Netflow Overview

PacNOG 6
Nadi, Fiji

Agenda

- Netflow
  - What it is and how it works
  - Uses and Applications
- Vendor Configurations/ Implementation
  - Cisco and Juniper
- Flow-tools
  - Architectural issues
  - Software, tools etc
- More Discussion / Lab Demonstration

Network Flows

- Packets or frames that have a common attribute.
- Creation and expiration policy – what conditions start and stop a flow.
- Counters – packets,bytes,time.
- Routing information – AS, network mask, interfaces.

Network Flows

- Unidirectional or bidirectional.
- Bidirectional flows can contain other information such as round trip time, TCP behavior.
- Application flows look past the headers to classify packets by their contents.
- Aggregated flows – flows of flows.

Working with Flows

- Generating and Viewing Flows
- Exporting Flows from devices
  - Types of flows
  - Sampling rates
- Collecting it
  - Tools to Collect Flows - Flow-tools
- Analyzing it
  - More tools available, can write your own

Flow Descriptors

- A Key with more elements will generate more flows.
- Greater number of flows leads to more post processing time to generate reports, more memory and CPU requirements for device generating flows.
- Depends on application. Traffic engineering vs. intrusion detection.

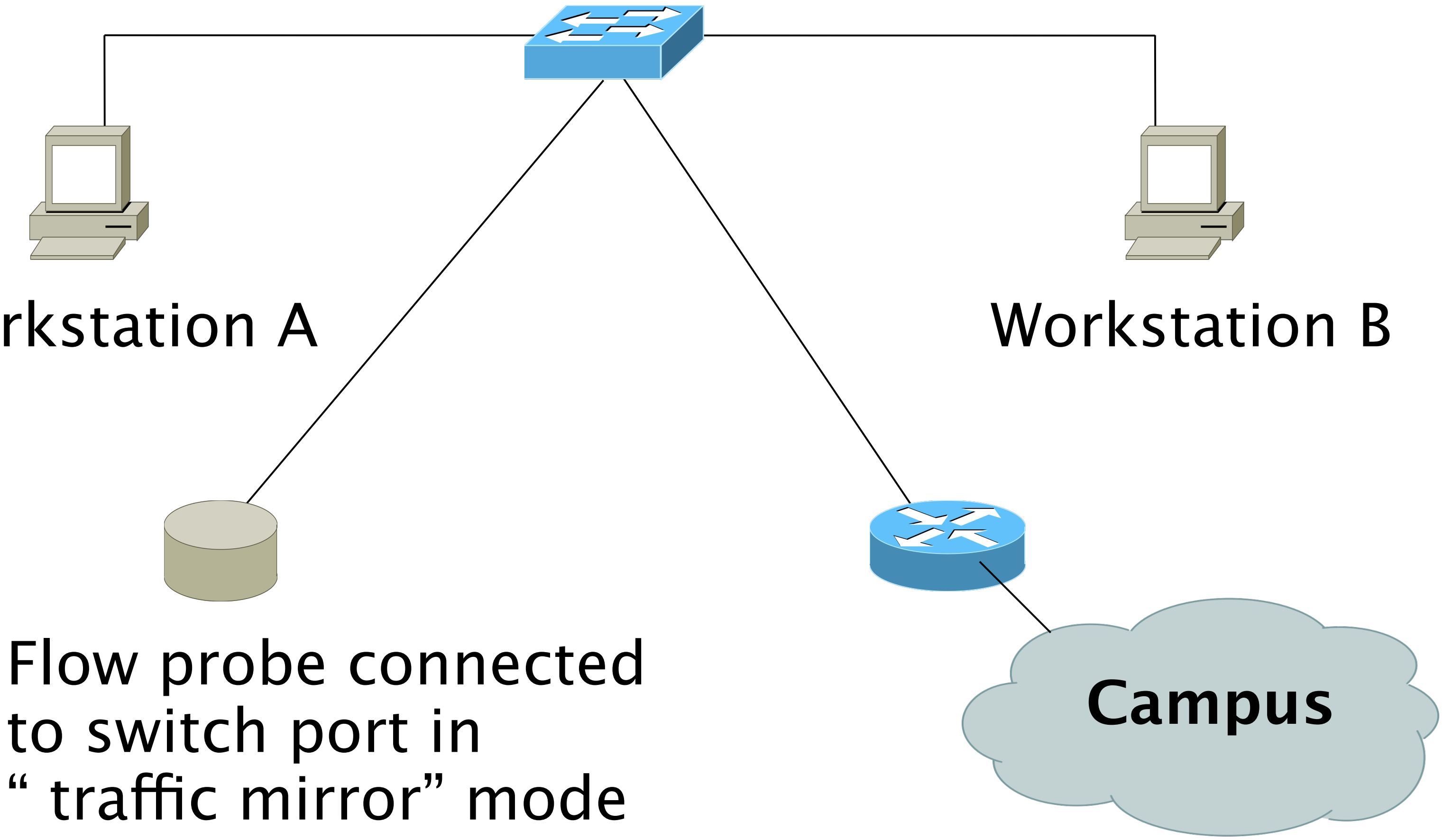
Flow Accounting

- Accounting information accumulated with flows.
- Packets, Bytes, Start Time, End Time.
- Network routing information – masks and autonomous system number.

Flow Generation/Collection

- Passive monitor
  - A passive monitor (usually a unix host) receives all data and generates flows.
  - Resource intensive, newer investments needed
- Router or other existing network device.
  - Router or other existing devices like switch, generate flows.
  - Sampling is possible
  - Nothing new needed

