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VISUAL HUNTING WITH LINKED DATA

ABOUT ME

Security Architect at Sqrrl. Research areas include threat intelligence, security analytics and the art & science of hunting.

15 years of detection & response experience in government, research, educational and corporate arenas.

A founding member of a Fortune 5's CIRT. Spent 5 years helping to build a global detection & response capability (500+ sensors, 5PB PCAP, 4TB logs/day).

AGENDA

What is Linked Data?

Why use Linked Data Analysis for Hunting?

Deriving Insights from Visualization

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WHAT IS LINKED DATA?

WHAT IS LINKED DATA?

“[…] a method of publishing structured data so that it can be interlinked and become more useful through semantic queries.”

Source: http://en.wikipedia.org/wiki/Linked_data, last checked May 2015

I DIDN'T QUITE CATCH THAT

Can you say it in English this time, please?

Data with connections to other data embedded in it, either implicitly or explicitly.

IMPLICIT LINKS ARE INFERRED

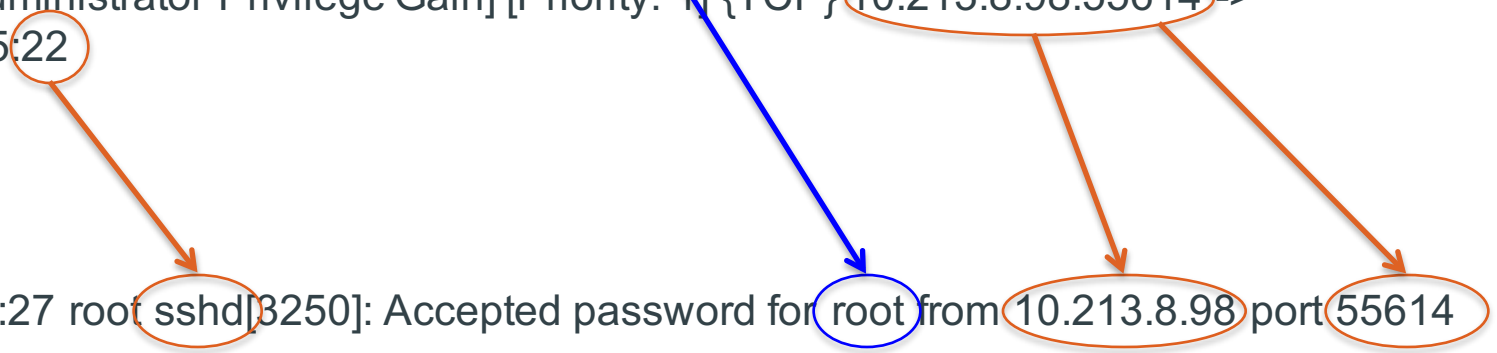
05/15/2015-16:50:27.725288 [**] [1:608273:1] Root logon detected [**] [Classification: Successful Administrator Privilege Gain] [Priority: 1] {TCP} 10.213.8.98:55614 -> 10.192.91.135:22

May 15 16:40:27 root sshd[3250]: Accepted password for root from 10.213.8.98 port 55614 ssh2

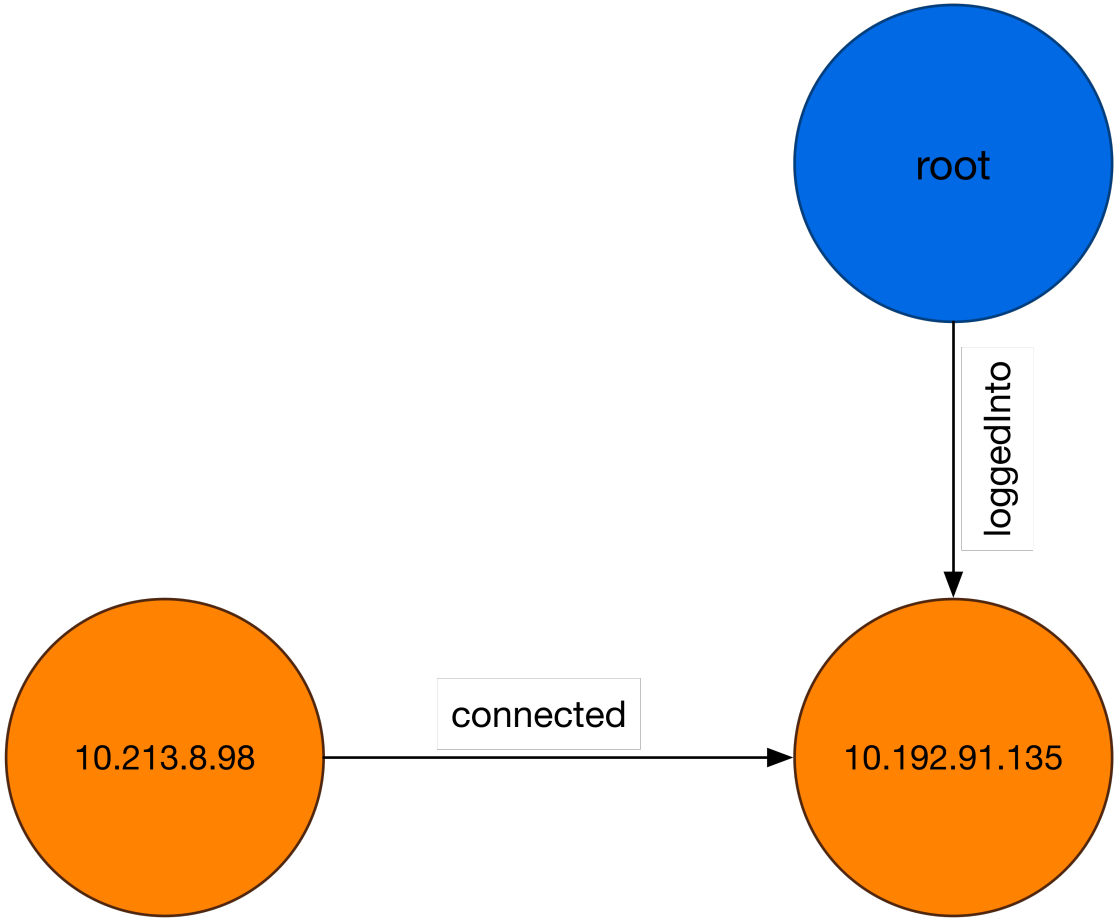
IMPLICIT LINKS ARE INFERRED

05/15/2015-16:50:27.725288 [**] [1:608273:1] Root logon detected [**] [Classification: Successful Administrator Privilege Gain] [Priority: 1] {TCP} 10.213.8.98:55614 -> 10.192.91.135:22

May 15 16:40:27 root sshd[3250]: Accepted password for root from 10.213.8.98 port 55614 ssh2



IMPLICIT LINKAGE



EXPLICIT LINKS ARE STATED

1999-03-29T13:01:38-0500 Fz892b2SFbpSayzLyl 172.16.113.204 194.7.248.153 Cr4RV91FD8iPXBuoT6 SMTP 1 MD5 text/x-c - 0.000000 T F 1522 - 0 0 F - 6d01739d1d56c64209098747a5756443 - - -

