CERT

Implementing Coarse, Long-Term Traffic Capture

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Outline of Talk

Introduction To Work

Logistics of Traffic Analysis

Implementing Traffic Capture

- Relational vs. Flatfile
- Implementing Robust Service

Analytical Tools

Future Goals

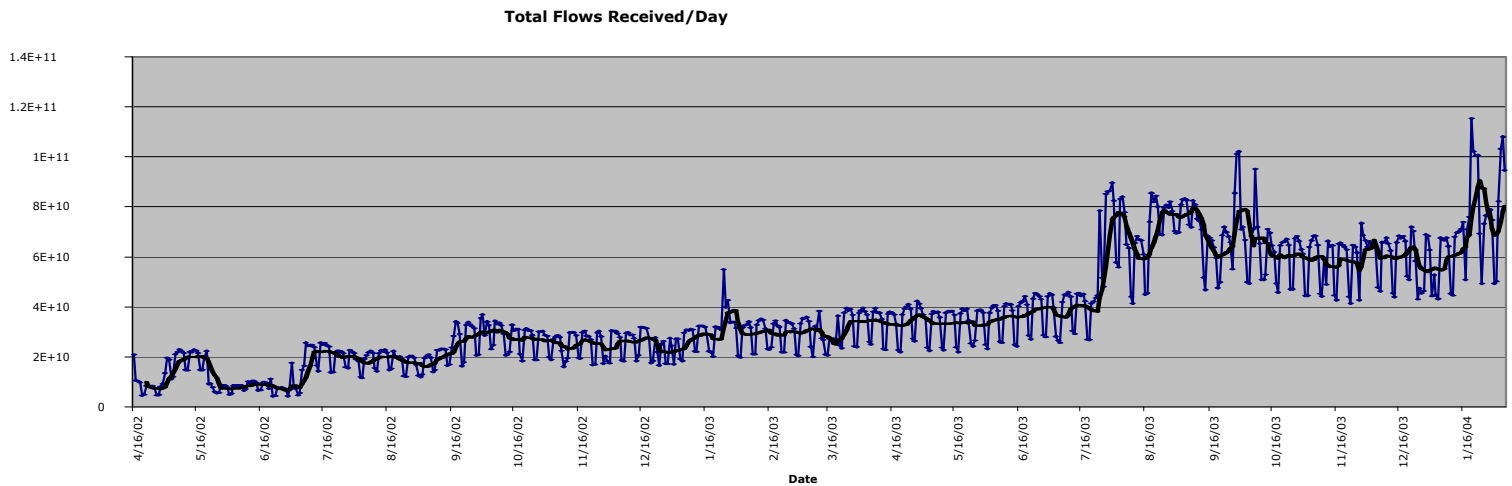
- Reaching the limits of flow
- Enhancing Netflow

The Work

Originally wanted raw data for security modeling

- Developed techniques for rapidly querying data
- It kind of snowballed from there…

The resulting system is now used by 50+ users, capture 250+GB of traffic/day and is used operationally 24/7



How well are we doing?

We receive *n* events per second

Analysts can process/tag/understand *k* events per second. k = n good; k << n normal

- Unfettered Analysis time is *insanely valuable*
- Requirements change as the network changes

Increase *k* by:

1. Reducing access time
2. Reducing the amount of lookup/doublechecking done by analysts
3. Classifying, discarding events
4. Making more inclusive events

Reducing Access Time

Large mechanical, governed by fixed rules

- The smaller the record, the better
- The more informative the data in that space, the better