Passive Monitor Collection



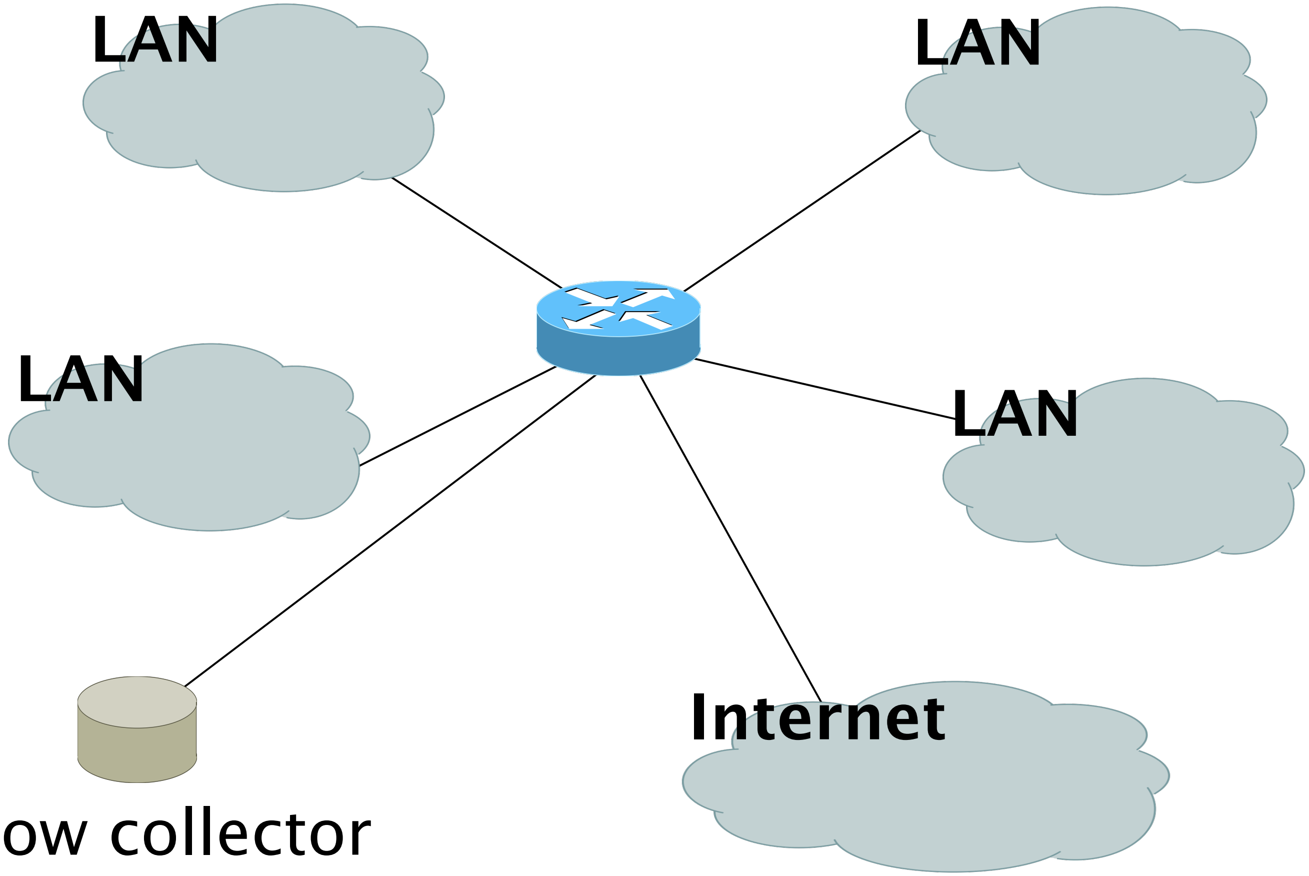
Workstation A

Workstation B

Flow probe connected
to switch port in
“ traffic mirror” mode

Campus

Router Collection



Flow collector
stores exported flows from router.

Passive Monitor

- Directly connected to a LAN segment via a switch port in “mirror” mode, optical splitter, or repeated segment.
- Generate flows for all local LAN traffic.
- Must have an interface or monitor deployed on each LAN segment.
- Support for more detailed flows – bidirectional and application.

Router Collection

- Router will generate flows for traffic that is directed to the router.
- Flows are not generated for local LAN traffic.
- Limited to “simple” flow criteria (packet headers).
- Generally easier to deploy – no new equipment.

Vendor implementations

Cisco NetFlow

- Unidirectional flows.
- IPv4 unicast and multicast.
- Aggregated and unaggregated.
- Flows exported via UDP.
- Supported on IOS and CatOS platforms.
- Catalyst NetFlow is different implementation.

Cisco NetFlow Versions

- 4 Unaggregated types (1,5,6,7).
- 14 Aggregated types (8.x, 9).
- Each version has its own packet format.
- Version 1 does not have sequence numbers – no way to detect lost flows.
- The “version” defines what type of data is in the flow.
- Some versions specific to Catalyst platform.

NetFlow v1

- Key fields: Source/Destination IP, Source/Destination Port, IP Protocol, ToS, Input interface.
- Accounting: Packets, Octets, Start/End time, Output interface
- Other: Bitwise OR of TCP flags.

NetFlow v5

- Key fields: Source/Destination IP, Source/Destination Port, IP Protocol, ToS, Input interface.