1999-03-29T13:01:38-0500 Cr4RV91FD8iPXBuoT6 194.7.248.153 1027 172.16.113.204 25 1 delta.peach.mil <hamishs@delta.peach.mil><tierneyr@goose.eyrie.af.mil> Mon, 29 Mar 1999 08:01:38 -0400 - tierneyr@goose.eyrie.af.mil - <19990329080138.CAA2048> - Phonetics software Tech, - (from mail@localhost) by delta.peach.mil (SMI-8.6/SMI-SVR4)\x09id: CAA2048; Mon, 29 Mar 1999 08:01:38 -0400 - 250 Mail accepted 172.16.113.204,194.7.248.153 - F Fz892b2SFbpSayzLyl F

1999-03-29T13:01:38-0500 Cr4RV91FD8iPXBuoT6 194.7.248.153 1027 172.16.113.204 25 tcp smtp 0.113325 1923 336 SF ShAdDafF 13 2447 12 820 (empty)

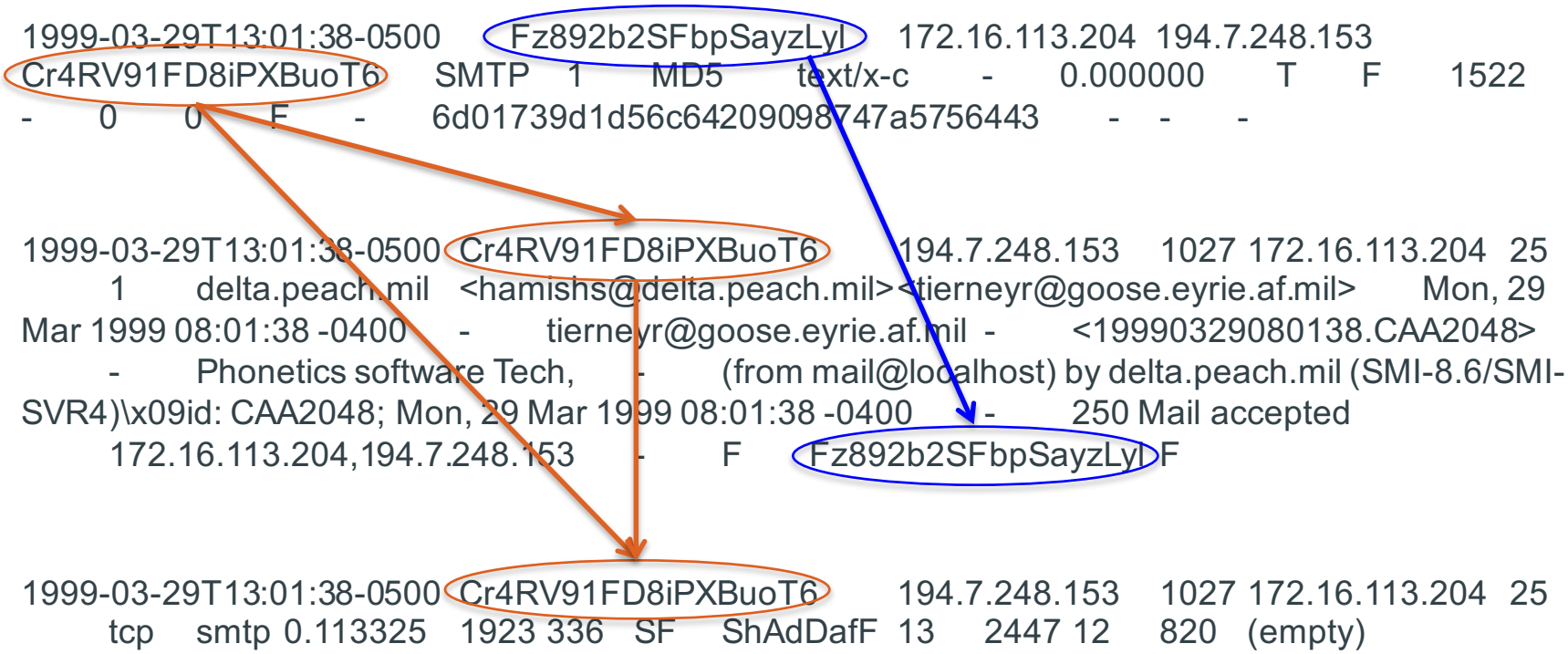
EXPLICIT LINKS ARE STATED

1999-03-29T13:01:38-0500 Fz892b2SFbpSayzLyl 172.16.113.204 194.7.248.153 Cr4RV91FD8iPXBuoT6 SMTP 1 MD5 text/x-c - 0.000000 T F 1522 - 0 0 F - 6d01739d1d56c64209098747a5756443 - - -

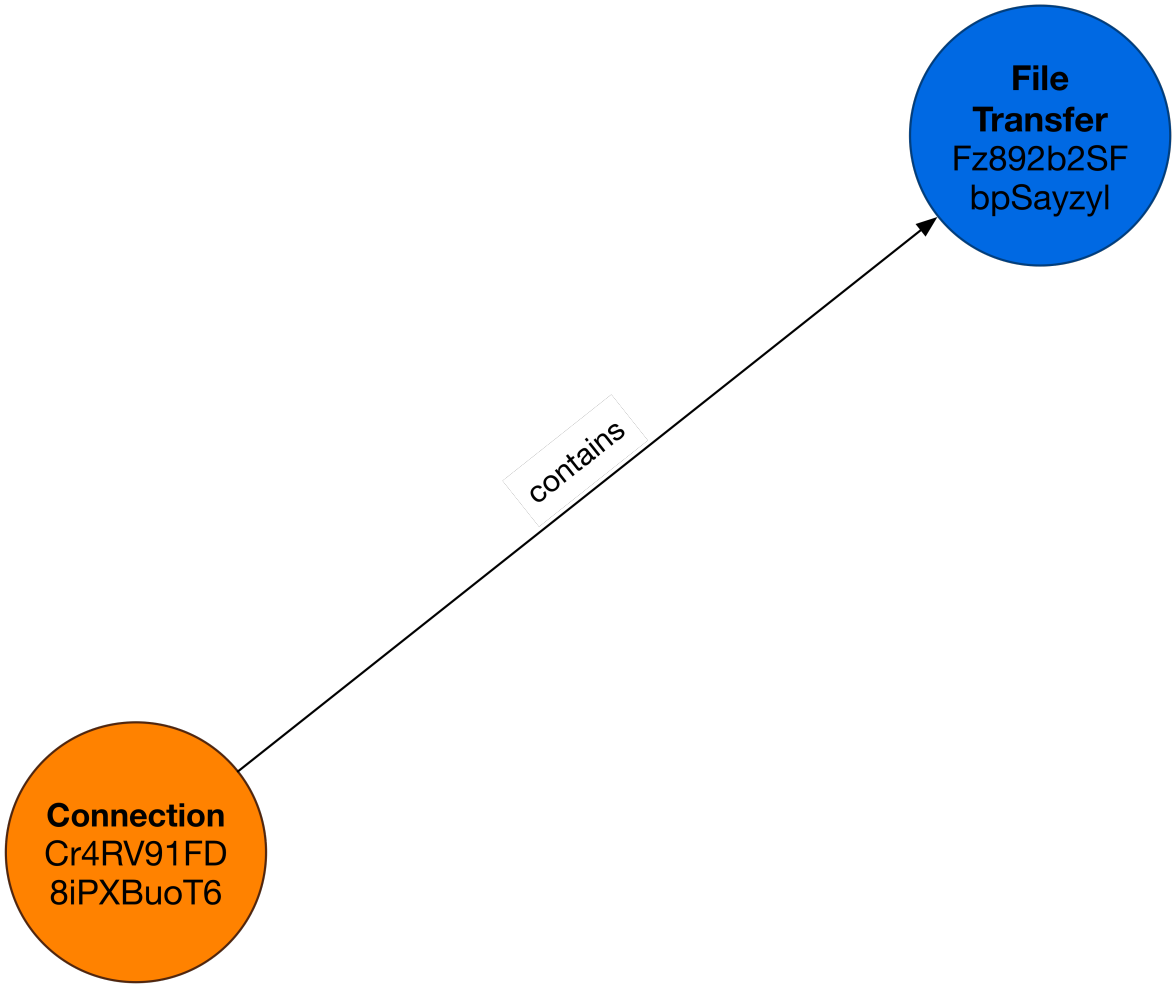
1999-03-29T13:01:38-0500 Cr4RV91FD8iPXBuoT6 194.7.248.153 1027 172.16.113.204 25 1 delta.peach.mil <hamishs@delta.peach.mil><tierneyr@goose.eyrie.af.mil> Mon, 29 Mar 1999 08:01:38 -0400 - tierneyr@goose.eyrie.af.mil - <19990329080138.CAA2048> - Phonetics software Tech, - (from mail@localhost) by delta.peach.mil (SMI-8.6/SMI-SVR4)\x09id: CAA2048; Mon, 29 Mar 1999 08:01:38 -0400 - 250 Mail accepted 172.16.113.204,194.7.248.153 - F Fz892b2SFbpSayzLyl F