Start by using netflow, then enhancing the netflow format

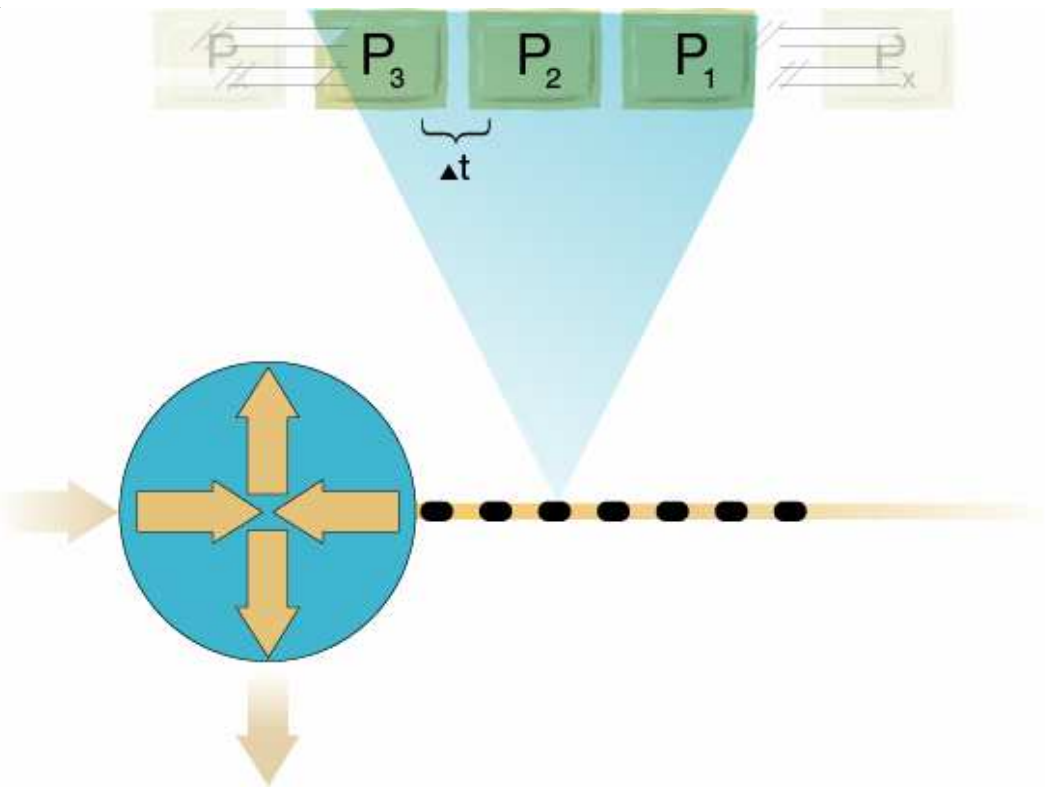
Source Data

Use flow data: a flow is a summary of packet data between two sites

No payload information

Flows are generated by sensors throughout the network

Flows are logistically manageable: GB vs TB



NetFlow Data

saddress	source IP	**daddress**	dest IP
sport	source port	**dport**	dest port
protocol	IP protocol	**packets**	# of packets
bytes	# of bytes	**flags**	TCP Flags
stime	first pkt. time	**duration**	time taken
etime	last pkt. time	**sensor**	sensor

Most security relevant information from standard flow record

Routing information is maintained through categories

Why Flow?

