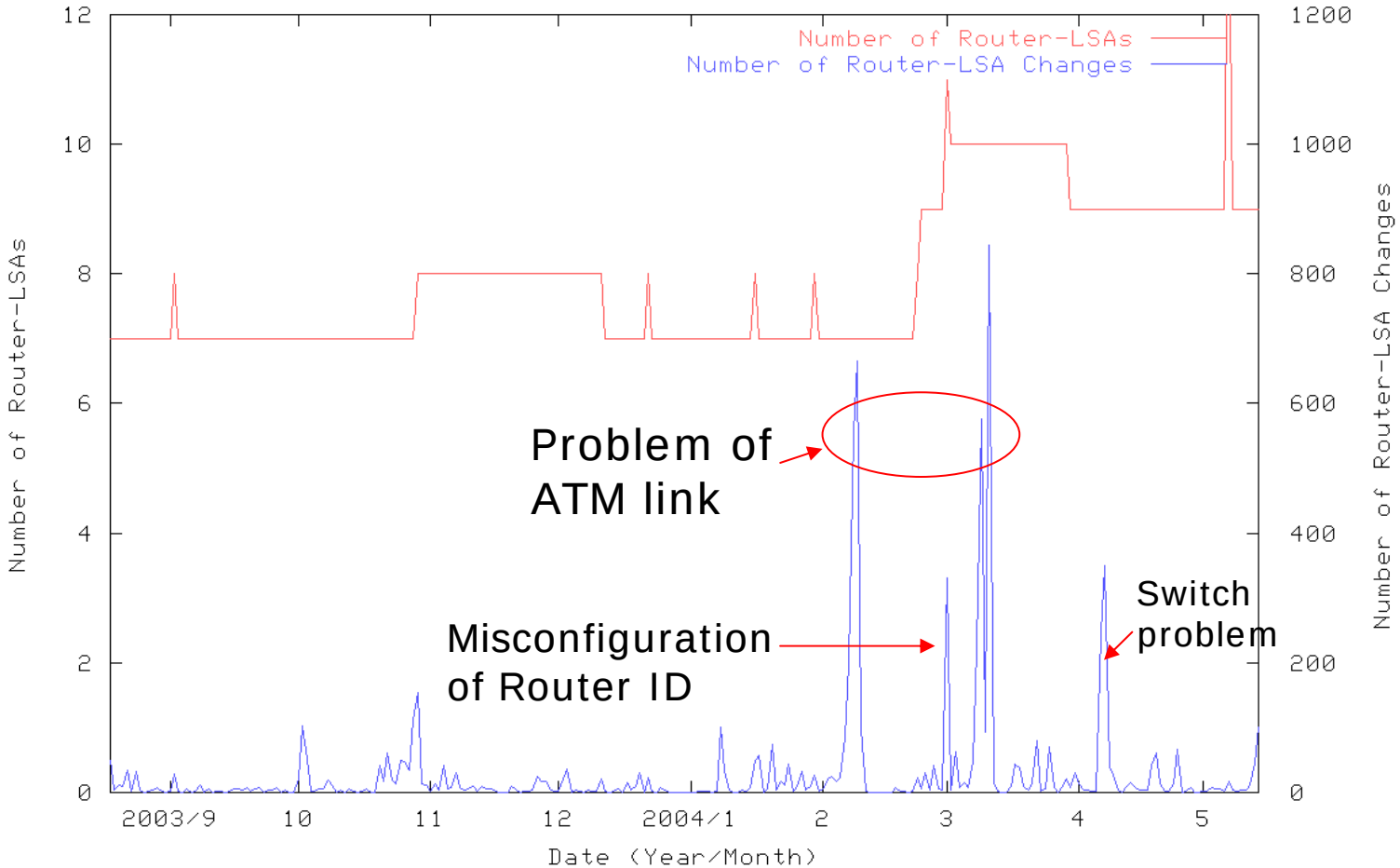

ASBR-Summary-LSA




Period: August 2000 – May 2004

# Measurement of the APAN-JP Network

## Router-LSA



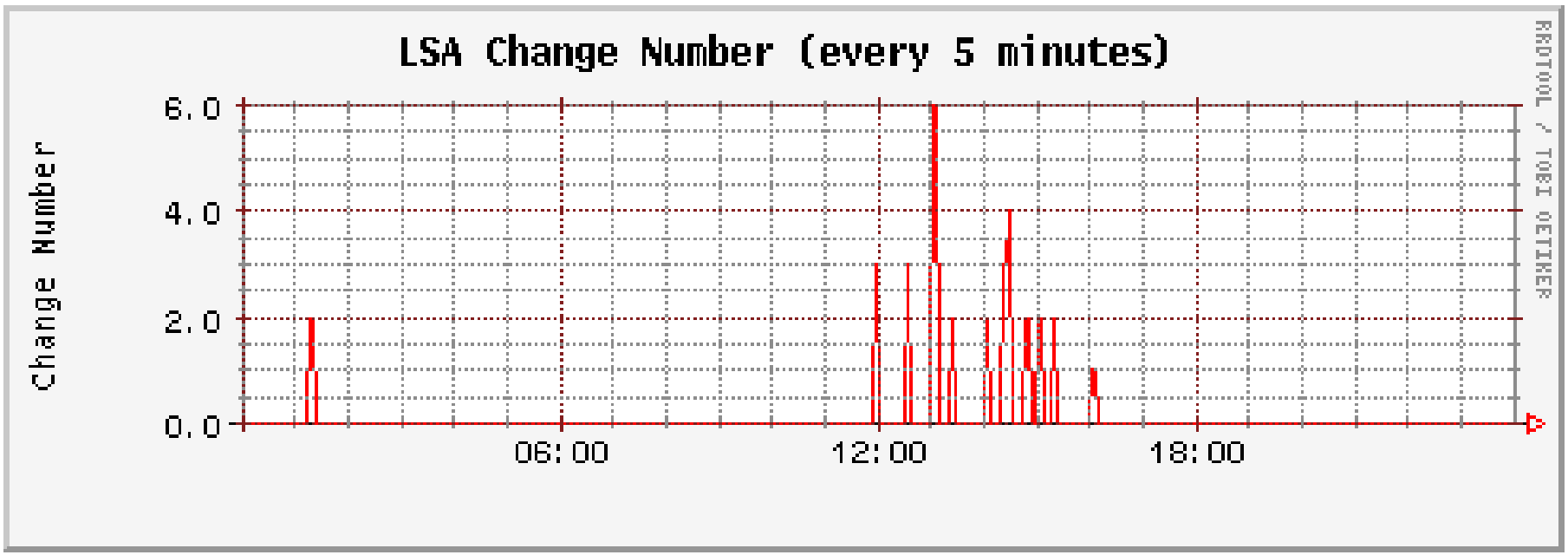

Period: August 2003 – May 2004

# Major LSA Oscillation Patterns

- Some LSA oscillation patterns and possible causes
  - Relatively frequent oscillation in short term
    - Congestion or interface/link problems
  - Frequent oscillation in short term
    - Misconfiguration of Router-ID or p2p interface/link problems
  - Relatively frequent oscillation in long term
    - Interface/link problems
  - Less frequent oscillation in long term
    - Interface/link problems

