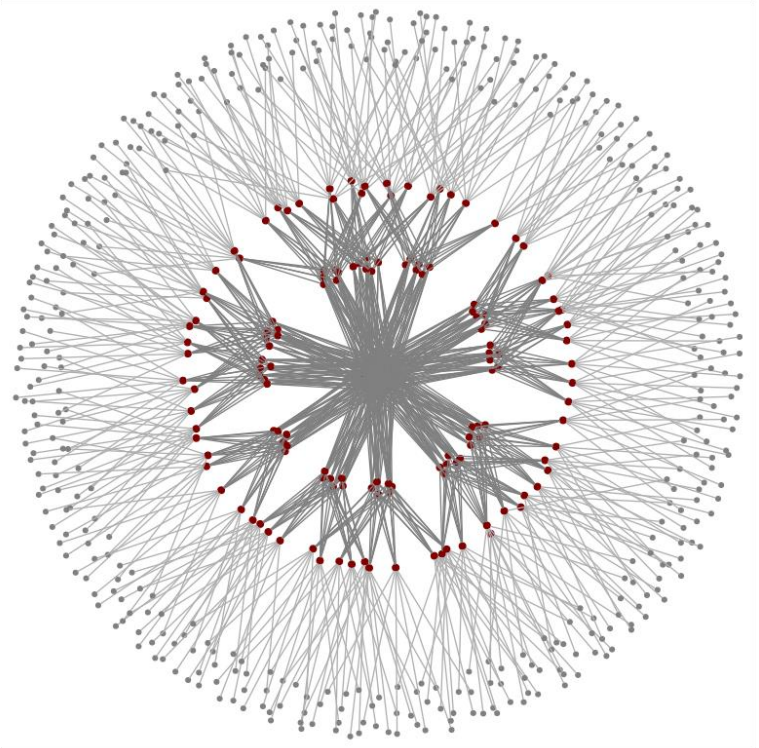
HAWKEYE

PERFORMANCE MONITORING FOR DATA CENTERS



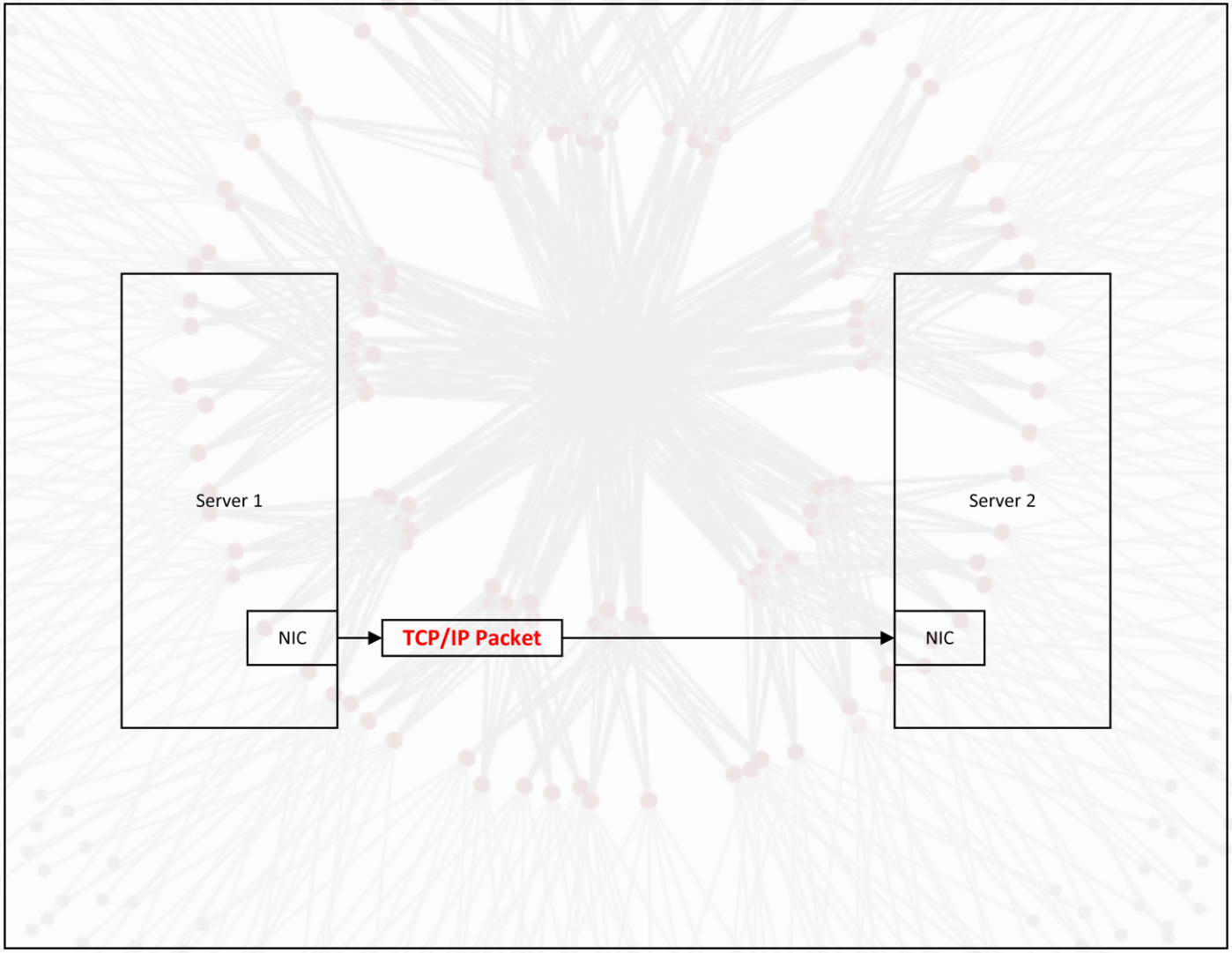
SHABBIR SUTERWALA

INSIGHT DE FELLOW

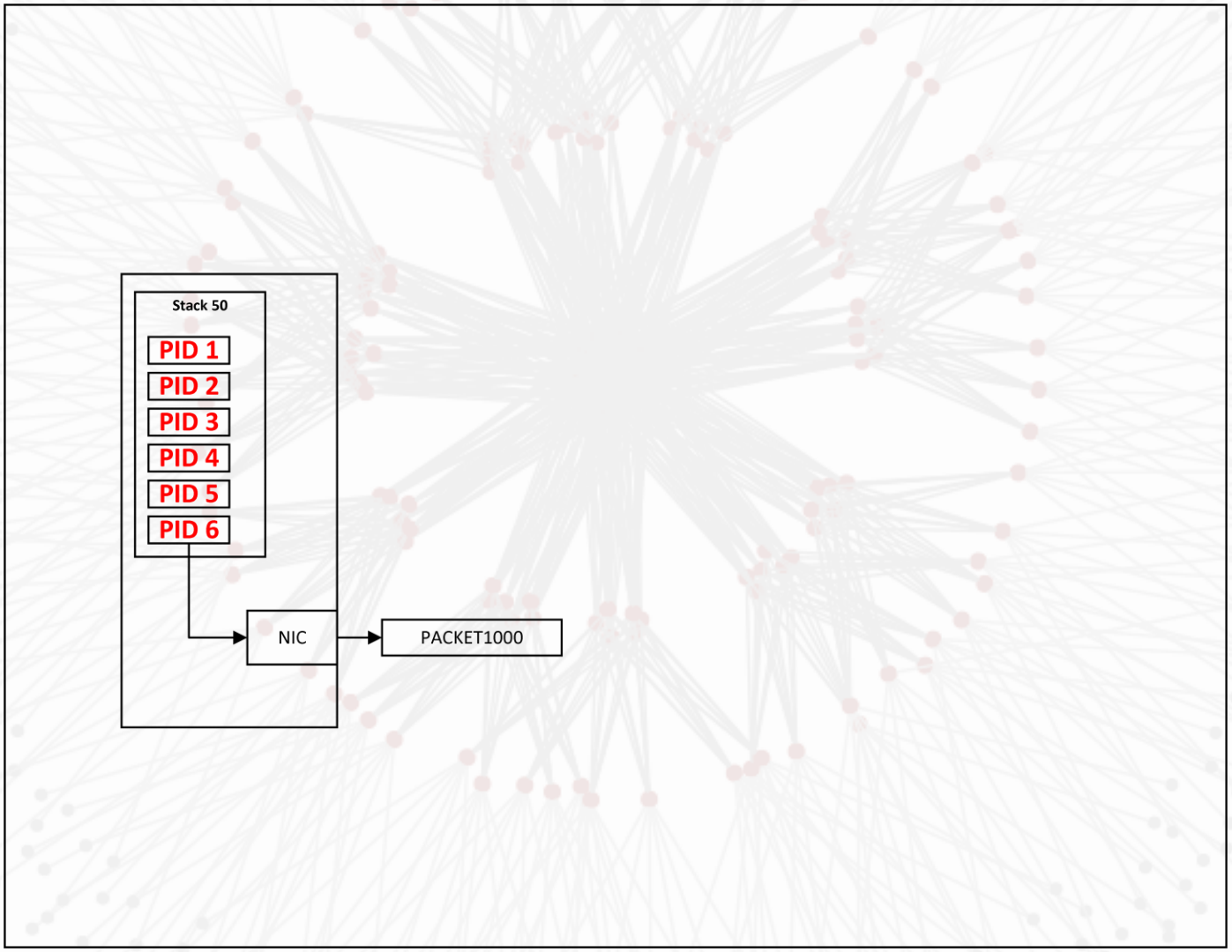
HAWKEYE – USE CASES

- Analyze over or under performance
- Preemptively reorganize cluster
  - Load balance
  - Capacity planning
  - MTBF stats
  - Power consumption
  - Scheduled batch jobs
- At second's time window