Payload: out of the question, too large

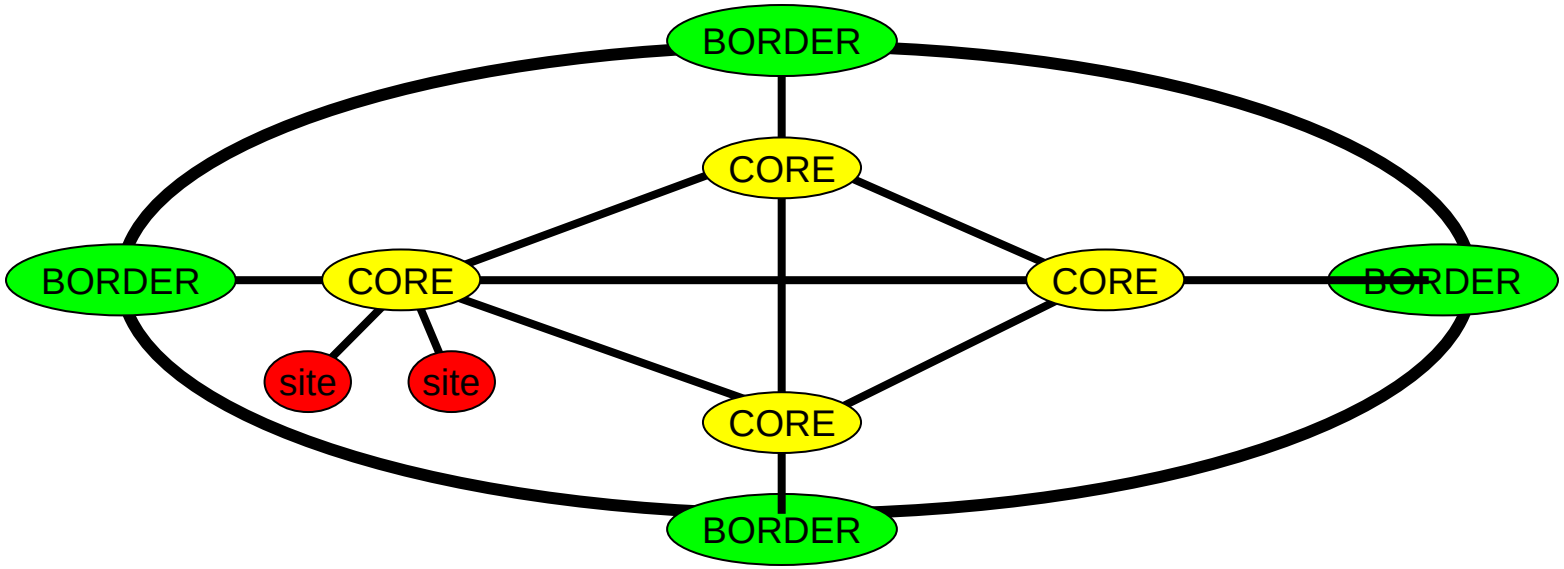
Limited payload: what to keep?

Ultimately, we are governed by what we can store on disk.

- If we had to pick 48 (or, in our case, 22) bytes of information, this is the highest-value 22 we could pick from a group of records

Not complete - flow is intended for traffic analysis, not security. More on this later

Network Architecture



Network is an outer ring with an inner core. Network itself crosses the globe.

Routing is asymmetrical - chance of {A,B} packet using the same router as {B,A} packet is low.Sensor Abstraction

Traffic Categorization

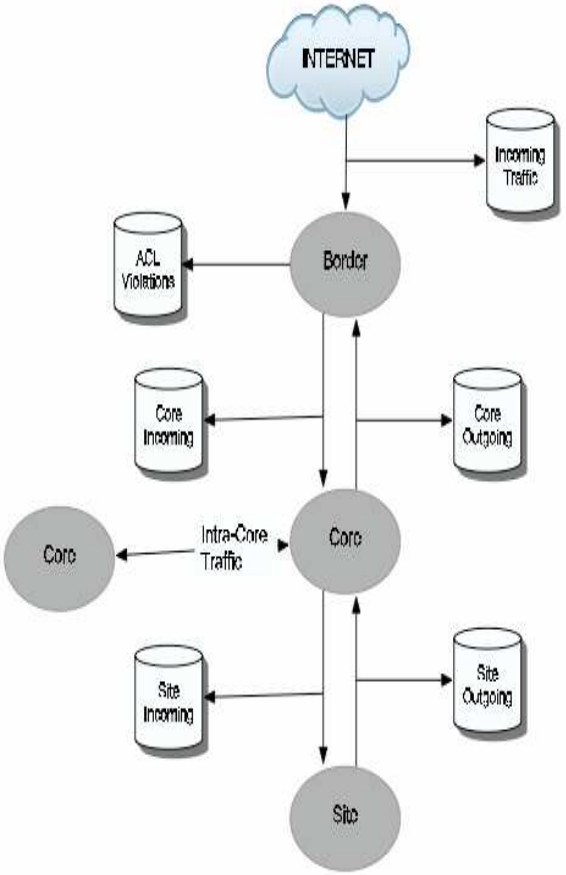
Routing information is used to categorize traffic:

- Incoming, Outgoing
- Aimed at router, null

Interface info is otherwise discarded

- Categories also ensure if you query one class/type combination you don't see duplicates

Special case: internally routed traffic

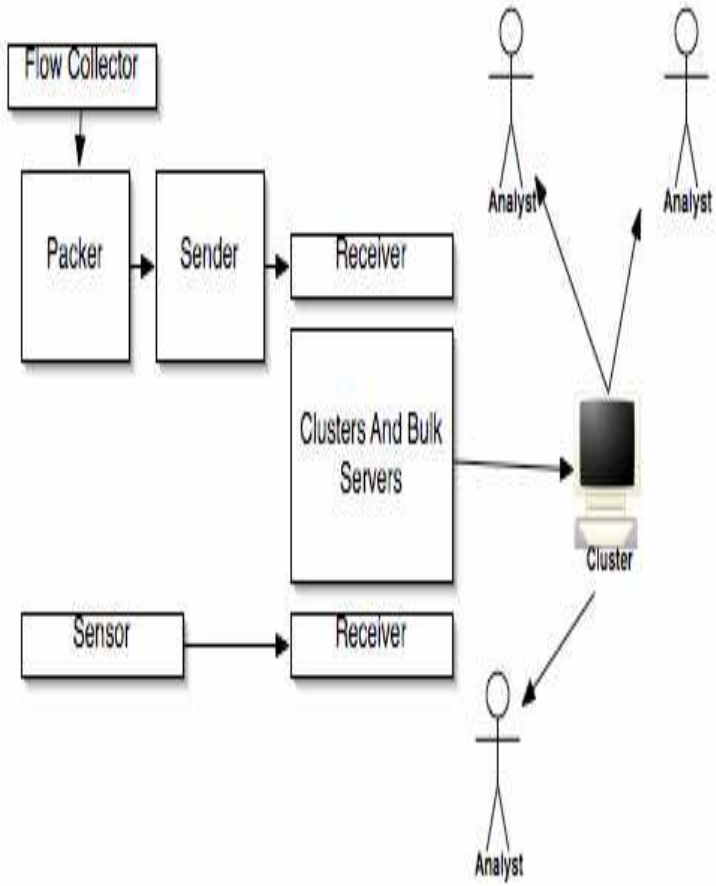


Collection System Architecture

Collection System consists of distributed sensors writing to a common parallel cluster

Sensors write common format, optimized for specific cases

Data is stored in flat files with fixed formats on disk



Why Flat Files?

Databases provide a lot of functionality for maintaining system integrity

- Locking
- Rollback, Time Travel

SiLK is write once, read many

- No updates, only inserts
- Each sensor writes to its own files

Interface is through a common library

- Formats don't change much, generally in response to our suggestions
  - Optimization, security enhancements
- Plan for an IPFIX update eventually

The Impact of Global Warming On Computer Security

Reliability is handled through multiply redundant storage

- Sensors have buffer space, as does packer
- Multiple ring structure means that a flow will be captured by a sensor
- Assumed a weekend of 3x normal traffic (Code Red)

Sensors have a “trickle” effect, where data is shipped in priority form if there’s an interrupt.