1999-03-29T13:01:38-0500 Cr4RV91FD8iPXBuoT6 194.7.248.153 1027 172.16.113.204 25 tcp smtp 0.113325 1923 336 SF ShAdDafF 13 2447 12 820 (empty)

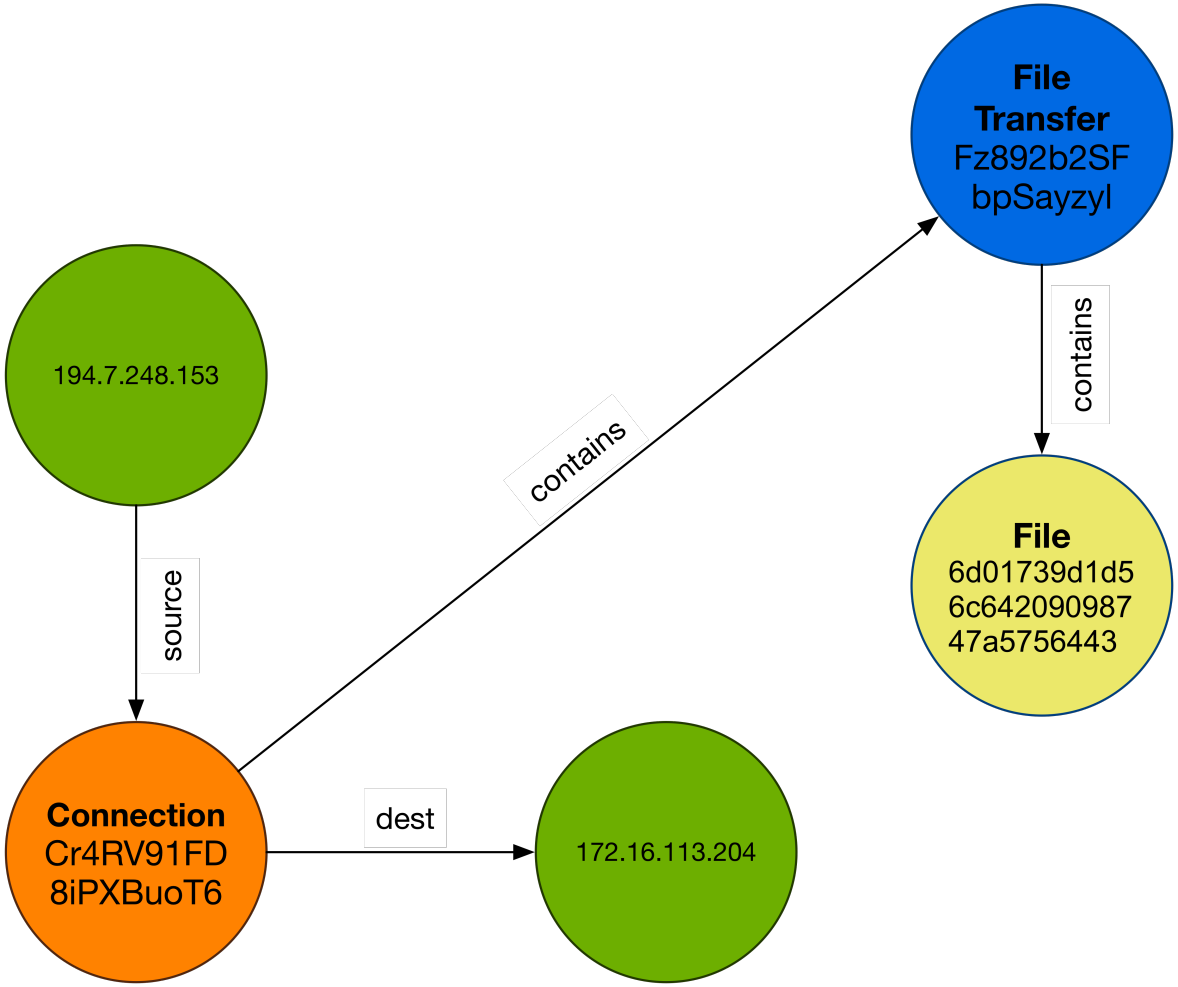
EXPLICIT LINKS ARE STATED



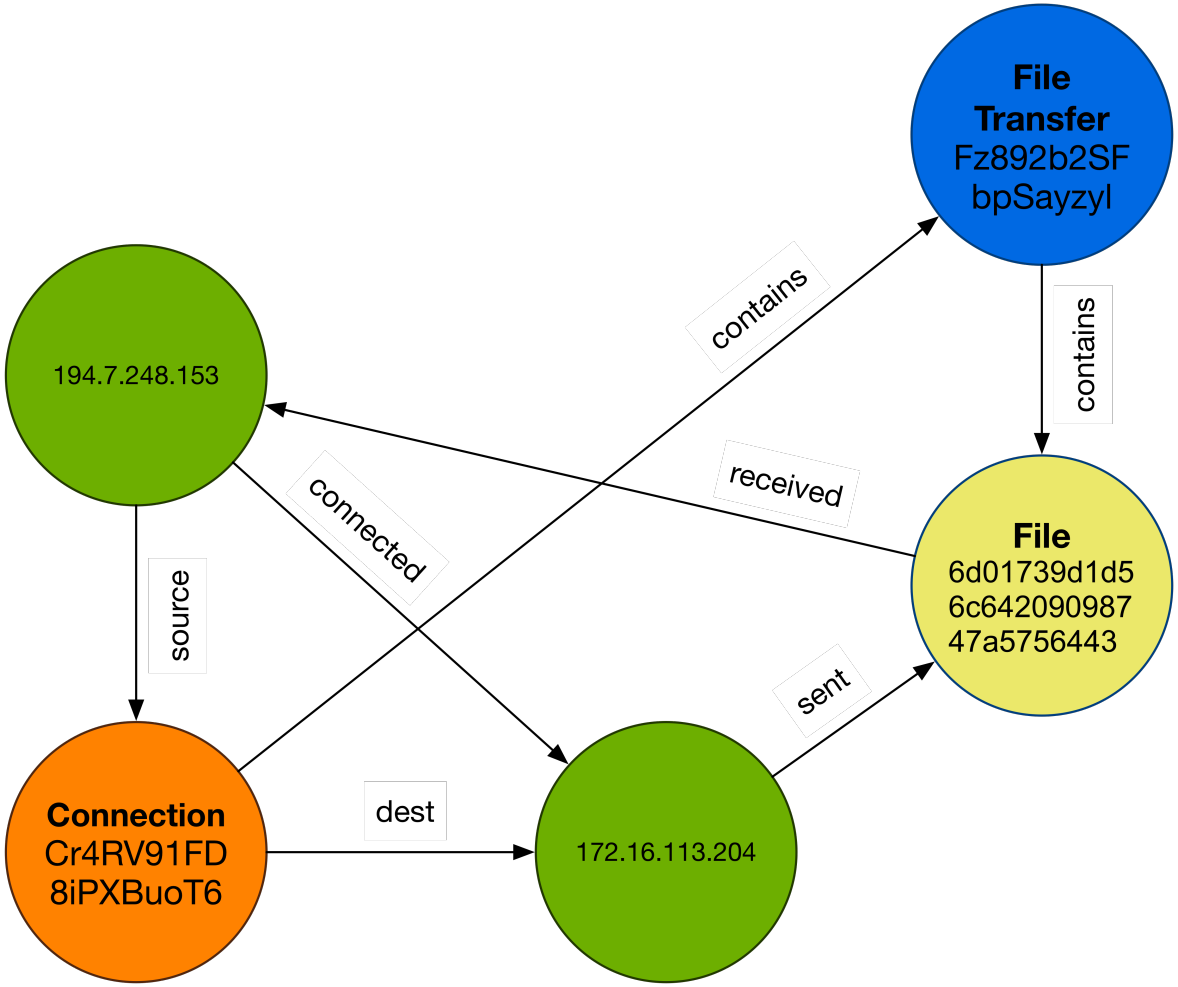
MODELING THE DATA



MODELING THE DATA



TRANSITIVE CLOSURE



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WHY USE LDA FOR HUNTING?

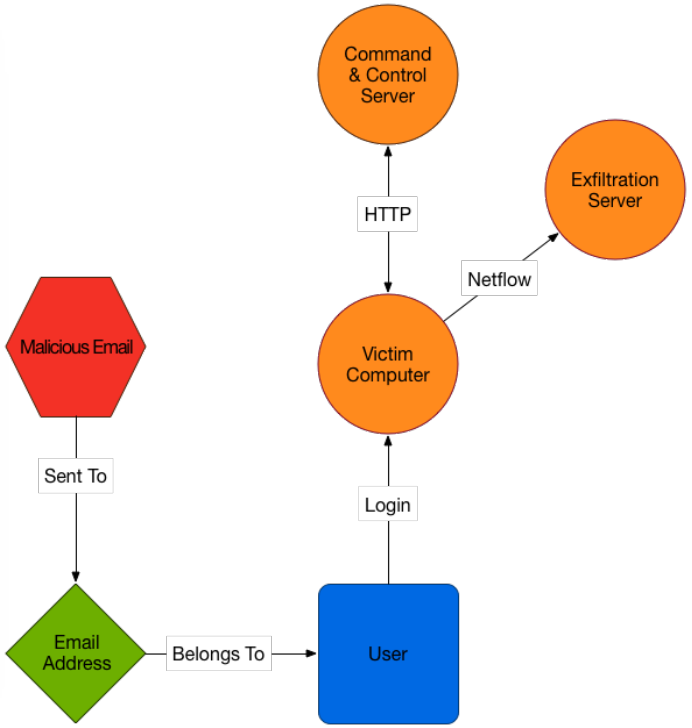
HOW YOU'RE PROBABLY DOING IT NOW
Row-oriented techniques get you only so far

```
Davids-MacBook-Pro-2:/Users/bianco/temp> grep 6d01739d1d56c64209098747a5756443 *.log
files.log:922712498.188977      Fz892b2SFbpSayzLyl      172.16.113.204  194.7.248.153
        Cr4RV91FD8iPXBuoT6      SMTP 1  MD5,SHA1        text/x-c        0.000000        T       F       1522    -       0
        0       F       -       6d01739d1d56c64209098747a57564430d1c6b7dcc82b05c719d4cc9dd8d8577e8cb36cb
        -
Davids-MacBook-Pro-2:/Users/bianco/temp> grep Cr4RV91FD8iPXBuoT6 *.log
conn.log:922712498.086765       Cr4RV91FD8iPXBuoT6      194.7.248.153   1027    172.16.113.204  25      tcp