# Relatively Frequent Oscillation in Short Term

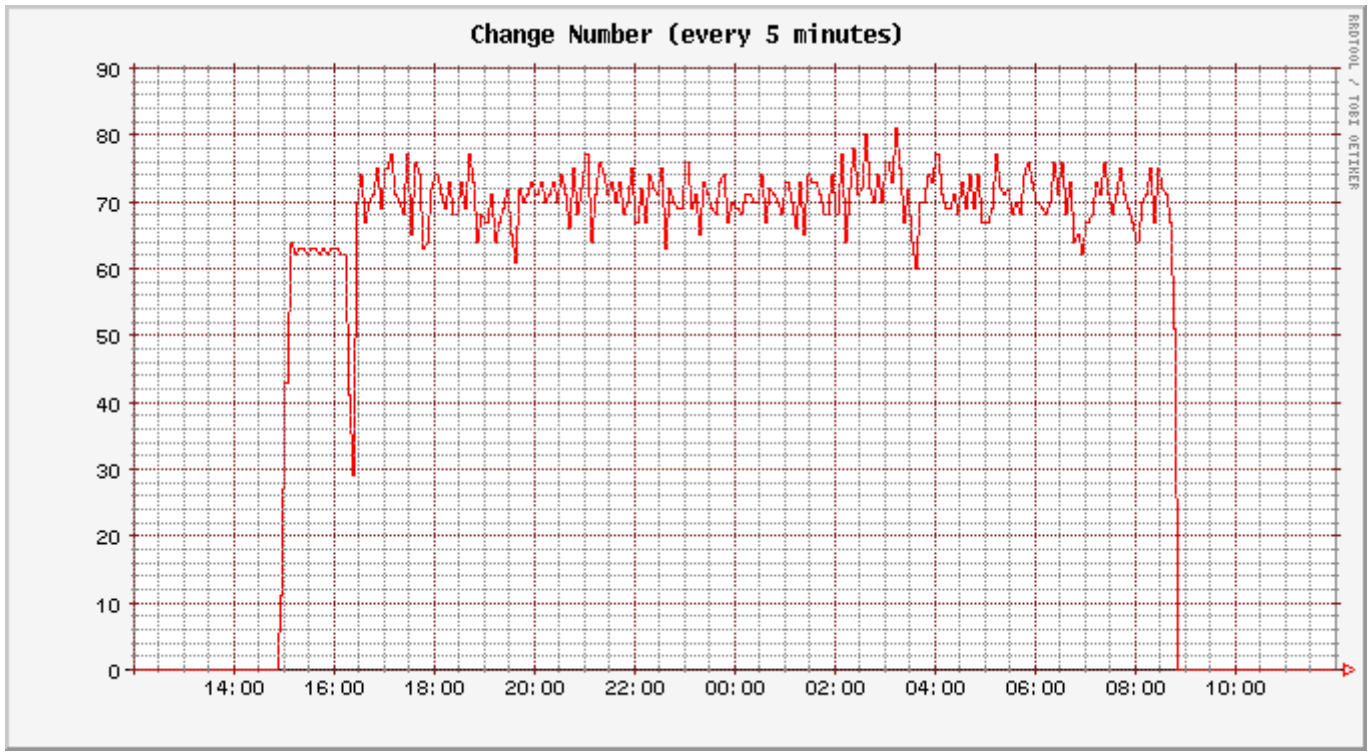
A router in Fukuoka, 5/7/04




- This kind of oscillation was observed most often
- Most were caused by congestion, but could also be L2 problems