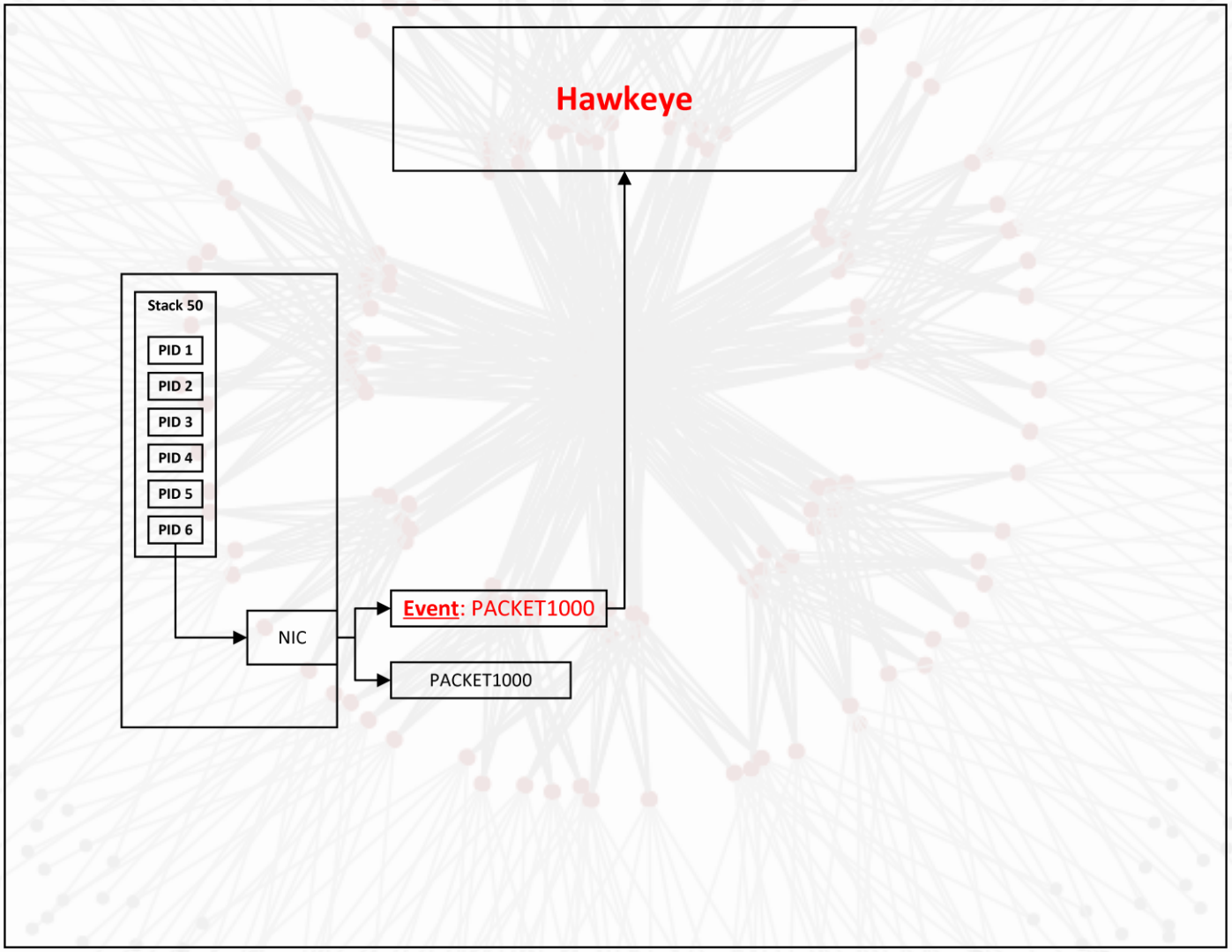
HAWKEYE - APPROACH



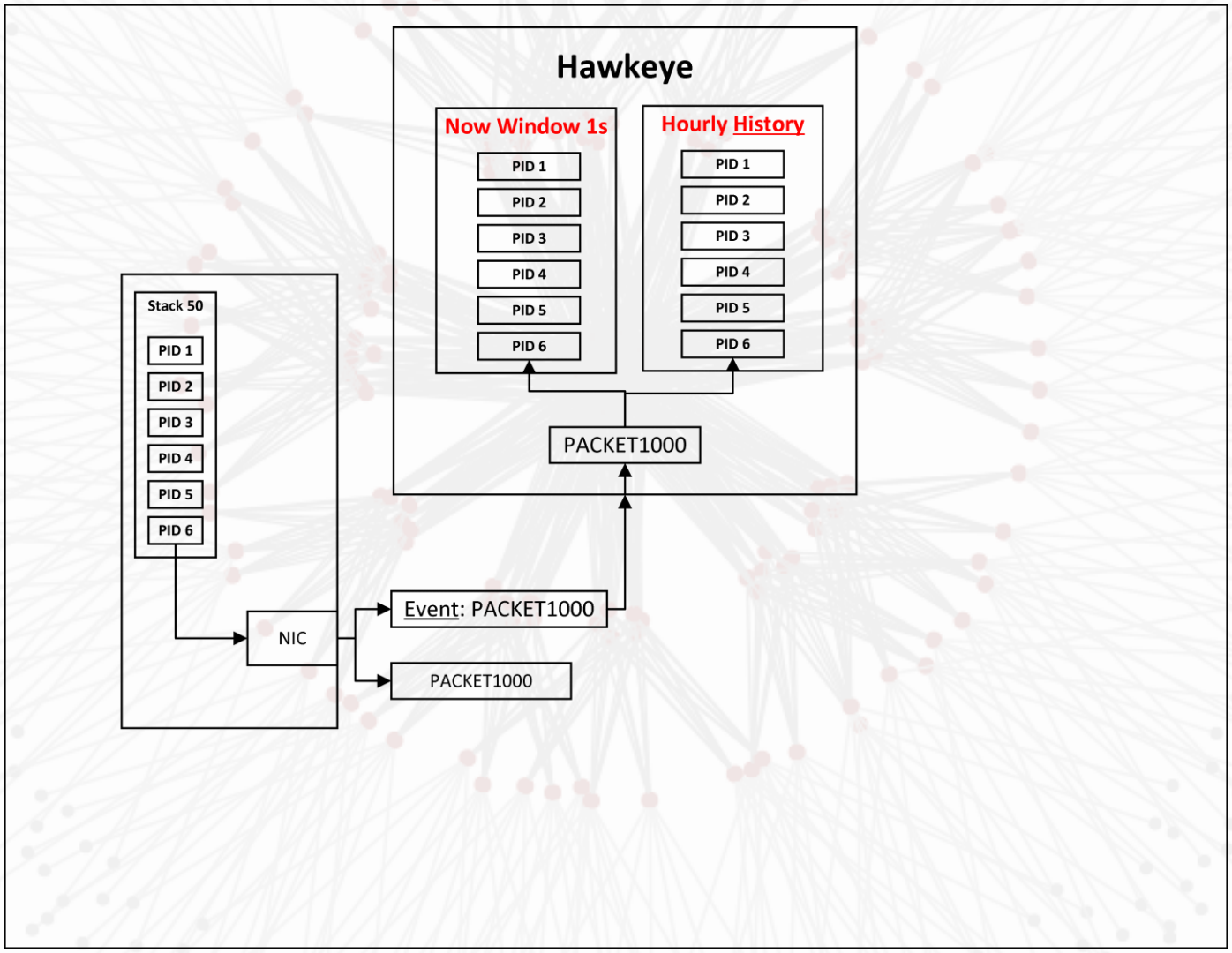
HAWKEYE - APPROACH



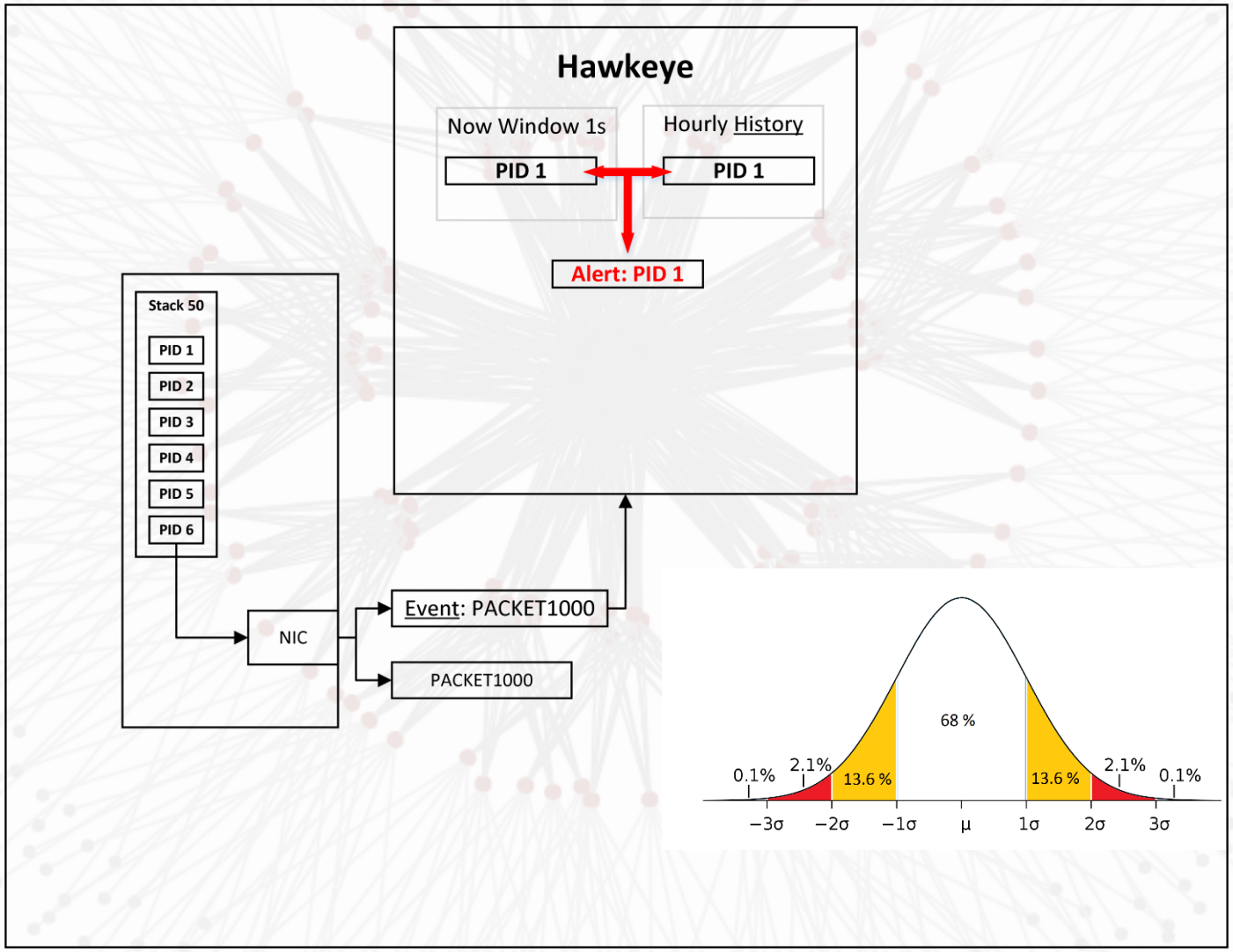
HAWKEYE - APPROACH



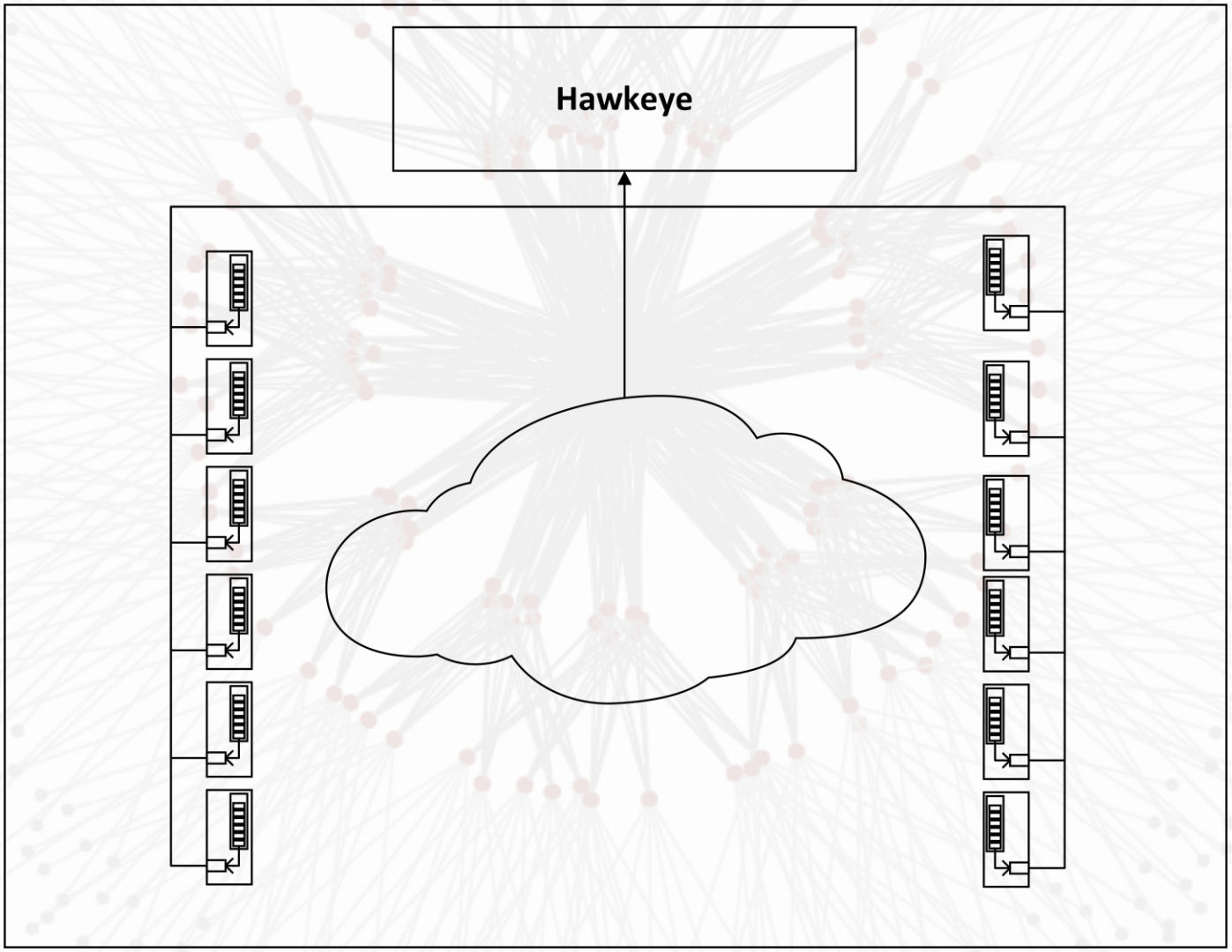
HAWKEYE - APPROACH



HAWKEYE - APPROACH



HAWKEYE - APPROACH



Hawkeye Home Monitors Documentation

Start Stop
Show 10 entries Search:

Monitor	Throughput	Min	0%-5% (-2σ+)	5%-16% (-σ+)	84%-95% (σ+)	95%-100% (2σ+)	Max
hawkeye	49831	49842	49942	49971	50029	50058	50076
kafka	58660	47732	49453	49719	50252	50518	50509
mysql	50185	49018	45943	48251	52867	55176	59898
SWID0	51554	49809	49178	49623	50514	50959	53366
SWID20	59800	NaN	NaN	NaN	NaN	NaN	NaN
