# Log aggregation and analysis

# Common logging issues

- Not centralised
- Centralised logging over UDP
- Not searchable
- Not verbose enough
- Too verbose

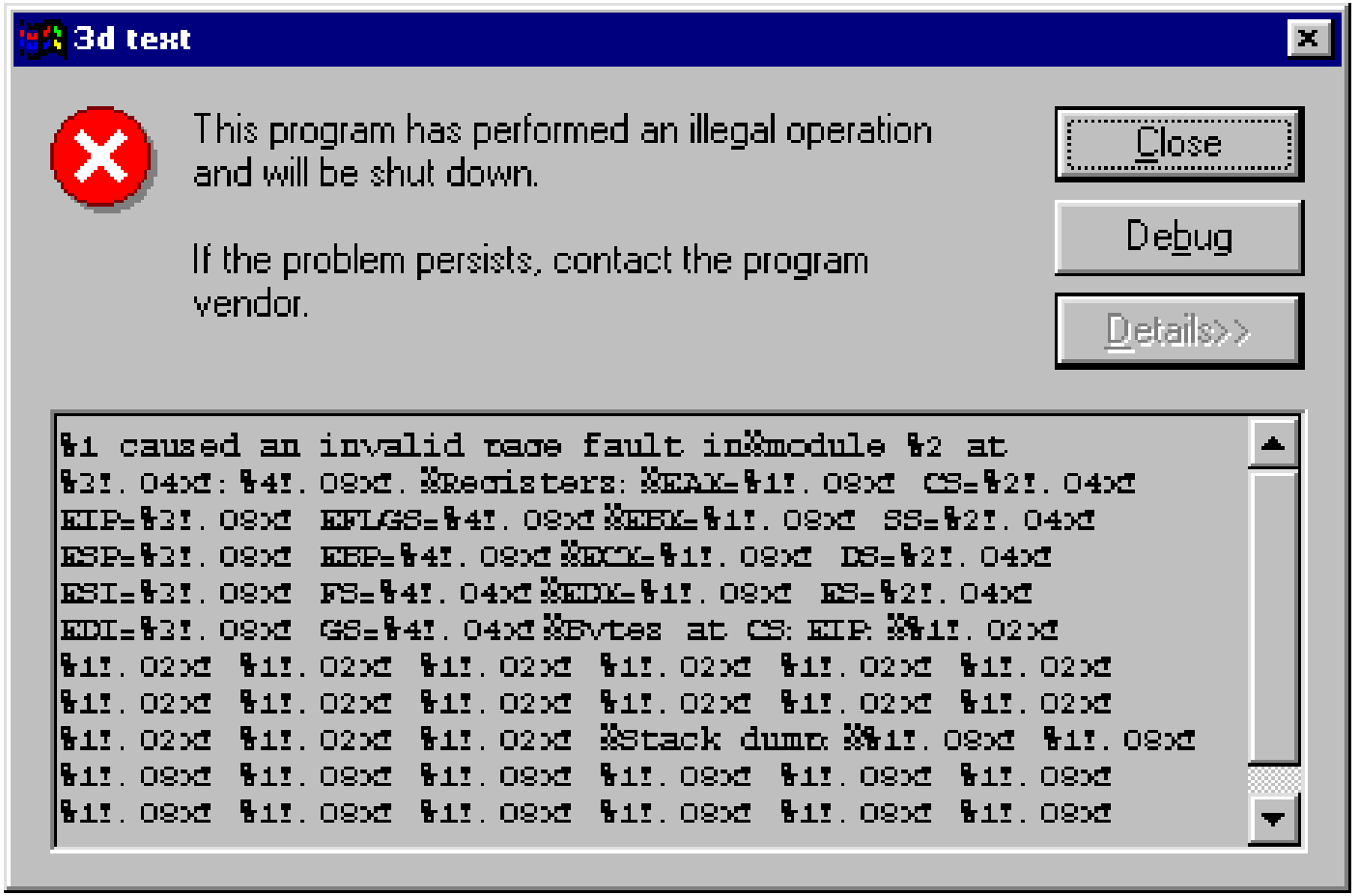
# Not centralised logs?