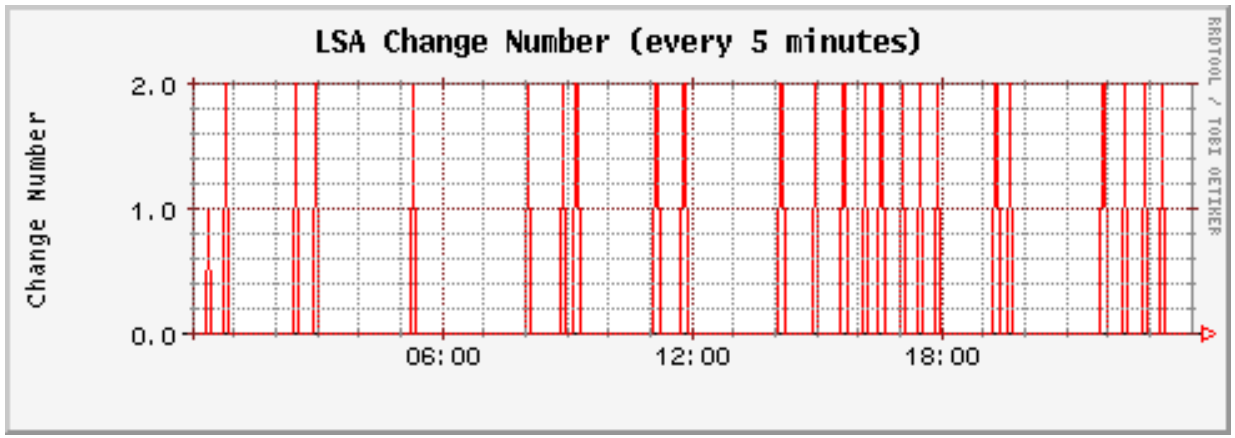
# Frequent Oscillation in Short Term

An L3 switch, 6/12/03-6/13/03, lasted for about 18 hours

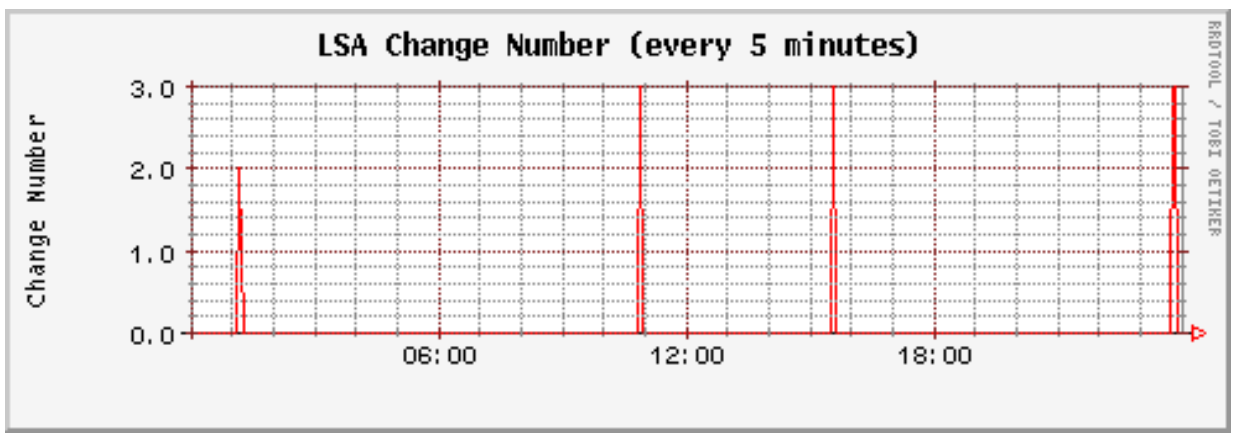



- Observed for several times
  - Most were caused by the misconfiguration of using the same router ID on two routers
    - Only one LSA flaps
  - Some were due to p2p interface/link problems
    - Two LSAs flap

# Relatively Frequent and Less Frequent Oscillation in Long Term




A router in San Francisco, lasted for 5 months from last to this year




A router in Kyoto, persisted for 2 months this year

– Most were caused by interface/link problems

# Causes of the Instability

- Identified causes
  - Congestion
    - Part of them were caused by DDoS
  - Interface/link failure
  - Misconfiguration
  - Software bug

# Rtanaly

- Rtanaly
  - A tool to detect and visualize IGP changes
- Features
  - Detects IGP changes in real-time and alert operators
    - Can also be used for offline data analysis
  - Visualization
  - Accessible through the web interface
  - Supports OSPFv2, OSPFv3 and IS-IS
  - xBSD and Linux
- Examples
  - http://rtanaly.koganei.wide.ad.jp/rtanaly
- Will be released early October, hopefully

# Summary

- Intra-domain Routing instability measurements
  - Regardless of network scale, intra-domain routing instability can occur frequently and persistently
  - It is important to deploy a monitoring system on your own network
- Rtanaly
  - Detect and visualize Intra-domain routing changes in real-time

# Acknowledgements


- My thanks to
  - WIDE Project and Nara Institute of Science and Technology
  - Operators of APAN-JP network


Thank you!