- Accounting: Packets, Octets, Start/End time, Output interface.
- Other: Bitwise OR of TCP flags, Source/Destination AS and IP Mask.
- Packet format adds sequence numbers for detecting lost exports.

NetFlow v8

- Aggregated v5 flows.
- Not all flow types available on all equipments
- Much less data to post process, but loses fine granularity of v5 – no IP addresses.

Cisco IOS Configuration

- Configured on each input interface.
- Define the version.
- Define the IP address of the collector (where to send the flows).
- Optionally enable aggregation tables.
- Optionally configure flow timeout and main (v5) flow table size.
- Optionally configure sample rate.

Cisco IOS Configuration

```
interface FastEthernet0/0
 description Access to backbone
 ip address 169.223.11.194 255.255.252.0
 ip route-cache flow
 duplex auto
 speed auto
!
interface FastEthernet0/1
 description Access to local net
 ip address 169.223.2.1 255.255.255.128
 ip route-cache flow
 duplex auto
 speed auto


ip flow-export version 5
ip flow-export destination 169.223.2.2 5004
```

Cisco IOS Configuration

```
gw-169-223-2-0#sh ip flow export
Flow export v5 is enabled for main cache
  Export source and destination details :
  VRF ID : Default
    Destination(1)  169.223.2.2 (5004)
  Version 5 flow records
  55074 flows exported in 3348 udp datagrams
  0 flows failed due to lack of export packet
  0 export packets were sent up to process level
  0 export packets were dropped due to no fib
  0 export packets were dropped due to adjacency issues
  0 export packets were dropped due to fragmentation failures
  0 export packets were dropped due to encapsulation fixup failures
```