- Web servers
- Java application servers
- “Modern” applications which do not use syslog
- Cron scripts

# Not searchable

- Logs on disk can only be searched by people with access to the system
- Humans needing access to logs:
  - Administrators (sysadmin, netadmin, DBA)
  - Developers
  - Customer support
  - Business analysts

# Not verbose enough



# Too verbose

```
java.lang.RuntimeException
        at sun.reflect.NativeConstructorAccessorImpl.newInstance0(Native Method)
        at sun.reflect.NativeConstructorAccessorImpl.newInstance(NativeConstructorAccessorImpl.java:39)
        at sun.reflect.DelegatingConstructorAccessorImpl.newInstance(DelegatingConstructorAccessorImpl.java:27)
        at java.lang.reflect.Constructor.newInstance(Constructor.java:513)
        at org.codehaus.groovy.reflection.CachedConstructor.invoke(CachedConstructor.java:77)
        at org.codehaus.groovy.runtime.callsite.ConstructorSite$ConstructorSiteNoUnwrapNoCoerce.callConstructor(ConstructorSite
        at org.codehaus.groovy.runtime.callsite.CallSiteArray.defaultCallConstructor(CallSiteArray.java:52)
        at org.codehaus.groovy.runtime.callsite.AbstractCallSite.callConstructor(AbstractCallSite.java:192)
        at org.codehaus.groovy.runtime.callsite.AbstractCallSite.callConstructor(AbstractCallSite.java:196)
        at newifyTransform$_run_closure1.doCall(newifyTransform.gdsl:21)
        at sun.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
        at sun.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:39)
        at sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:25)
        at java.lang.reflect.Method.invoke(Method.java:597)
        at org.codehaus.groovy.reflection.CachedMethod.invoke(CachedMethod.java:86)
        at groovy.lang.MetaMethod.doMethodInvoke(MetaMethod.java:234)
        at org.codehaus.groovy.runtime.metaclass.ClosureMetaClass.invokeMethod(ClosureMetaClass.java:272)
        at groovy.lang.MetaClassImpl.invokeMethod(MetaClassImpl.java:893)
        at org.codehaus.groovy.runtime.callsite.PogoMetaClassSite.callCurrent(PogoMetaClassSite.java:66)
        at org.codehaus.groovy.runtime.callsite.AbstractCallSite.callCurrent(AbstractCallSite.java:151)
        at newifyTransform$_run_closure1.doCall(newifyTransform.gdsl)
        at sun.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
        at sun.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:39)
        at sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:25)
        at java.lang.reflect.Method.invoke(Method.java:597)
        at org.codehaus.groovy.reflection.CachedMethod.invoke(CachedMethod.java:86)
        at groovy.lang.MetaMethod.doMethodInvoke(MetaMethod.java:234)
        at org.codehaus.groovy.runtime.metaclass.ClosureMetaClass.invokeMethod(ClosureMetaClass.java:272)
        at groovy.lang.MetaClassImpl.invokeMethod(MetaClassImpl.java:893)
        at org.codehaus.groovy.runtime.callsite.PogoMetaClassSite.call(PogoMetaClassSite.java:39)
        at org.codehaus.groovy.runtime.callsite.AbstractCallSite.call(AbstractCallSite.java:121)
        at org.jetbrains.plugins.groovy.dsl.GroovyDslExecutor$_processVariants_closure1.doCall(GroovyDslExecutor.groovy:54)
        at sun.reflect.GeneratedMethodAccessor61.invoke(Unknown Source)
        at sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:25)
        at java.lang.reflect.Method.invoke(Method.java:597)
        at org.codehaus.groovy.reflection.CachedMethod.invoke(CachedMethod.java:86)
        at groovy.lang.MetaMethod.doMethodInvoke(MetaMethod.java:234)
        at org.codehaus.groovy.runtime.metaclass.ClosureMetaClass.invokeMethod(ClosureMetaClass.java:272)
```