        smtp    0.113325        1923    336     SF      ShAdDafF        13      2447    12      820     (empty)
files.log:922712498.188977      Fz892b2SFbpSayzLyl      172.16.113.204  194.7.248.153
        Cr4RV91FD8iPXBuoT6      SMTP 1  MD5,SHA1        text/x-c        0.000000        T       F       1522    -       0
        0       F       -       6d01739d1d56c64209098747a57564430d1c6b7dcc82b05c719d4cc9dd8d8577e8cb36cb
        -
smtp.log:922712498.119932       Cr4RV91FD8iPXBuoT6      194.7.248.153   1027    172.16.113.204  25      1
        delta.peach.mil <hamishs@delta.peach.mil>       <tierneyr@goose.eyrie.af.mil>   Mon, 29 Mar 1999
08:01:38 -0400  -       tierneyr@goose.eyrie.af.mil     -       <19990329080138.CAA2048>        -       Phonetics
software Tech,  -       (from mail@localhost) by delta.peach.mil (SMI-8.6/SMI-SVR4)\x09id: CAA2048; Mon, 29
Mar 1999 08:01:38 -0400 -       250 Mail accepted       172.16.113.204,194.7.248.153    -       F
        Fz892b2SFbpSayzLyl      F
```

LINKED DATA ANALYSIS (LDA)