TASKID100	59382	48825	48140	49121	51082	52063	51200
TASKID20	52121	45721	46267	48166	51966	53865	55837
TASKTYPE100	66414	46820	48792	49400	50614	51222	52595
TASKTYPE20	41742	49765	49201	50096	51885	52780	52238
Monitor	Throughput	Min	0%-5% (-2σ+)	5%-16% (-σ+)	84%-95% (σ+)	95%-100% (2σ+)	Max

Showing 1 to 9 of 9 entries Previous 1 Next

Start Stop Show alerts in last 10 seconds
Show 10 entries Search:

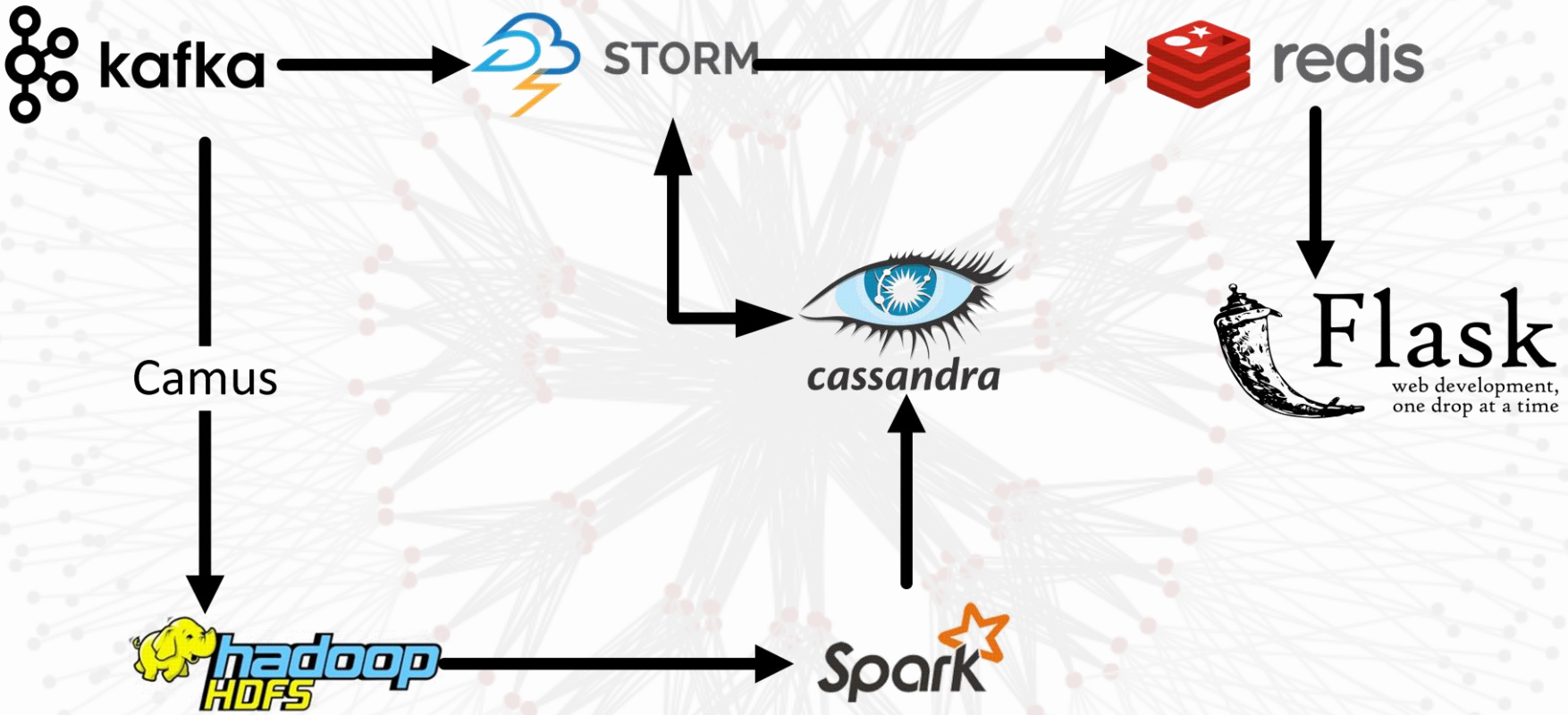
Alert	Sev	Time	Throughput	Min	0%-5% (-2σ+)	5%-16% (-σ+)	84%-95% (σ+)	95%-100% (2σ+)	Max
SWID0	red	Fri, 12 Feb 2016 23:14:33 GMT	42802	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:14:20 GMT	40684	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:14:12 GMT	46616	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:12:53 GMT	45195	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:09:48 GMT	57062	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:09:38 GMT	52507	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:09:37 GMT	51056	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:06:11 GMT	46921	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 23:00:44 GMT	41329	49809	49178	49623	50514	50959	53366
SWID0	red	Fri, 12 Feb 2016 22:59:54 GMT	58190	49809	49178	49623	50514	50959	53366
Alert	Sev	Time	Throughput	Min	0%-5% (-2σ+)	5%-16% (-σ+)	84%-95% (σ+)	95%-100% (2σ+)	Max