Cisco IOS Configuration

```
gw-169-223-2-0#sh ip cache flow
IP packet size distribution (3689551 total packets):
   1-32   64   96  128  160  192  224  256  288  320  352  384  416  448  480
   .000 .483 .189 .014 .002 .003 .001 .000 .000 .000 .000 .000 .000 .000 .001

    512  544  576 1024 1536 2048 2560 3072 3584 4096 4608
   .001 .000 .008 .002 .288 .000 .000 .000 .000 .000 .000

IP Flow Switching Cache, 278544 bytes
  26 active, 4070 inactive, 55206 added
  1430681 ager polls, 0 flow alloc failures
  Active flows timeout in 30 minutes
  Inactive flows timeout in 15 seconds
IP Sub Flow Cache, 25800 bytes
  26 active, 998 inactive, 55154 added, 55154 added to flow
  0 alloc failures, 0 force free
  1 chunk, 2 chunks added
  last clearing of statistics never
```

Cisco IOS Configuration

```
ip flow-top-talkers
 top 10
 sort-by bytes


gw-169-223-2-0#sh ip flow top-talkers

SrcIf         SrcIPaddress    DstIf         DstIPaddress    Pr SrcP DstP Bytes
Fa0/1         169.223.2.2     Fa0/0         169.223.11.33   06 0050 0B64  3444K
Fa0/1         169.223.2.2     Fa0/0         169.223.11.33   06 0050 0B12  3181K
Fa0/0         169.223.11.33   Fa0/1         169.223.2.2     06 0B12 0050    56K
Fa0/0         169.223.11.33   Fa0/1         169.223.2.2     06 0B64 0050    55K
Fa0/1         169.223.2.2     Local         169.223.2.1     01 0000 0303    18K
Fa0/1         169.223.2.130   Fa0/0         64.18.197.134   06 9C45 0050    15K
Fa0/1         169.223.2.130   Fa0/0         64.18.197.134   06 9C44 0050    12K
Fa0/0         213.144.138.195 Fa0/1         169.223.2.130   06 01BB DC31  7167
Fa0/0         169.223.15.102  Fa0/1         169.223.2.2     06 C917 0016  2736
Fa0/1         169.223.2.2     Local         169.223.2.1     06 DB27 0016  2304
10 of 10 top talkers shown. 49 flows processed.
```

Cisco command summary

- Enable CEF (done by default)
  - `ip cef`
- Enable flow on each interface

```
ip route cache flow OR
ip flow ingress
ip flow egress
```

- View flows
  - `show ip cache flow`
  - `show ip flow top-talkers`

Cisco Command Summary

- Exporting Flows to a collector

```
ip flow-export version 5 [origin-as|peer-as]
ip flow-export destination x.x.x.x <udp-port>
```