Different techniques, different perspectives

```
Terminal — tcsh — 80×24
Davids-MacBook-Pro-2:/Users/bianco/temp> cat conn.log | bro-cut -d | grep 172.16
.112.100 | head -7
1999-03-29T08:04:24-0500        CIraWsmNr6FfQnoN4       197.218.177.69  1207    1
72.16.112.100   25      tcp     smtp    0.079181        8789    243     SF      S
hAdDaFf 18      9513    14      807     (empty)
1999-03-29T08:06:03-0500        CJPYgv2yRihidyJfMj      197.182.91.233  1215    1
72.16.112.100   25      tcp     smtp    0.071476        876     244     SF      S
hAdDFaf 12      1360    11      688     (empty)
1999-03-29T08:10:07-0500        CZfV5S2A27ehEoAANk      197.218.177.69  1681    1
72.16.112.100   25      tcp     smtp    0.204133        1372    245     SF      S
hAdDaFf 13      1896    12      729     (empty)
1999-03-29T08:11:38-0500        CcEiS51qFZdVwo9Ch7      194.7.248.153   2100    1
72.16.112.100   25      tcp     smtp    0.226013        4357    243     SF      S
hAdDaFf 15      4961    13      767     (empty)
1999-03-29T08:12:10-0500        CH3KYt2602LaqpHSXj      196.227.33.189  2104    1
72.16.112.100   25      tcp     smtp    0.272825        4275    243     SF      S
hAdDaFf 15      4879    13      767     (empty)
1999-03-29T08:14:31-0500        Cyffo12ohJirmLxY7       195.115.218.108 2113    1
72.16.112.100   25      tcp     smtp    0.073653        2953    245     SF      S
hAdDaFf 14      3517    12      729     (empty)
1999-03-29T08:14:52-0500        CG5wlSu93zWh6PWy5       197.182.91.233  2120    1
72.16.112.100   25      tcp     smtp    0.086192        3633    247     SF      S
hAdDaFf 14      4197    12      731     (empty)
Davids-MacBook-Pro-2:/Users/bianco/temp>
```

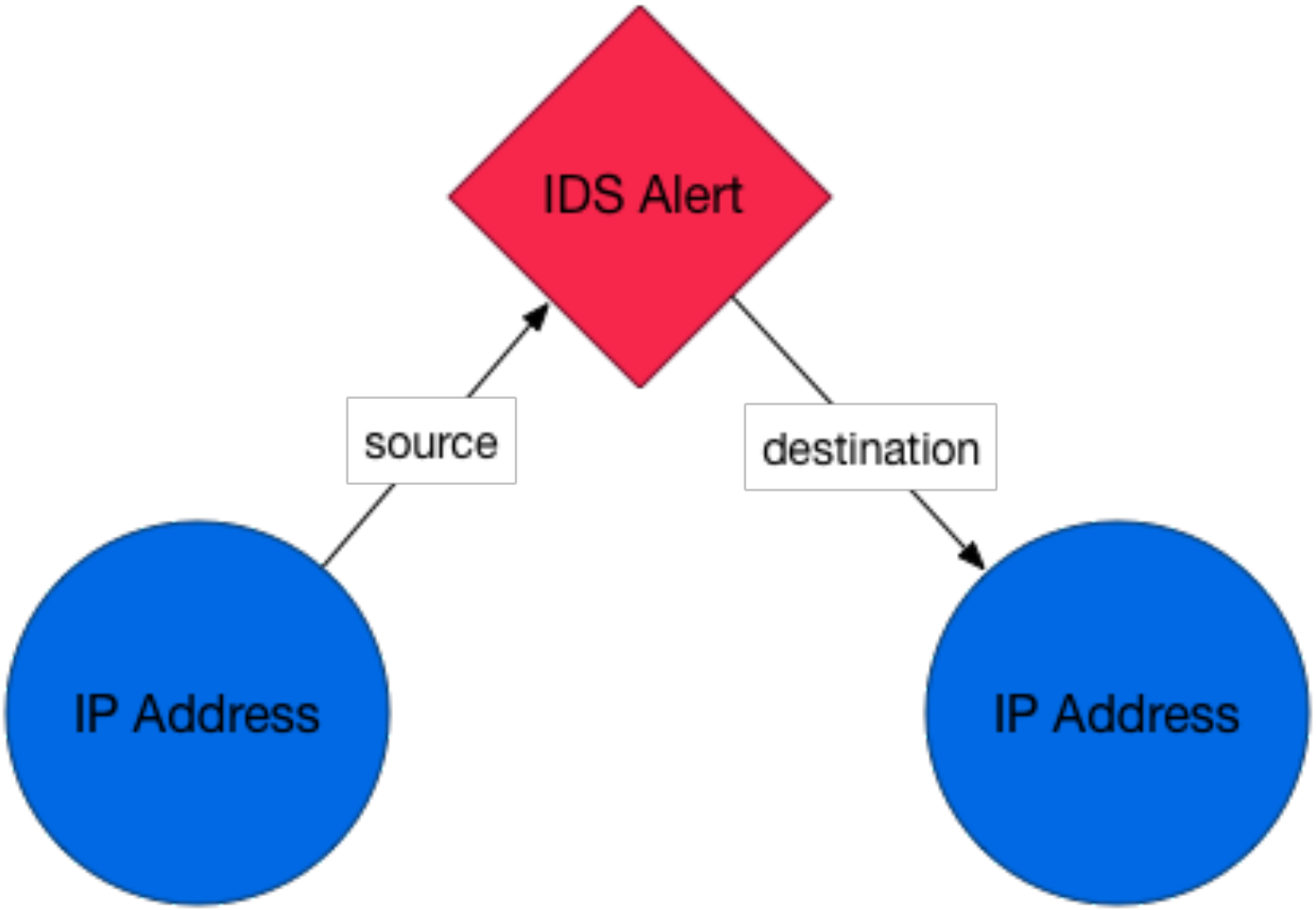


ROW TECHNIQUES VS. LDA

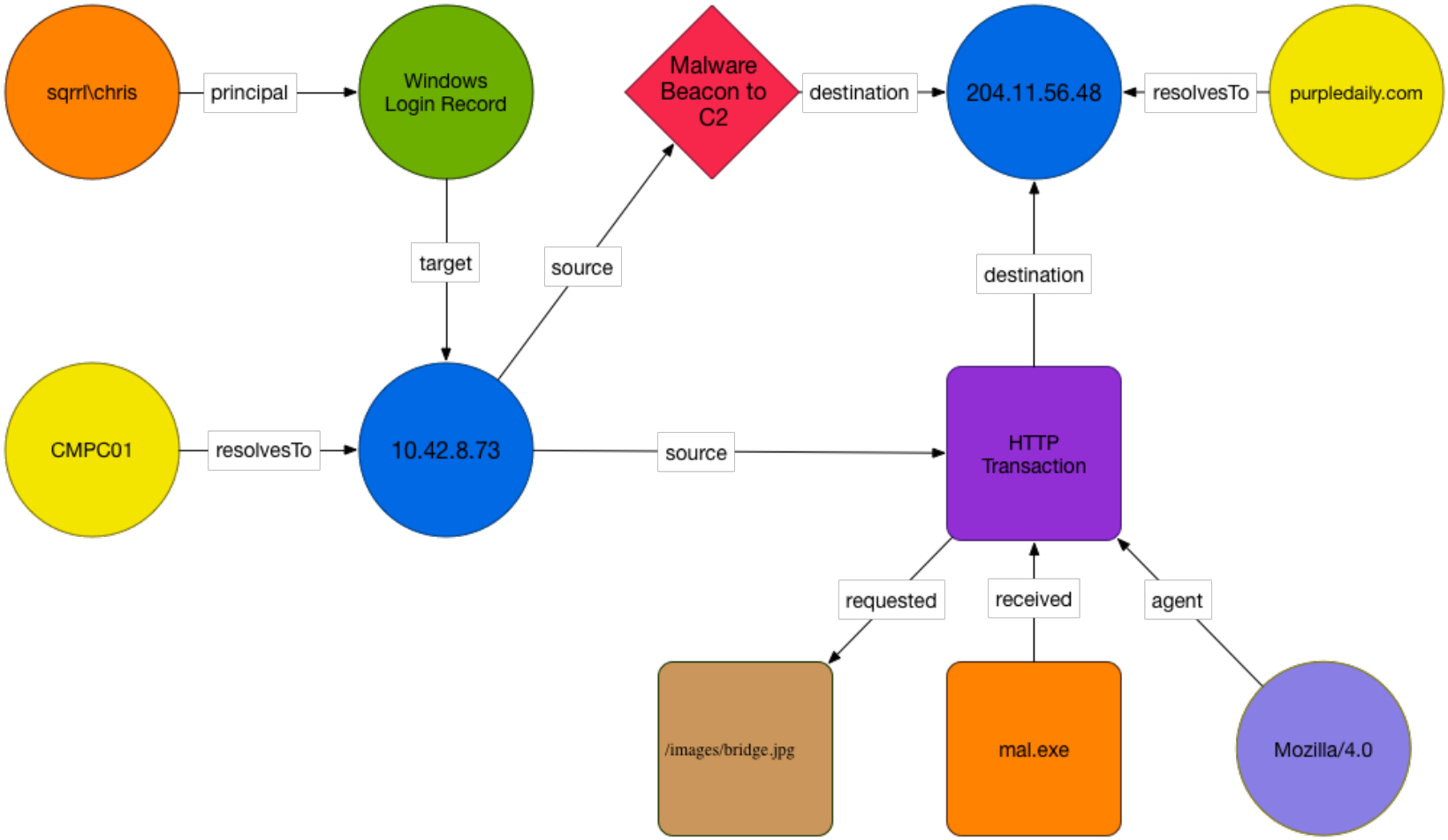
Row Oriented Analysis
Operates on individual events Many existing toolsets (grep/awk, ELSA, Splunk, ELK stack, etc) Hard to see the big picture Limited pivoting ability Best for searching, counting and extracting detailed proof of events