- Exploit business cycle

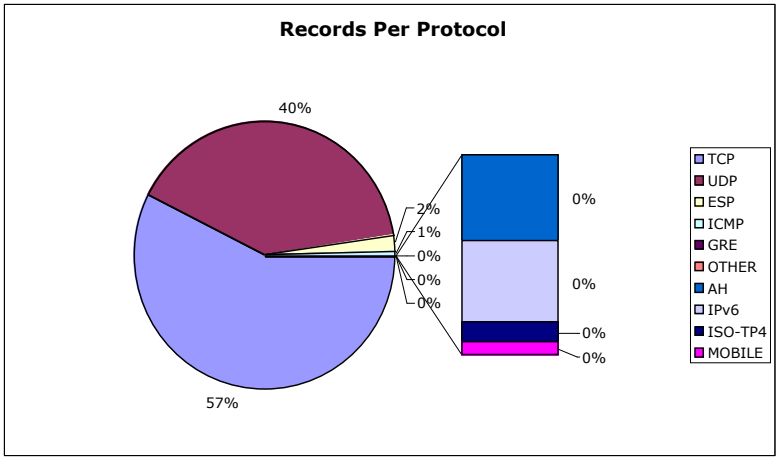
That said, don’t build your datacenter in a hurricane zone if you can avoid it

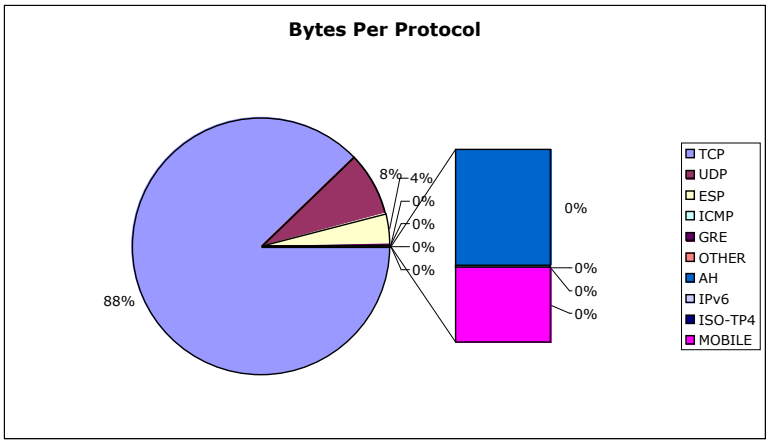
Basic Statistics

On a *per-flow* basis, the majority of traffic is aberrant

- Short sessions
- ACL violations

The majority of traffic is TCP, then UDP, then either ICMP or ESP depending on metric used.





Analytical Tools

Security analysis is log analysis, *perl* is the most basic security tool

- Perl tends to be text heavy, I/O bound
- Our data is highly structured

Use the SiLK toolset instead

- Binary applications, optimized in C that provide rapid analysis facilities

SiLK features

Works in binary data

- ASCII at the very last step - usually 6-8x larger than binary per record

Tool Categories

- Basic query/filter tools (per record selection)
- UNIX replacements (sort, uniq)
- Data structure tools (arbitrary sets of IP addresses, groups of flows)
- Decision/mapping tools (scan detection, service mapping)

General goal is to write high-speed applications in C, then stitch together with scripts to write arbitrary detectors

Future Directions

Netflow: still some unexplored domains

- Mapping
- Using per-IP/AS information

Otherwise, the goal is to expand flow and add properties

Passive Mapping

Track network features using flow

- Simple features - router/server presence and configuration
- More advanced: communications networks (ie, bittorrent, email)

Continuously audit the network to figure out how it is configured

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Expanding Sensors

Replace netflow

- Put format under our control
- Include security specific data

First version: flocaps

- Converted UDP netflow broadcasts into tcp signals in compressed format
- Priority transfer

Next:

- Expand for security

AMP

Developed by clients: DAG Card + TCPDump with flow output

Next questions: What to store

- Expanded time (ms)
- Four byte hash of payload/ICMP message
- Initial flags

Eventual system

Analyst's Desktop

- Integrate multiple data sources - realtime responses, alerts, archival data, maps

Heterogenous data sources

- Some sources are more useful "zoomed in"
  - BGP, DNS? (Chosen for criticality)
  - ICMP, IGPs? (Chosen for information)
- Maintain a continuous buffer of data?

Conclusions

Introduction to architectural basics

An installation is available at http://silktools.sourceforge.net

- Provides core packing system and analytical tools

Find out more at http://www.cert.org/netsa

CERT runs a regular Netflow workshop; for more info see http://www.cert.org/flocon