Showing 1 to 10 of 24 entries Previous 1 2 3 Next

DATA – 5TB / DAY

```
HawkeyeEvent: {
    tsIn:       1453407175613828,       tsOut:    1453407175614662,
    packetID: "PACKET19083“,
    monitorGroup: [
            {type: “T”,     subgroup:“AppType“,    id:“App“,            power: 6},
            {type: “I”,     subgroup: "AppID“,     id: "Hawkeye“,       power: 5},
            {type: “T”,     subgroup: "SwType“,    id: "SWTYPE42“,      power: 4},
            {type: “I”,     subgroup: "SwID“,      id: "SWID20“,        power: 3},
            {type: “T”,     subgroup: "TaskType“,  id: "TASKTYPE21“,    power: 2},
            {type: “I”,     subgroup: "TaskID“,    id: "TASKID154“,     power: 1}
    ]
}
```

PIPELINE

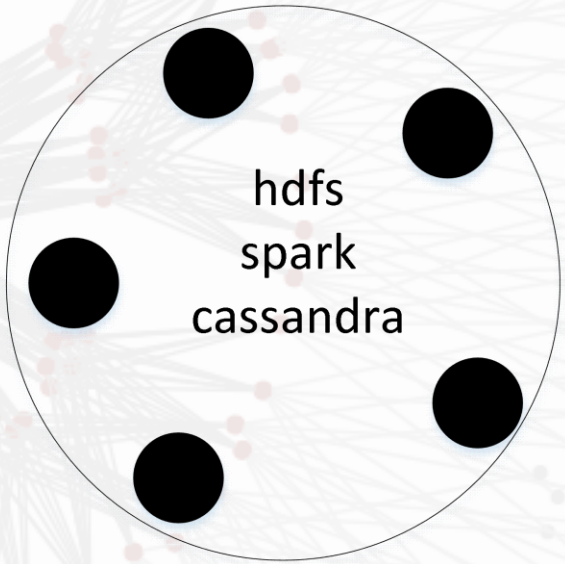

kafka
STORM
redis
Camus
cassandra
Flask
web development,
one drop at a time
hadoop
HDFS
Spark

SCHEMA - SUBSET

```
cqlsh:hawkeye4> select monitor,alert_time_year,alert_time_ms,alert_sev,alert_through from monitor_alerts limit 10;

 monitor     | alert_time_year | alert_time_ms            | alert_sev | alert_through
-------------+-----------------+--------------------------+-----------+---------------
 TASKTYPE906 |            2016 | 2016-02-09 07:42:52+0000 |       red |    56294.5102
 TASKTYPE906 |            2016 | 2016-02-09 07:41:07+0000 |    yellow |   50991.99029
 TASKTYPE906 |            2016 | 2016-02-09 07:40:22+0000 |       red |   53721.05583
 TASKTYPE906 |            2016 | 2016-02-09 07:39:11+0000 |       red |           31199
 TASKTYPE906 |            2016 | 2016-02-09 07:39:10+0000 |       red |   39959.44444
 TASKTYPE906 |            2016 | 2016-02-09 07:39:09+0000 |       red |   39253.16667
 TASKTYPE906 |            2016 | 2016-02-09 07:37:34+0000 |       red |   45606.15385
 TASKTYPE906 |            2016 | 2016-02-09 07:36:15+0000 |       red |   47540.79369
 TASKTYPE906 |            2016 | 2016-02-09 07:34:38+0000 |    yellow |   48636.09091
 TASKTYPE906 |            2016 | 2016-02-09 07:32:20+0000 |       red |   48223.12379

(10 rows)
cqlsh:hawkeye4> select * from monitor_history limit 10;

 monitor     | record_time_year | record_time_ms           | nevents | tdeltaagg | time_window_size_ms
-------------+------------------+--------------------------+---------+-----------+---------------------
 TASKTYPE305 |             2016 | 2016-02-08 11:15:44+0000 |     400 |  20181033 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 11:05:44+0000 |    1237 |  61621326 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:55:44+0000 |    2813 | 139698082 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:45:44+0000 |    1130 |  57024590 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:35:43+0000 |    1868 |  91425185 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:25:43+0000 |     213 |  10622745 |              600000
 TASKTYPE906 |             2016 | 2016-02-09 07:39:42+0000 |    2240 | 110067754 |              600000
 TASKTYPE906 |             2016 | 2016-02-09 07:29:42+0000 |    3046 | 153359384 |              600000
 TASKTYPE906 |             2016 | 2016-02-09 07:19:42+0000 |    1823 |  89980295 |              600000
 TASKTYPE906 |             2016 | 2016-02-09 07:09:42+0000 |    2586 | 128722574 |              600000
```