Linked Data Analysis
Aggregates data into entities and relationships Visual representation promotes understanding of the data Apply specialized graph algorithms: • Search for “patterns” in a graph • Identify important nodes with betweenness, page rank, etc. • Path finding (“auto-pivot++”)

A TYPICAL IDS/SIEM ALERT



EXISTING LINKS SHOW CONTEXT



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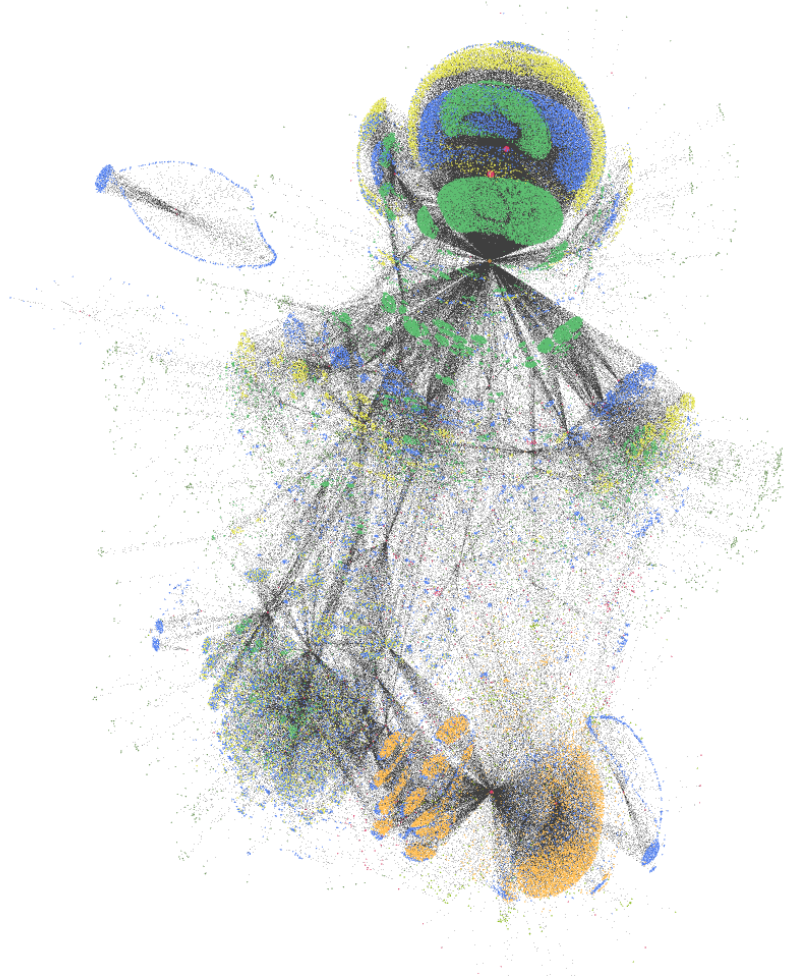
DERIVING INSIGHTS FROM VISUALIZATION

A WORD ABOUT PROCESS

To replicate this at home, you will need…

DARPA99 Challenge Data	http://www.ll.mit.edu/ideval/data/1999data.html
Bro Network Analysis Platform	https://www.bro.org
Bro2Graph Scripts	https://github.com/DavidJBianco/Bro2Graph
Rexster Graph DB	https://github.com/tinkerpop/rexster/wiki
Bulbflow Python API	http://bulbflow.com/
	pip install bulbs
Gephi	https://gephi.github.io/
	Be sure to get the “Give Colors To Nodes” and “Graph Streaming” Plugins!

FIRST TRY: GRAPH ALL THE THINGZ!!



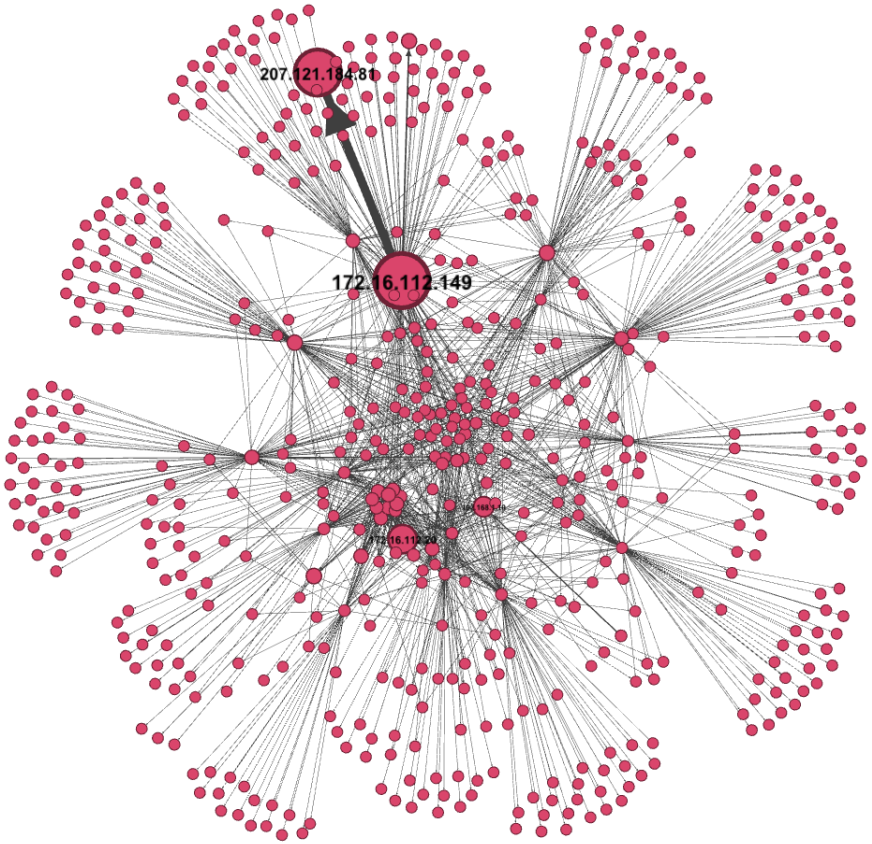
Nodes are color coded, so you can begin to see a few hints based on colors and structures.