- Exporting aggregated flows

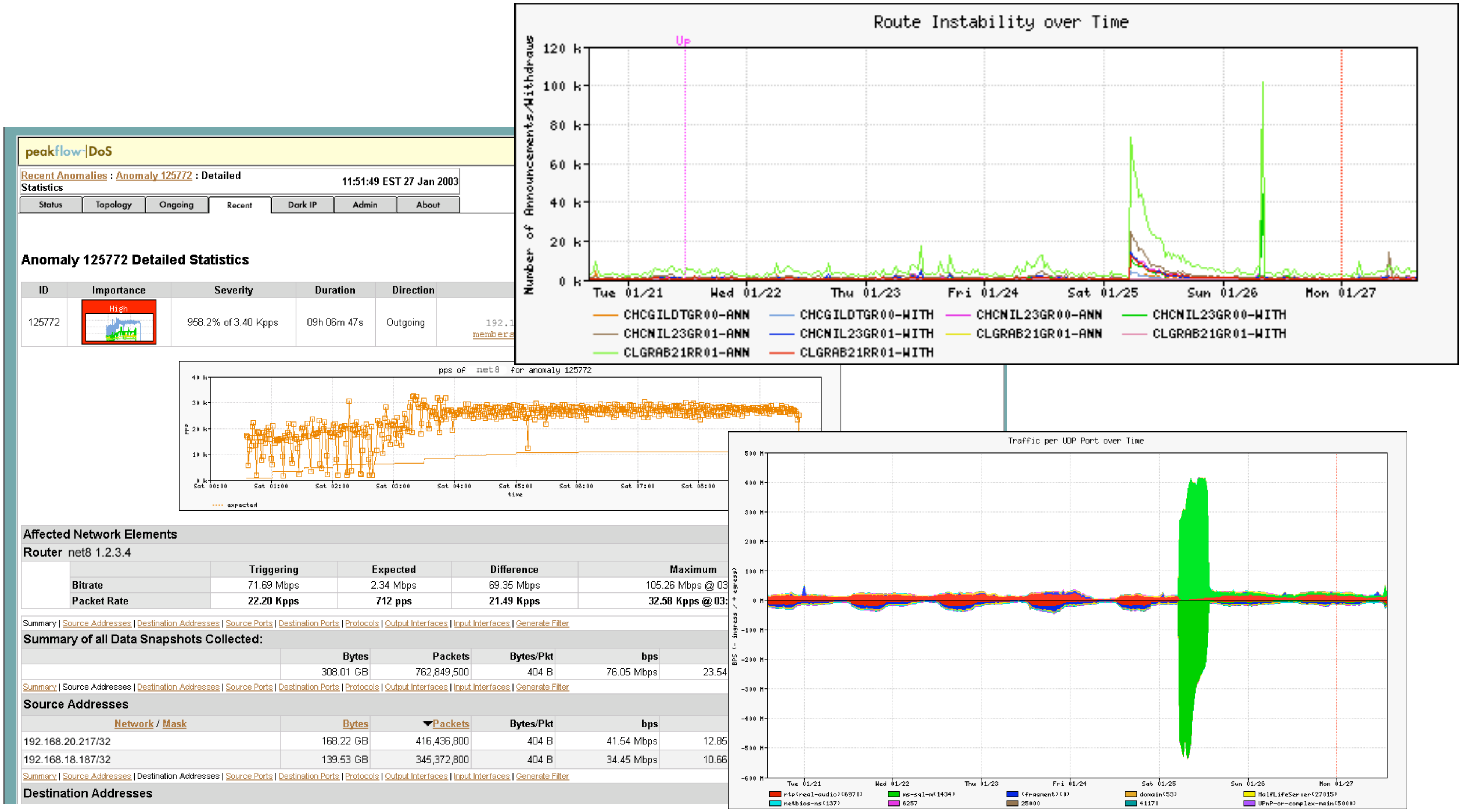
```
ip flow-aggregation cache as|prefix|dest|source|proto
  enabled
  export destination x.x.x.x <udp-port>
```

Flows and Applications

Uses for Flow

- Problem identification / solving
  - Traffic classification
  - DoS Traceback (some slides by Danny McPherson)
- Traffic Analysis
  - Inter-AS traffic analysis
  - Reporting on application proxies
- Accounting
  - Cross verification from other sources
  - Can cross-check with SNMP data

Detect Anomalous Events: SQL “Slammer” Worm*



peakflow|DoS

Recent Anomalies : Anomaly 125772 : Detailed Statistics

11:51:49 EST 27 Jan 2003

Status | Topology | Ongoing | Recent | Dark IP | Admin | About

Anomaly 125772 Detailed Statistics

ID	Importance	Severity	Duration	Direction	
125772	High	958.2% of 3.40 Kpps	09h 06m 47s	Outgoing	192.1 members

Affected Network Elements

Router net8 1.2.3.4

		Triggering	Expected	Difference	Maximum
	Bitrate	71.69 Mbps	2.34 Mbps	69.35 Mbps	105.26 Mbps @ 03
	Packet Rate	**22.20 Kpps**	**712 pps**	**21.49 Kpps**	**32.58 Kpps @ 03:**

Summary | Source Addresses | Destination Addresses | Source Ports | Destination Ports | Protocols | Output Interfaces | Input Interfaces | Generate Filter