CLUSTER

10 m4.xlarge
1TB



Instances : $57.36 / 24 hours
Storage : $70 / month

LESSONS LEARNED

- Start with Query
- Invest in a scheduler
- Make the cluster secure from day 0

SHABBIR SUTERWALA

- Team Lead, Architecture / Principal Architect @ Infor
  - Cloverleaf → Ingestion & processing engine for healthcare market
- Previously worked at Cisco, AMD and Storage Startup
  - Built OS, Virtual Machines, File Systems

BACKUP SLIDES

SCHEMA - FULL

```
cqlsh:hawkeye4> select * from monitor_alerts limit 10;

 monitor     | alert_time_year | alert_time_ms            | alert_sev | alert_through | max_through | min_through | sigma1neg_through | sigma1pos_through | sigma2neg_through | sigma2pos_through
-------------+-----------------+--------------------------+-----------+---------------+-------------+-------------+-------------------+-------------------+-------------------+-------------------
 TASKTYPE906 |            2016 | 2016-02-08 17:09:32+0000 |       red |   50332.85922 |  49526.7681 | 49337.22816 |       49297.97315 |       49566.02311 |       49163.94816 |        49700.0481
 TASKTYPE906 |            2016 | 2016-02-08 16:54:46+0000 |       red |   47908.37136 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:54:21+0000 |       red |       55228.96 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:54:01+0000 |       red |   50332.85922 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:53:18+0000 |       red |    49474.7233 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:53:01+0000 |       red |   44555.64286 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:52:25+0000 |       red |       49039.2 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:50:32+0000 |       red |     53526.275 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
 TASKTYPE906 |            2016 | 2016-02-08 16:48:21+0000 |       red |    49882.4733 | 49337.22816 | 49337.22816 |       49337.22816 |       49337.22816 |       49337.22816 |       49337.22816
   TASKID402 |            2016 | 2016-02-08 17:09:26+0000 |    yellow |   52517.13821 | 49344.80952 |  43740.5122 |       42579.82421 |        50505.4975 |        38616.98757 |        54468.33415

(10 rows)
cqlsh:hawkeye4> select * from monitor_history  limit 10;

 monitor     | record_time_year | record_time_ms           | nevents | tdeltaagg | time_window_size_ms
-------------+------------------+--------------------------+---------+-----------+---------------------
 TASKTYPE305 |             2016 | 2016-02-08 11:15:44+0000 |     400 |  20181033 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 11:05:44+0000 |    1237 |  61621326 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:55:44+0000 |    2813 | 139698082 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:45:44+0000 |    1130 |  57024590 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:35:43+0000 |    1868 |  91425185 |              600000
 TASKTYPE305 |             2016 | 2016-02-08 10:25:43+0000 |     213 |  10622745 |              600000
 TASKTYPE906 |             2016 | 2016-02-08 16:55:06+0000 |    2596 | 128571490 |              600000
 TASKTYPE906 |             2016 | 2016-02-08 16:45:06+0000 |    2060 | 101634690 |              600000
 TASKTYPE906 |             2016 | 2016-02-08 16:31:17+0000 |    1648 |  81307752 |              600000
 TASKTYPE906 |             2016 | 2016-02-08 16:21:17+0000 |    2060 | 101634690 |              600000

(10 rows)
```

HAWKEYE – HOW?

- Chatty App → Low Performance
- Measure by counting TCP/IP Packets
  - Throughput = Total Packets / Time
- Include Network Latency
  - Throughput = (Total Latency / Total Packets) / Time

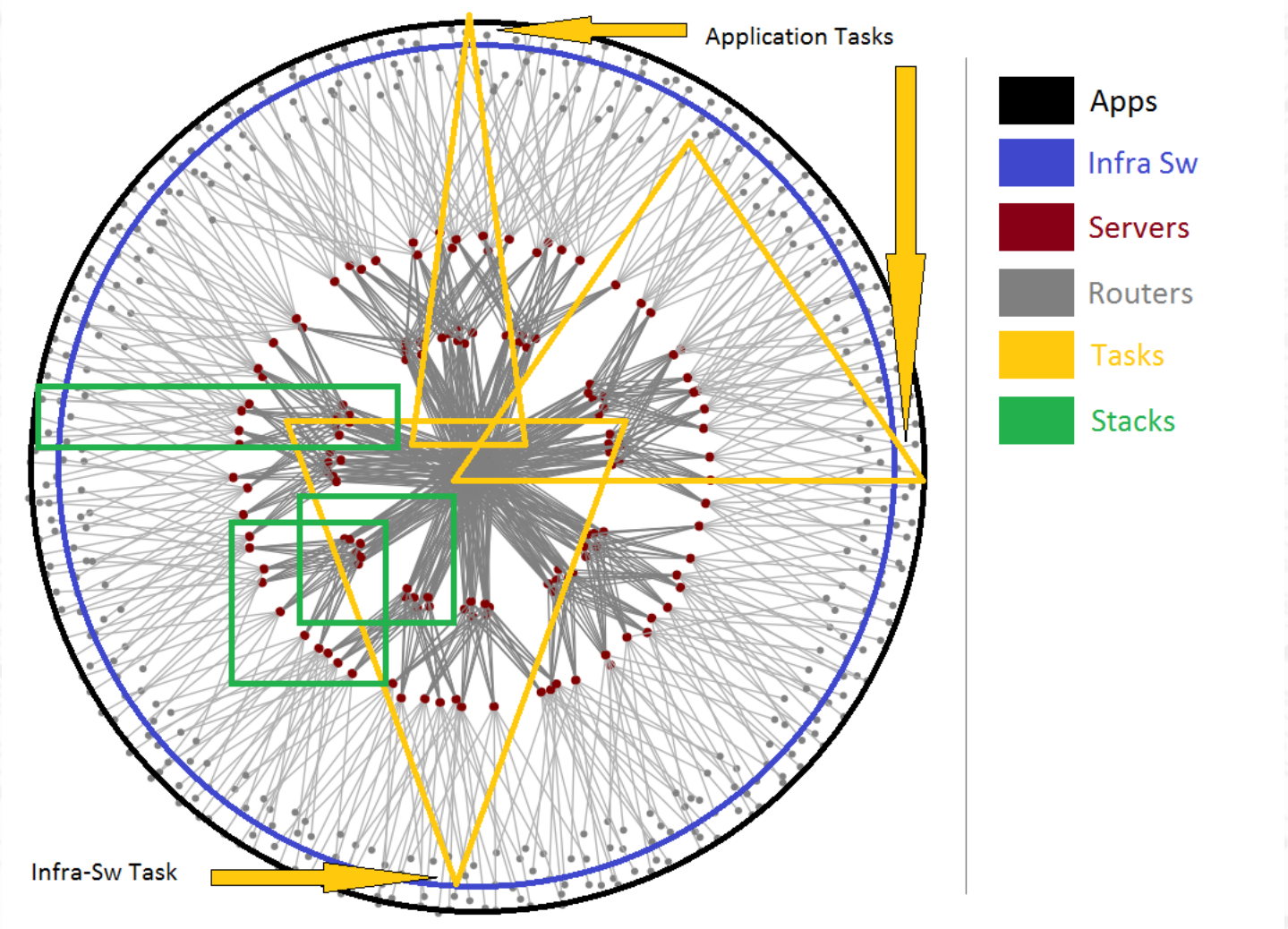
HAWKEYE – WHEN?