There are some obvious hubs of activities, some strongly associated with certain colors.

This gets messy quickly! Best to restrict it to a specific network sensor, subnet, types of nodes, etc.

Graphing multiple node types against each other is often interesting.

JUST THE HOSTS



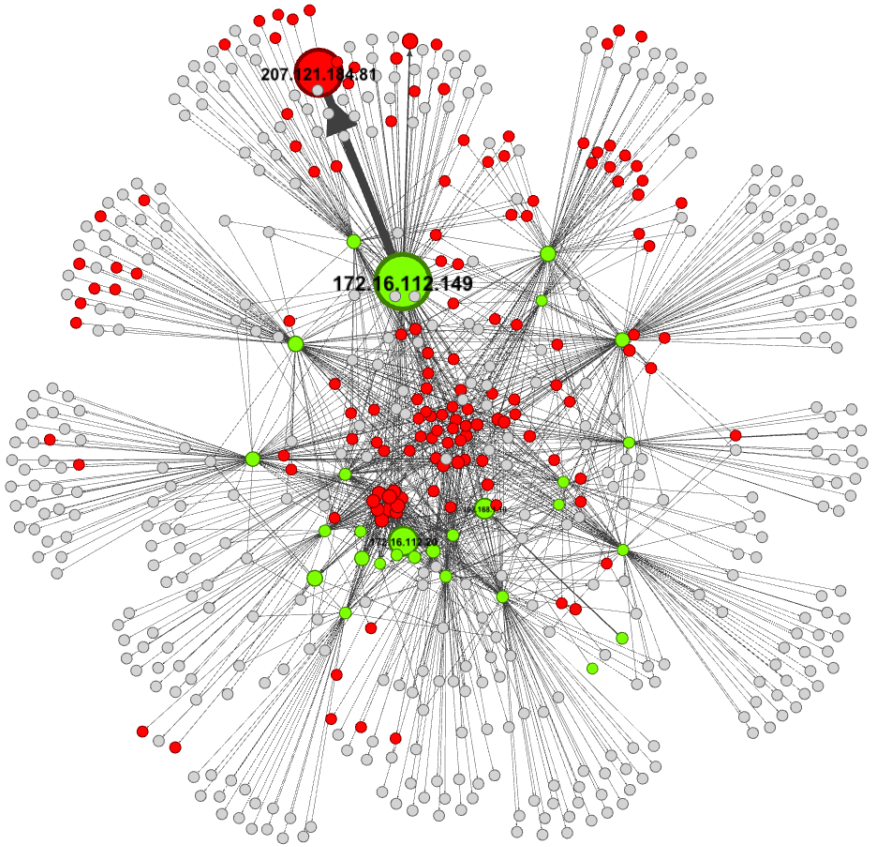
Interesting features start to appear!

Nodes are hosts present in your logs.
Edges denote some sort of connection.
Sizes denote rank.

See those two big hosts with the fat edge between them? What's that about?

All the hosts are the same color, though. Can we show the local vs. the remote hosts?

STILL HOSTS, BUT MORE CONTEXT



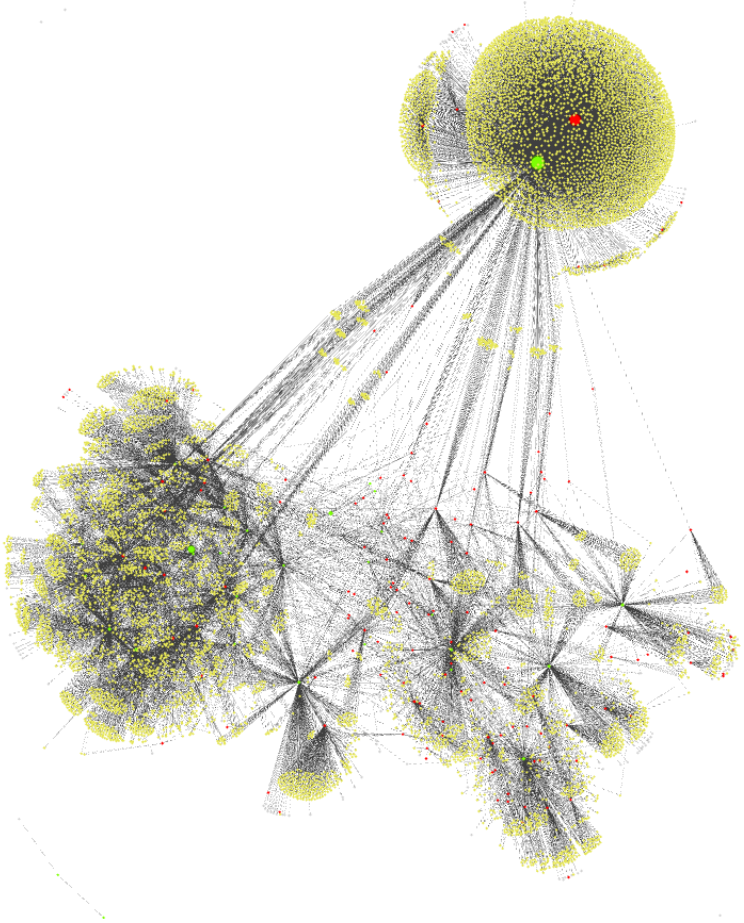
Bro tells us which hosts it knows are local (green), which it knows are not (red). Anything else is unknown (grey) but mostly not local.

Those big two hosts? They tell a bit more of a story now, don't they?

There are a *lot* of connections from the 172.16.112.149 system to that 207.121.184.81 Internet host.

Maybe check that one out first.