Summary of all Data Snapshots Collected:

	Bytes	Packets	Bytes/Pkt	bps	
	308.01 GB	762,849,500	404 B	76.05 Mbps	23.54

Summary | Source Addresses | Destination Addresses | Source Ports | Destination Ports | Protocols | Output Interfaces | Input Interfaces | Generate Filter

Source Addresses

Network / Mask	Bytes	▼Packets	Bytes/Pkt	bps	
192.168.20.217/32	168.22 GB	416,436,800	404 B	41.54 Mbps	12.85
192.168.18.187/32	139.53 GB	345,372,800	404 B	34.45 Mbps	10.66

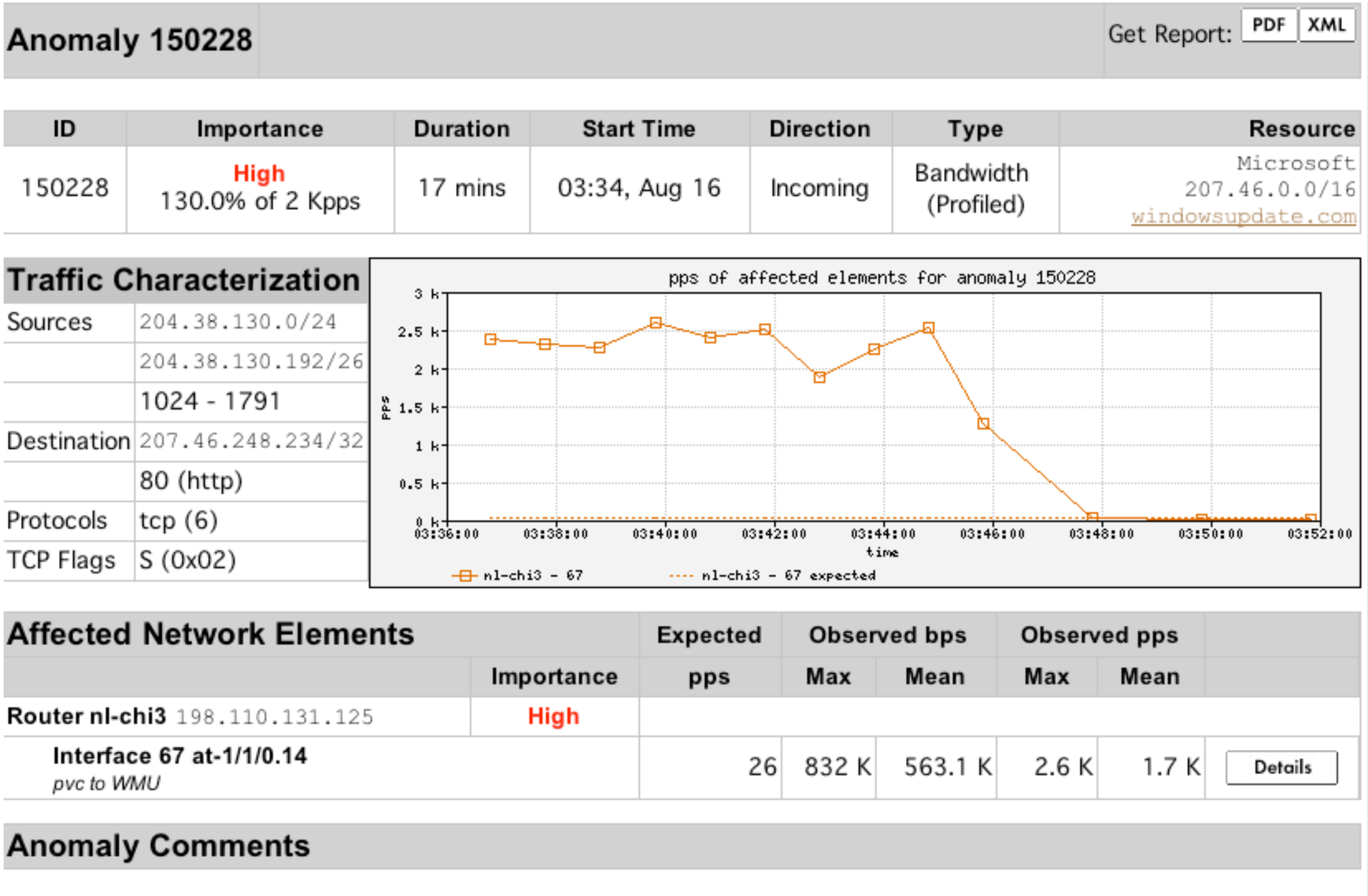
Summary | Source Addresses | Destination Addresses | Source Ports | Destination Ports | Protocols | Output Interfaces | Input Interfaces | Generate Filter

