Anatoly Kulakov

Structured Logging

Paladyne

Why logging?

- **Troubleshooting & Remediation**
  - Where did the problem occur?
- **Performance & Cost**
  - How my changes impact overall performance?
- **Learning & Improvement**
  - Can I detect or prevent this problem in the future?
- **Trends**
  - Do I need to scale?
- **Customer Experience**
  - Are my customers getting a good experience?


(?:(?:\r\n)?[\t])*(?:(?:(?:[^()<>@,;:\\".\[\]\000-\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]])))|"(?:[^\"\r\\]|\\.|
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\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]])))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t])*)(?:\.(?:(?:\r\n)?[\t])*(?:[^()<>@
,;:\\".\[\]\000-\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t]))*)|
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\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t])*))*(?:,@(?:(?:\r\n)?[\t])*(?:[^()<>@,;:\\".\[\]\000-
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000-\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|"(?:[^\"\r\\]|\\.|(?:(?:\r\n)?[\t]))*"(?:(?:\r\n)?[\t])*))
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\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t])*)(?:\.(?:(?:\r\n)?[\t])*(?:[^()<>@
,;:\\".\[\]\000-\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t])*))*(?:,
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[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[\t])*))*)*:(?:(?:\r\n)?[\t])*)?(?:[^()<>@,;:\\".\[\]\000-(?:(?:(?:\r\n)?[\t])+|\Z|
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?[\t])*)(?:,\s*(?:(?:[^()<>@,;:\\".\[\]\000-\031]+(?:(?:(?:\r\n)?[\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|"(?:[^\"\r\\]|\\.|(?:(?:\r\n)?
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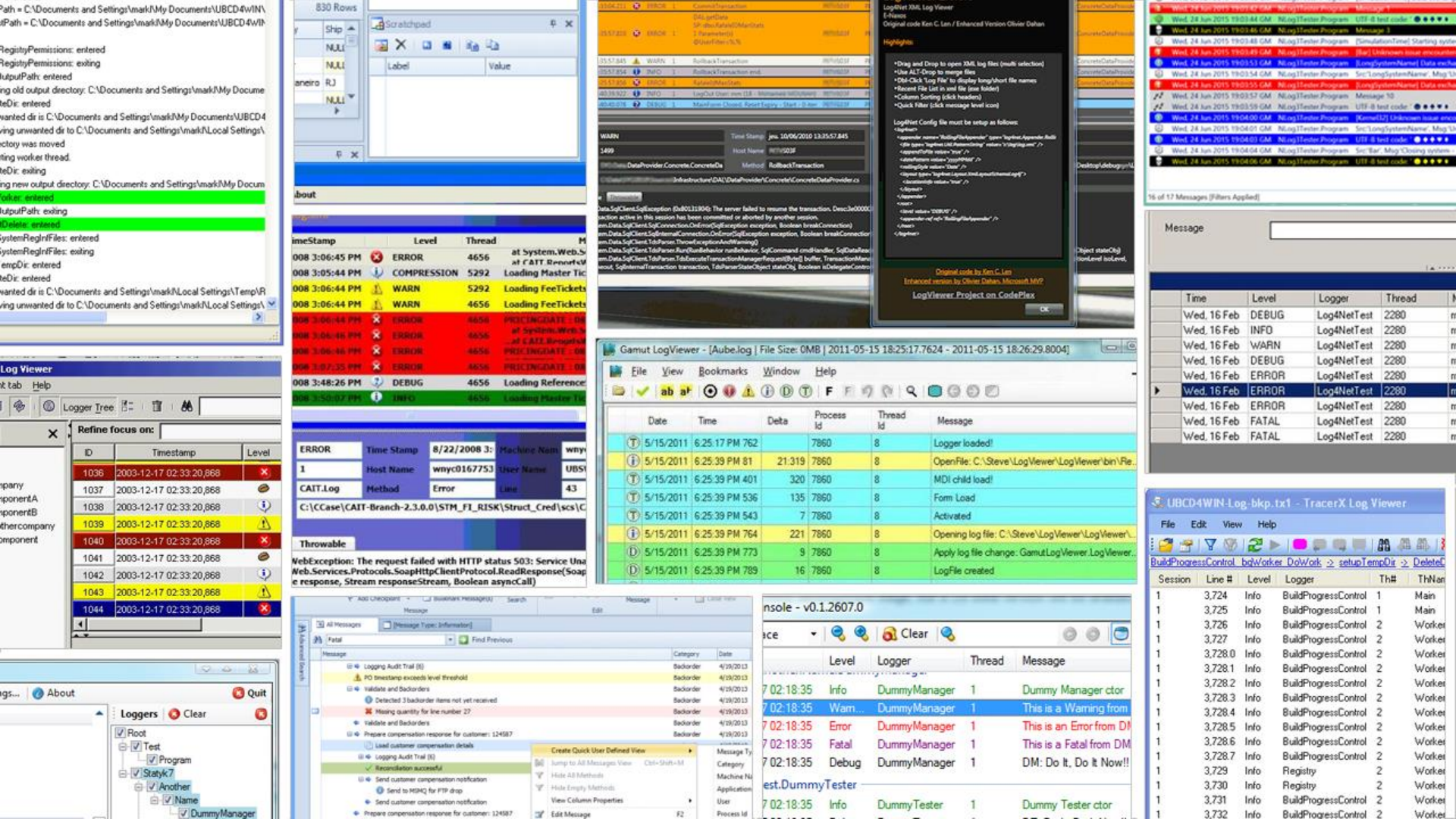
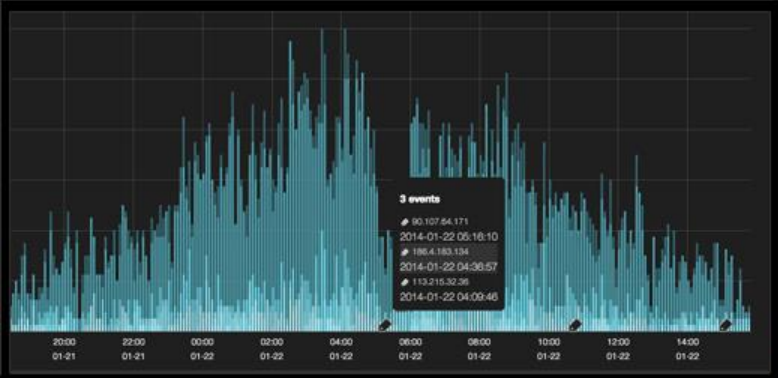
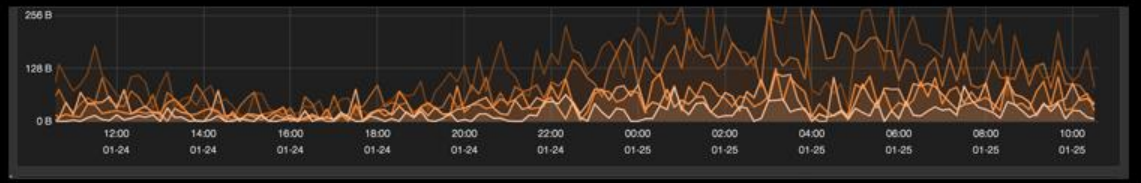
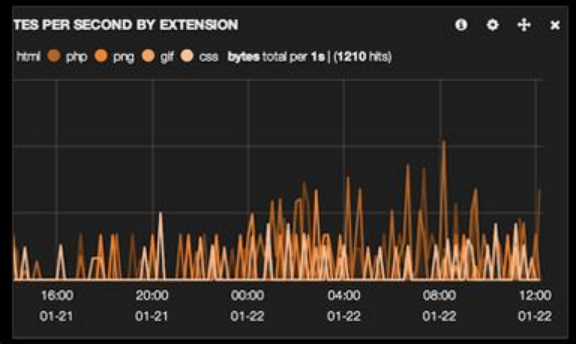

