From NetFlow to IPFIX

the evolution of IP flow information export

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What is IPFIX?

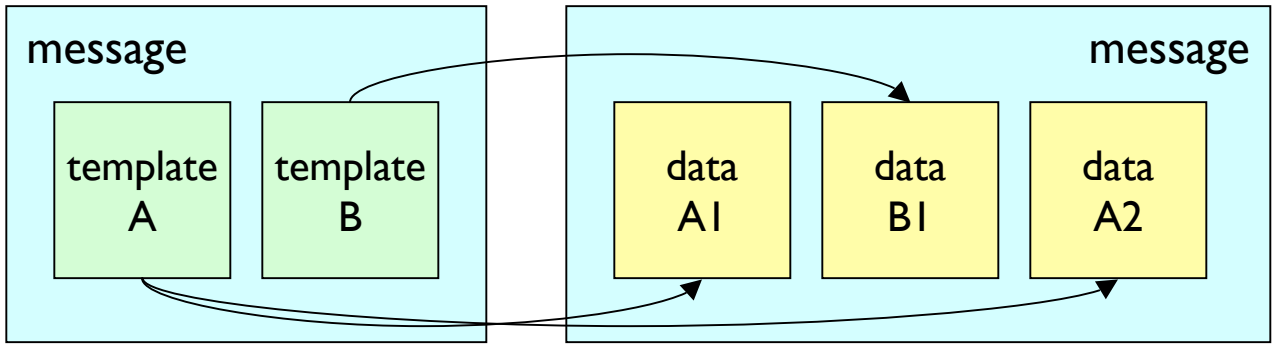
- Emerging IETF standard for flexible export of IP flow data from routers or other metering processes.
- Defines
  - a rich, easily extensible information model,
  - a template-driven data representation,
  - and a unidirectional protocol for export of IP flow data over a variety of transport protocols.
- Does not define specific requirements for flow assembly, flow key selection, etc.

History and Motivation

- IETF IPFIX working group started in 2001 to define a standard flow export protocol.
- Selected Cisco NetFlow V9 as a basis for this new protocol.
  - Evolution of previous NetFlow versions.
  - Added templates for flexible data definition.
- Developed protocol from this basis to meet defined requirements.
  - IPFIX information model is maintained as a superset of V9 information model, but otherwise the two are not directly interoperable without message translation.

Representation

- Templates in the message stream describe the data sets.
- Allows flexible and efficient representation of flows on the wire.



Information model

- The information model supports reporting a wide variety of information elements:
  - "Five-tuple" (IPv4, IPv6) and standard counters
  - Packet treatment: e.g., routed next hop and AS
  - Detailed counters: e.g., sum of squares, flag counters
  - Timestamps down to nanosecond resolution
  - Any ICMP, TCP, UDP header field
  - Layer 2, VLAN, MPLS, and other sub-IP information
- Flow keys are not limited to specific information elements.
- New IEs registered with IANA.
- Enterprise-specific IEs for private extensions.

Comparison to sFlow

- sFlow is a packet sampling protocol
  - Intended for many of the same applications as NetFlow and IPFIX.
  - Use of packet sampling instead of flow assembly reduces state overhead on measurement device.
  - Analogous to PSAMP, which extends IPFIX for export of sampled packet data.
- Both provide flexible export, but…
  - sFlow provides message types for flexibility,
  - IPFIX provides templates and information elements:
  - IPFIX allows definition of novel message types on the fly.

Status

- It's taken longer than we'd thought, but we're nearly done…
- Core IPFIX protocol documents completed in 2006, (probably) to be published as RFCs in 2007.
- Working group continuing to define extensions to and applications of the protocol.
  - Bidirectional flow export
  - Redundancy reduction for export efficiency
  - Flow storage and File-based interoperability
  - MIB and XML-based configuration for IPFIX devices
  - etc…
- Implementations tracking the draft standard available now.

Bidirectional Flow Export

- Bidirectional flow (biflow) metering and analysis is applicable to several use cases:
  - data reduction
  - separation of "answered" traffic from unanswered
  - full reconstruction of TCP sessions
- The IPFIX protocol has no direct support for single-record export of bidirectional flows (biflows).
- This extension allows "reversal" of any element within the Information Model for biflow export.
- To be published as an RFC this year.

Reducing Redundancy

- Technique for bandwidth-saving information export
  - Separates the export of flow records such that attributes common to several flow records are sent only once.
  - Links common flow properties to specific properties with a unique identifier.
- To be published as an RFC this year.

Flow Storage

- Many analysis tools interoperate not via direct communication, but via file exchange.
  - exchange available via a variety of transport methods (HTTP, FTP, SSH+SCP, SMTP+MIME, etc., etc.)
  - files support a variety of useful operations (compression, encryption, etc.)
  - files are a natural unit of grouping related flow data (e.g. a single security incident or query result).
- Existing de-facto standard for flow storage: NetFlow PDU files
  - Not extensible for data fields not in NetFlow.

Flow Storage: IPFIX as basis

- IPFIX defines a template-driven data representation and a rich, easily extensible information model, so :
- Ideal basis for a flow storage format
  - Extensible and self-describing, unlike V5 PDU files
  - Adequate semantic flexibility for flow data without overhead of e.g. XML.
  - Additional applicability to IPFIX (or NetFlow V9) collection infrastructures.

IPFIX Files

- An IPFIX file is any serialized stream of IPFIX Messages.
  - Alternately, a “file transport” for IPFIX.
- Provides a set of extensions:
  - File contents
  - Error detection and recovery
  - Extended type information for enterprise-specific information elements.
- To be published as an RFC in 2008.

IPFIX Implementations (1)

- YAF (Yet Another Flowmeter)
  - takes packets from the wire or libpcap dumpfiles.
  - writes IPFIX Files or exports IPFIX Messages.
  - supports bidirectional flow export.
- SiLK (System for Internet Level Knowledge)
  - large-scale flow storage and command-line analysis suite.
  - supports NetFlow V5 and IPFIX flow collection.
  - can analyze IPFIX Files directly, as well.
- libfixbuf: an IPFIX library in C
  - Used by YAF and SiLK
- Available from http://tools.netsa.cert.org/

IPFIX Implementations (2)

- OpenIMP
  - provides metering processes, export/collection, and analysis tools.
  - specifically focused on active and passive quality of service measurement.
  - available from http://www.ip-measurement.org/openimp/
- libipfix: another IPFIX library in C
  - supports Reducing Redundancy extension
  - supports IPFIX File and mysql storage
  - used by OpenIMP
  - available from http://meteor.fokus.fraunhofer.de/libipfix/

IPFIX Implementations (3)

- Versatile Monitoring Toolkit (VERMONT)
  - provides metering processes, export/collection, and monitoring tools.
  - implements IPFIX and related PSAMP (packet sampling) protocol.
  - available from http://vermont.berlios.de/
- ntop
  - web-based traffic measurement application
  - acts as IPFIX collecting process
  - available from http://www.ntop.org/

FIN

- IPFIX is an emerging standard for flexible flow export, representation, and storage.
  - For those who want to follow the progress:
  - http://tools.ietf.org/wg/ipfix - WG tools page
  - http://www.ietf.org/html.charters/ipfix-charter.html
- Implementations available now
  - IPFIX interoperability events in July '05, March '06, and November '06 so far.

Questions?

- ask now
- or later:

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