EXAMINING HOSTS & FILES

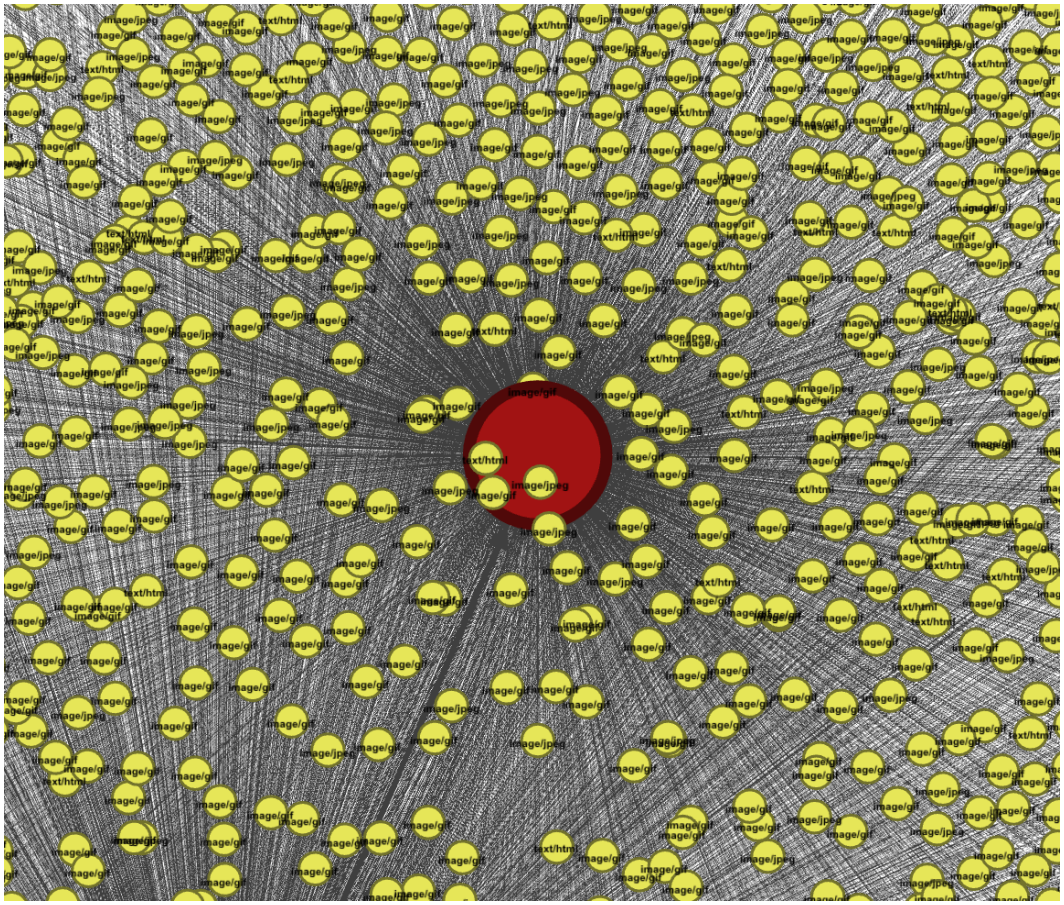


Adding file nodes to the graph also shows some interesting relationships.

Those same two hosts now make a dandelion shape.

What are those files?

EXTREME CLOSEUP



Zooming in starts to make things more clear.

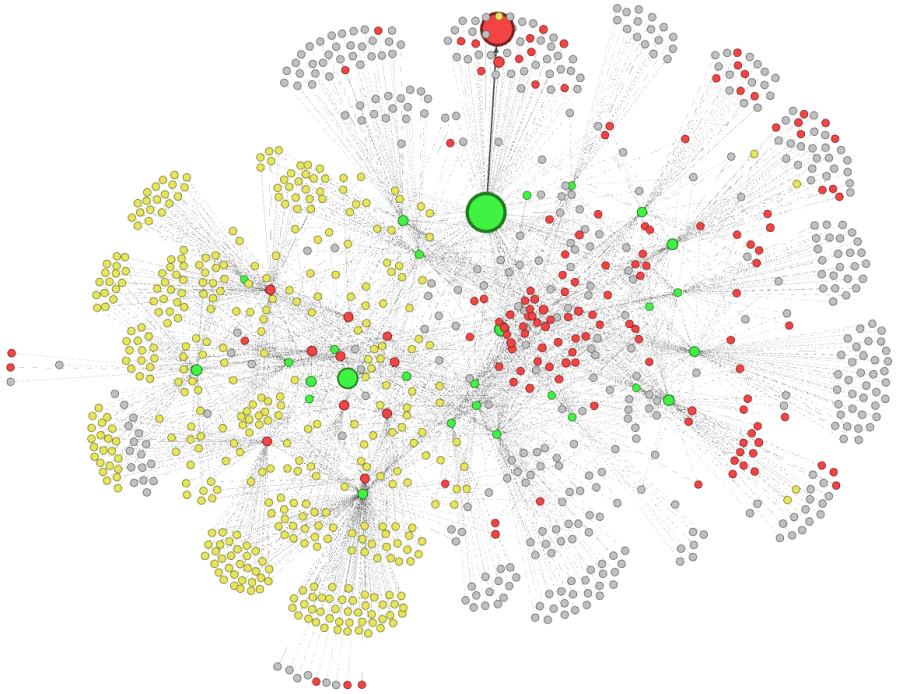
Lots of images, a few HTML pages…

This is probably all web traffic!

The thick “connectedTo” edge shows lots of HTTP transactions initiated by the internal node.

Directions on the files show they are responses from the server.

FILTER TO SIMPLIFY THE GRAPH



Normal web traffic in this graph is highly likely to be legitimate, so filter it out.

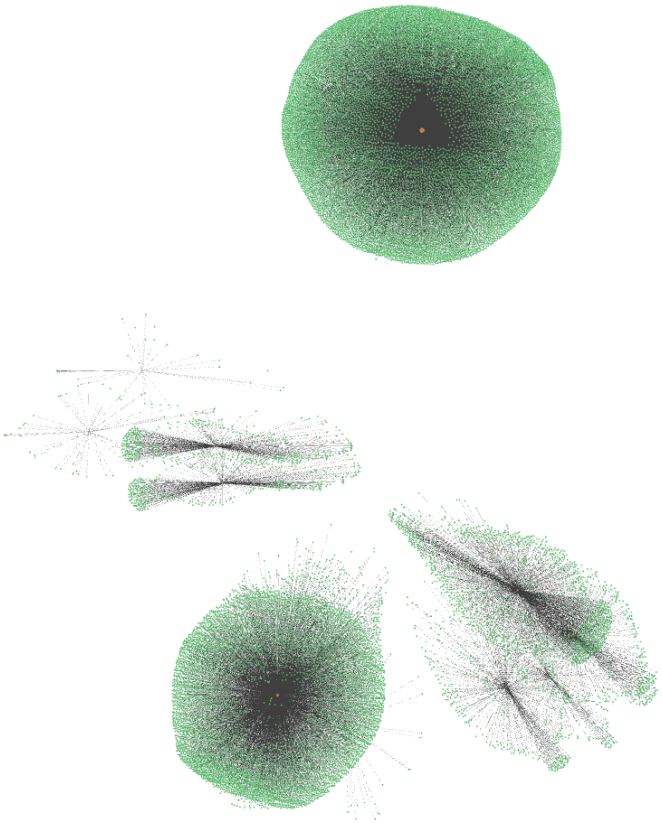
What's left is **much** simpler.

We don't have time for a full investigation here, but follow the same process:

Dig into some of those clusters
Filter out the known good

If there's anything left, it's pretty suspicious!

BONUS: USER AGENTS IN USE



Green nodes are individual HTTP transactions. Brown ones are specific HTTP User-Agent strings.

In theory, most users have similar computers & software, so most will have similar UAs.

We expect to see a few big groups. It's the small groups you want to focus most on (unless you think you have a big malware problem).

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CONCLUSION

QUESTIONS?

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