- Alerts – per monitor
  - Throughput now vs. historical data
  - Upper bound and lower bound
- Game – per stack
  - Rank user's stack's performance in real time

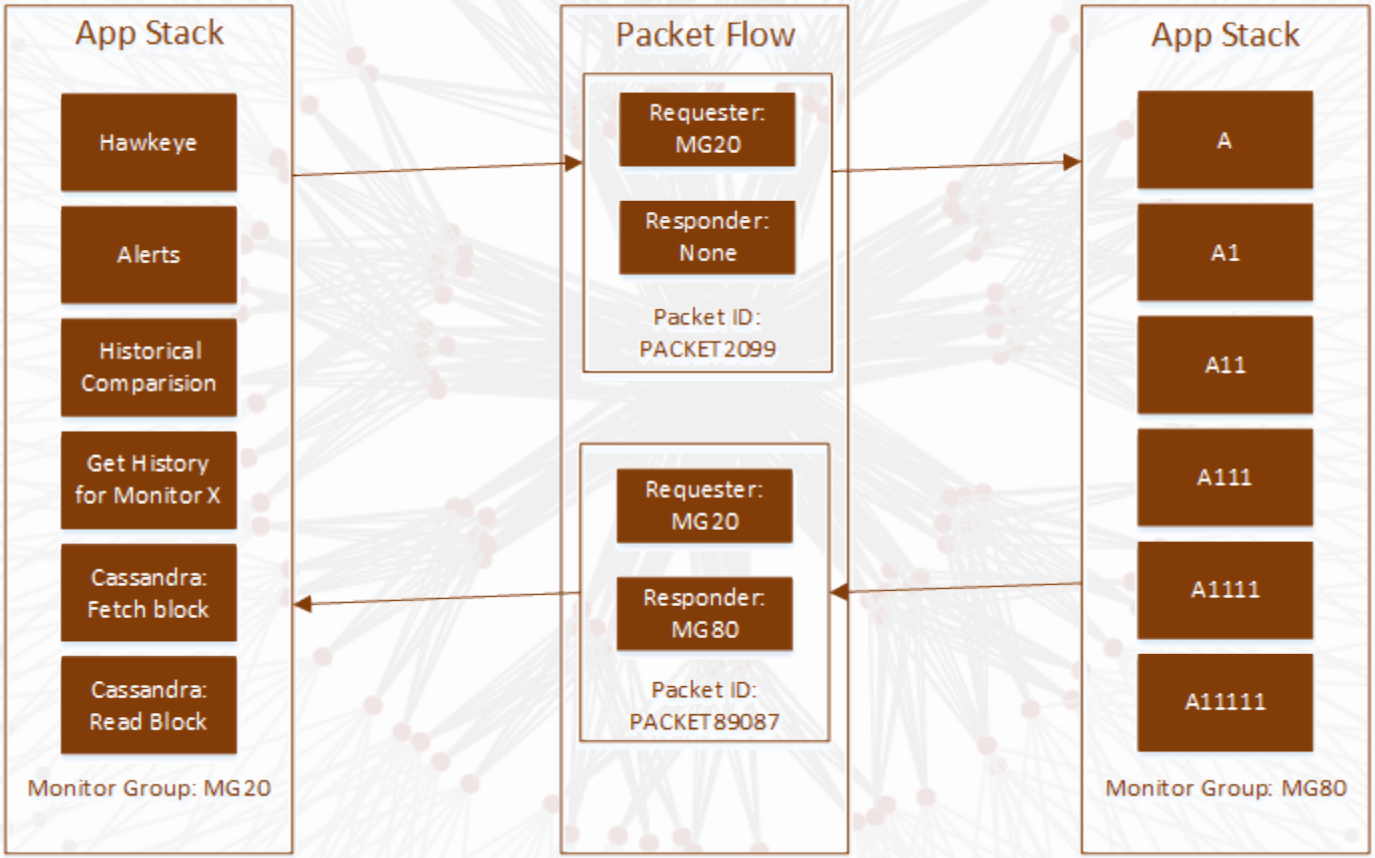
DATA

- Event:
  - TCP/IP packet timestamp In / Out
  - List of Monitors
- Engineered Data for Insight Project
- Real World
  - Hook into kernel: network stack, scheduler
  - Hi priority demon using *top*
  - Hypervisor

HAWKEYE MONITORS



HAWKEYE – EXECUTION



HAWKEYE - APPROACH

- Sniff each TCP/IP packet
- Packet (P) → Source Stack (S
- At P's arrival:

  For each source in SS

  Add P's latency to source
- Now Window (1s):

  For each source in Hawkeye

  Alert of throughput's pvalue < 0.