# Logging over UDP

- Lossy
  - You lose logs when you need them the most
  - When things go wrong and you need to debug
    - Network overload
    - Packet drops
  - UDP fragmentation is a problem
    - Must be handled by the application
    - Many popular applications do not (node.js for example)

# Access control

- Limiting access to centralised logging is another issue
  - Especially to sensitive data
    - Debug logs
    - Personally identifiable information
- Corporate policies
  - Helpdesk access to email logs?
  - Netflow logs?

# The ELK stack

- “New” hotness
  - Elasticsearch
  - Logstash
  - Kibana
- Good for basic textual logging
- Somewhat fragile under very high load

# Elasticsearch

- A full text search based on Lucene
  - Java application (Use a new JRE – 1.8 is good)
- Limited indexing features
  - Indexing options could be better
- High performance
- Scalable

# Logstash

- Jruby based log processor
- Ships with input and output filters for a very wide variety of input
  - Syslog
  - Email
  - Apache logs
  - …
  - Ability to write custom filters

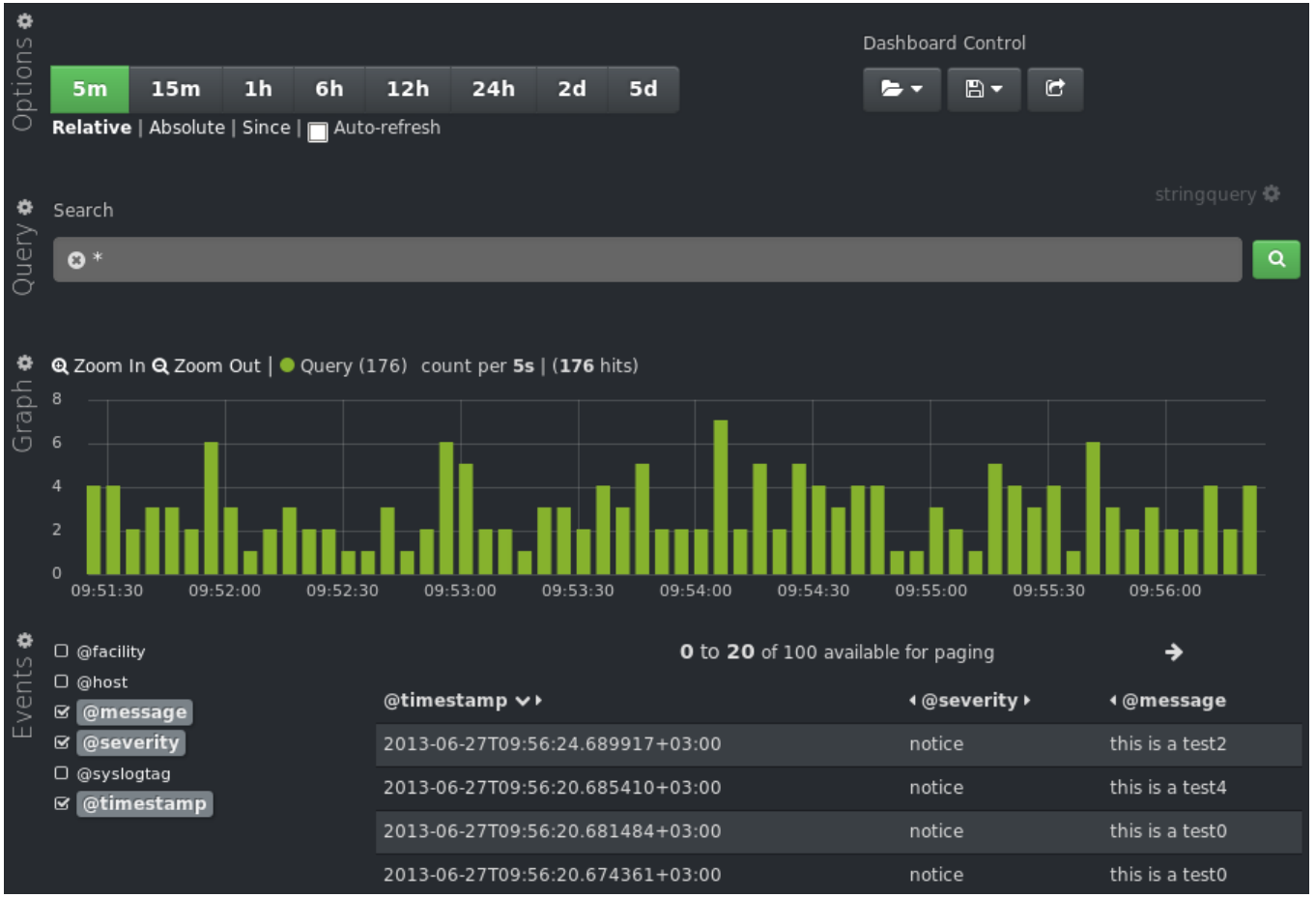
# Kibana

- Javascript based frontend for search
- Shows raw logs and some graphing based on number of events
- Ability to store predefined dashboards
- AAA is delegated to the webserver

# Benefits

- Store indexed logs
  - Quickly search through logs
  - Saves admin time on debugging tickets
  - ES will duplicate indices, avoid wasting RAID space
- Limit access to logs by index name
  - Alias indices to save on space