Destination Addresses

Flow-based Detection (cont)*

- Once baselines are built anomalous activity can be detected
  - Pure **rate-based** (pps or bps) anomalies may be legitimate or malicious
  - Many **misuse** attacks can be immediately recognized, even **without** baselines (e.g., TCP SYN or RST floods)
  - **Signatures** can also be defined to identify “interesting” transactional data (e.g., proto udp and port 1434 and 404 octets(376 payload) == slammer!)
  - Temporal compound signatures can be defined to detect with higher precision

Flow-based Commercial Tools…*



Anomaly 150228

Get Report: PDF XML

ID	Importance	Duration	Start Time	Direction	Type	Resource
150228	High 130.0% of 2 Kpps	17 mins	03:34, Aug 16	Incoming	Bandwidth (Profiled)	Microsoft 207.46.0.0/16 windowsupdate.com

Traffic Characterization

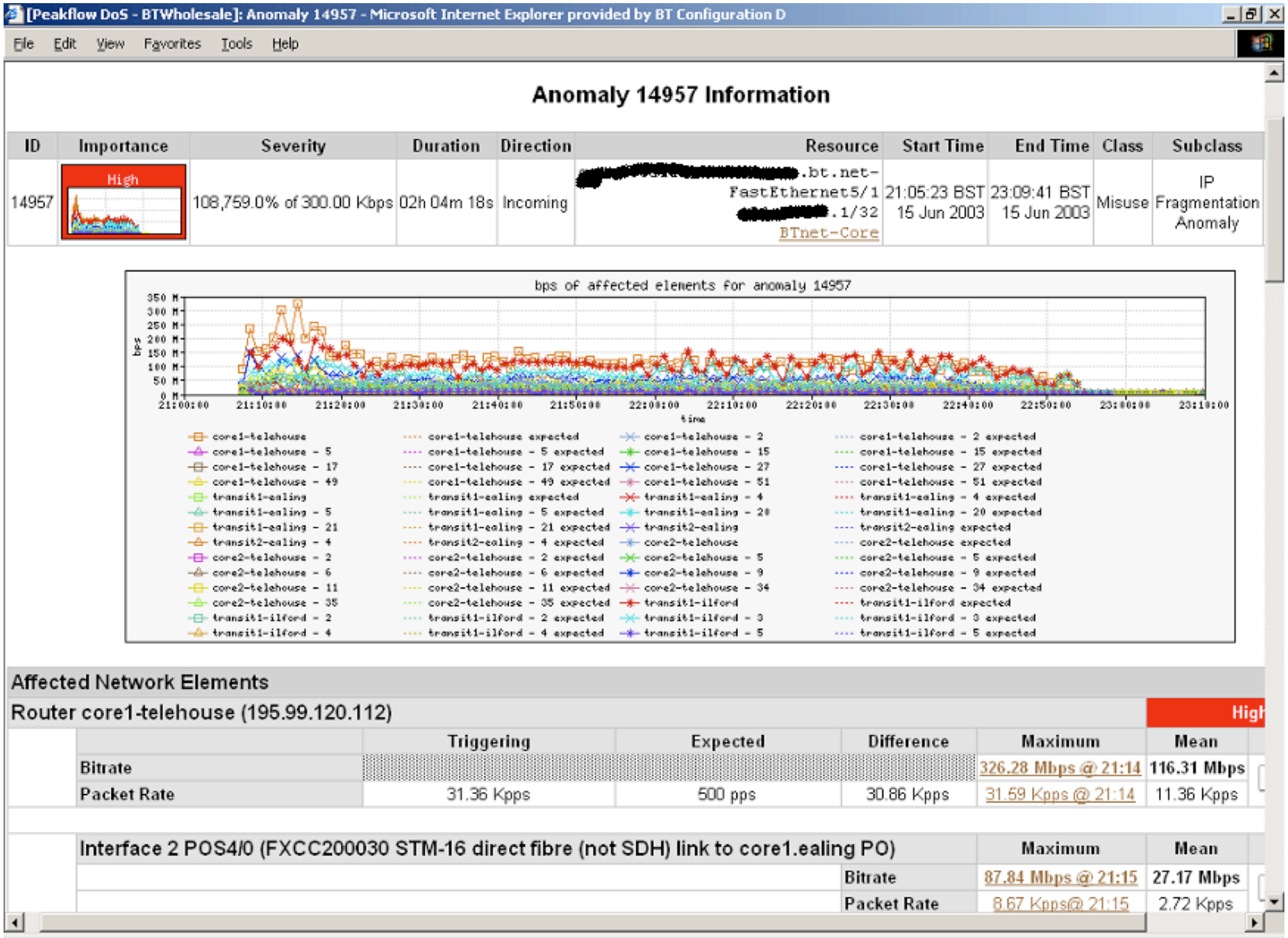
Sources	204.38.130.0/24
	204.38.130.192/26
	1024 - 1791
Destination	207.46.248.234/32
	80 (http)
Protocols	tcp (6)
TCP Flags	S (0x02)

