Flow Indexing

Making queries go faster

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How is large scale flow data used?

“Selection” is the most generic and most popular query type. Selection queries specify a source IP address, a destination IP address, or both”

– Publication NetSA-2011-19

• When flow data is being searched to corroborate information from other sources, entry is often via an IP address or set of IP addresses.

• While other information (flowtype primarily) may limit the scope of the data pull, it is common to read through many files containing no relevant records.
Motivation: Alert Processing

• Alerts from IDS or similar sensors are often corroborated (or refuted) with flow data.
• The alert typically has a time window (stime / etime) and one or more IP addresses (or {src/dst} pairs).
• Data pull for the alert examines all the data within the time window (+/- an error margin) for all of the IPs.
  – Many of the examined files have no relevant data
  – Sometimes there is no data satisfying the pull criteria (differences in sensor placement and source visibility).
• Avoid fruitless work whenever possible
Can we short circuit the data pull?

• Indices are the traditional mechanism for short circuiting sequential searches.
  – A book index usually points to a specific page.
  – SiLK flow files were not designed for random access, and the index terms (IP addresses) often take up 25% or more of each record so a traditional term -> page index is not a solution.

• On the other hand, absence of an index entry means that we don’t have to read the book.
  – If there are lots of missing entries, our reading list is limited.
The SiLK file repository (refresher)

• For the data set we are using, files are stored in a directory hierarchy
  <data_rootdir>/
      class/
      type/
      year/
      month/
      day/

• day/ directory contains per sensor hourly files with names of the form: <flowtype>-<sensor>_YYYYMMDD.HH

• May be up to (#class X #type X #sensor) files to search
  rwfglob –start-date=YYYY/MM/DD:HH –flowtype=all/all
  provides a complete list for a given hour
IPsets as indices

• For each flow file, we create IPsets for its source and destination addresses and a union containing both.

• Now, questions like
  “Which, if any, of the hourly files contains data with:
    a) Source IP == aaa.bbb.ccc.ddd or
    b) Destination address == mmm.nnn.ooo.ppp or
    c) Either source or destination address == www.xxx.yyy.zzz”

and IPset queries can be answered from the indices.

• Index files are much much smaller than the flow files. Querying indices is much faster than filtering flows, especially when there are a small number of hits and we can avoid reading some flow files.
Automagic index creation

- We observe that flow data usually settles about 30 – 45 minutes after the close of the flow hour.
  - Run a script to create indices on a timed basis.
    - Can be done within the existing framework
    - Refresh if index is out of date (again timed) or
    - Refresh on attempt to use stale index (in access scripts)
  - Make index creation part of the packing process
    - Saves a pass over the data.
    - Index updated with late additions to the flow file.
    - Ensures consistency
    - Requires changes to packing process
Benefits

• Substantial savings in data pulls.
  – No need to pass files without selected IPs
  – Negative answers fast, no data, no waiting
  – Reduced processing and analyst workloads
• Potential for long term studies from indices alone
  – When did we first see www.xxx.yyy.zzz
  – How often are we visited by aaa.bbb.ccc.ddd
  – What sites were active in fff.ggg.0.0/16 in May 09
• Can even aid in “tuple” searches
  – If there is src -> dst traffic, it will be in files where
    src is in the sIPset and dst is in the dIPset.
Possible Improvements / Extensions

• External IP set representation can be made much more compact allowing faster queries.
  – Set / Bag union / intersection can be streamed. Avoid building structures in memory.
• Consolidated hourly indices can be formed using bags. Up to 64 hourly files searched in 1 stream op.
• Dedicated index servers using large ram / SSD for processing recent indices.
• Index hierarchy with hourly, monthly, 5 year indices
  – hourly index detail for protocols, volumes, etc. if deemed useful.
Current Status

• Currently have
  – An indexing script available on the analysis servers
  – A script for constructing repository queries using indexes

• We have 9 sensors, 4 flowtypes = 36 files/hour
  – being able to skip 2 files pays for the index search
  – big payoff most of the time based on limited trial

• Near-term goals
  – Deploy an automated tool for parsing IP address information out of SNORT alerts
Parsing Snort Alerts Automatically
Configuration Capability

- Tuning to what the analyst actually cares about
  - System ignores all alerts it is not explicitly configured to handle

- Automation will be configurable through a web interface
  - Filtering based on fields within the alert
Conclusions

• Indexing of flow is effective and inexpensive.
• For a large class of queries, it can significantly reduce query time by eliminating files from consideration.
• Everything can be done within the SiLK framework

but

• Some reorganization of the data and improvements in the tools (more efficient data structures, tool approaches, multi-key sets) could make things much better.
• Routine indexing of \{sip,dip\}, ports, protocols and of size, rate, frequency, etc., distributions with graphical presentation (RDD tool?) would be a big plus.
Questions

Talk to me!
I’ll be around through Thursday noon
You can reach me through RedJack