- Elasticsearch can expire and delete indices
  - elasticsearch-curator

# Default Kibana output




kibana
Discover
Visualize
Dashboard
Settings
November 23rd 2012, 07:33:18.582 to May 17th 2014, 10:37:14.548
LAPD: Crime Dashboard
*
LAPD: Tile map
1 – 2540
2540 – 5079
5079 – 7618
7618 – 10157
10157 – 12696
Leaflet | Tiles by MapQuest — Map data © OpenStreetMap contributors, CC-BY-SA
LAPD: Crime Type by Area
Legend
77th Street
Southwest
N Hollywood
Pacific
Mission
Southeast
LAPD: Crime Status by Crime Type
Legend
TRAFFIC DR #
BATTERY - SIMPLE...
THEFT PLAIN - PET...
BURGLARY FROM ...
BURGLARY
VEHICLE - STOLEN
LAPD: Monthly histogram by Crime Type
Count
date_rptd per month
2013-03-31
2013-06-30
2013-09-30
2013-12-31
2014-03-31
Legend
TRAFFIC DR #
BATTERY - SIMPLE...
SPOUSAL(COHAB) ...
ASSAULT WITH DE...
THEFT PLAIN - PET...
BURGLARY FROM ...
BURGLARY
VEHICLE - STOLEN
THEFT OF IDENTITY
THEFT-GRAND (OV...
DOCUMENT FORG...
LAPD: Intersections
Count
Top 5 location
WESTERN AV
VERMONT AV
SUNSET BL
6TH ST
SHERMAN WY
Legend
3RD ST
VERNON AV
WASHINGT...
WILSHIRE BL
BEVERLY BL
WESTERN AV
LA BREA AV
GOWER ST
ALVARADO ST
DETROIT ST
SAN PEDRO

# Limitations

- ES does not have good query rate limiting
  - ES will try to execute all queries and run out of resources
  - No automatic query killer yet
  - Elasticsearch doesn't have good failure recovery semantics
    - A hard reboot of a working cluster can take hours
- Query logging is lacking
  - Kibana queries are logged by the webserver
  - Direct access to ES gives no query logs

?