Affected Network Elements

	Importance	Expected	Observed bps		Observed pps		
		pps	Max	Mean	Max	Mean	
Router nl-chi3 198.110.131.125	High						
Interface 67 at-1/1/0.14 *pvc to WMU*		26	832 K	563.1 K	2.6 K	1.7 K	Details

Anomaly Comments

Commercial Detection
A Large Scale DOS attack*


[Peakflow DoS - BTWholesale]: Anomaly 14957 - Microsoft Internet Explorer provided by BT Configuration D
File
Edit
View
Favorites
Tools
Help

Anomaly 14957 Information

ID	Importance	Severity	Duration	Direction	Resource	Start Time	End Time	Class	Subclass
14957	High	108,759.0% of 300.00 Kbps	02h 04m 18s	Incoming	[redacted].bt.net-FastEthernet5/1 [redacted].1/32 BTnet-Core	21:05:23 BST 15 Jun 2003	23:09:41 BST 15 Jun 2003	Misuse	IP Fragmentation Anomaly

Affected Network Elements

Router core1-telehouse (195.99.120.112) High

	Triggering	Expected	Difference	Maximum	Mean
Bitrate				326.28 Mbps @ 21:14	116.31 Mbps
Packet Rate	31.36 Kpps	500 pps	30.86 Kpps	31.59 Kpps @ 21:14	11.36 Kpps

Interface 2 POS4/0 (FXCC200030 STM-16 direct fibre (not SDH) link to core1.ealing PO)	Maximum	Mean
Bitrate	87.84 Mbps @ 21:15	27.17 Mbps
Packet Rate	8.67 Kpps@ 21:15	2.72 Kpps

Traffic Analysis

- Can see traffic based on source and destination AS
  - Source and destination AS derived through the routing table on the router
  - Introduces the need to run full mesh BGP at IXPs as well as transit and peering
  - Source and destination prefix based flows can be collected and plotted against external prefix to ASN data

Accounting

- Flow based accounting can be a good supplement to SNMP based accounting.

References

- flow-tools:
  http://www.splintered.net/sw/flow-tools
- NetFlow Applications

  http://www.inmon.com/technology/netflowapps.php
- Netflow HOW-TO
  http://www.linuxgeek.org/netflow-howto.php
- IETF standards effort:
  http://www.ietf.org/html.charters/ipfix-charter.html

References

- Abilene NetFlow page
  http://abilene-netflow.itec.oar.net/
- Flow-tools mailing list:
  flow-tools@splintered.net
- Cisco Centric Open Source Community
  http://cosi-nms.sourceforge.net/related.html