Gamut LogViewer - [Aube.log | File Size: 0MB | 2011-05-15 18:25:17.7624 - 2011-05-15 18:26:29.8004]
File View Bookmarks Window Help
Date Time Delta Process Id Thread Id Message
5/15/2011 6:25:17 PM 762 7860 8 Logger loaded!
5/15/2011 6:25:39 PM 81 21:319 7860 8 OpenFile: C:\Steve\LogViewer\LogViewer\bin\Re...
5/15/2011 6:25:39 PM 401 320 7860 8 MDI child load!
5/15/2011 6:25:39 PM 536 135 7860 8 Form Load
5/15/2011 6:25:39 PM 543 7 7860 8 Activated
5/15/2011 6:25:39 PM 764 221 7860 8 Opening log file: C:\Steve\LogViewer\LogViewer\...
5/15/2011 6:25:39 PM 773 9 7860 8 Apply log file change: GamutLogViewer.LogViewer...
5/15/2011 6:25:39 PM 789 16 7860 8 LogFile created
Log Viewer
Refine focus on:
ID Timestamp Level
1036 2003-12-17 02:33:20,868
1037 2003-12-17 02:33:20,868
1038 2003-12-17 02:33:20,868
1039 2003-12-17 02:33:20,868
1040 2003-12-17 02:33:20,868
1041 2003-12-17 02:33:20,868
1042 2003-12-17 02:33:20,868
1043 2003-12-17 02:33:20,868
1044 2003-12-17 02:33:20,868
Level Thread Message
008 3:06:45 PM ERROR 4656
008 3:05:44 PM COMPRESSION 5292 Loading Master Tic
008 3:06:44 PM WARN 5292 Loading FeeTickets
008 3:06:44 PM WARN 4656 Loading FeeTickets
008 3:48:26 PM DEBUG 4656 Loading Reference
ERROR Time Stamp 8/22/2008 3:
1 Host Name wnyc0167753
CAIT.Log Method Error Line 43
C:\CCase\CAIT-Branch-2.3.0.0\STM_FI_RISK\Struct_Cred\scs\C
Throwable
WebException: The request failed with HTTP status 503: Service Una
Web.Services.Protocols.SoapHttpClientProtocol.ReadResponse(Soap
e response, Stream responseStream, Boolean asyncCall)
Message
Time Level Logger Thread
Wed, 16 Feb DEBUG Log4NetTest 2280
Wed, 16 Feb INFO Log4NetTest 2280
Wed, 16 Feb WARN Log4NetTest 2280
Wed, 16 Feb DEBUG Log4NetTest 2280
Wed, 16 Feb ERROR Log4NetTest 2280
Wed, 16 Feb ERROR Log4NetTest 2280
Wed, 16 Feb ERROR Log4NetTest 2280
Wed, 16 Feb FATAL Log4NetTest 2280
Wed, 16 Feb FATAL Log4NetTest 2280
UBCD4WIN-Log-bkp.tx1 - TracerX Log Viewer
File Edit View Help
Session Line # Level Logger Th# ThNam
1 3,724 Info BuildProgressControl 1 Main
1 3,725 Info BuildProgressControl 1 Main
1 3,726 Info BuildProgressControl 2 Worke
1 3,727 Info BuildProgressControl 2 Worke
1 3,728.0 Info BuildProgressControl 2 Worke
1 3,728.1 Info BuildProgressControl 2 Worke
1 3,728.2 Info BuildProgressControl 2 Worke
1 3,728.3 Info BuildProgressControl 2 Worke
1 3,728.4 Info BuildProgressControl 2 Worke
1 3,728.5 Info BuildProgressControl 2 Worke
1 3,728.6 Info BuildProgressControl 2 Worke
1 3,728.7 Info BuildProgressControl 2 Worke
1 3,729 Info Registry 2 Worke
1 3,730 Info Registry 2 Worke
1 3,731 Info BuildProgressControl 2 Worke
1 3,732 Info BuildProgressControl 2 Worke
Clear
Level Logger Thread Message
Info DummyManager 1 Dummy Manager ctor
Warn... DummyManager 1 This is a Warning from
Error DummyManager 1 This is an Error from D
Fatal DummyManager 1 This is a Fatal from DM
Debug DummyManager 1 DM: Do It, Do It Now!!
Info DummyTester 1 Dummy Tester ctor
About
Quit
Loggers
Clear
Root
Test
Program
Statyk7
Another
Name
DummyManager

logstash

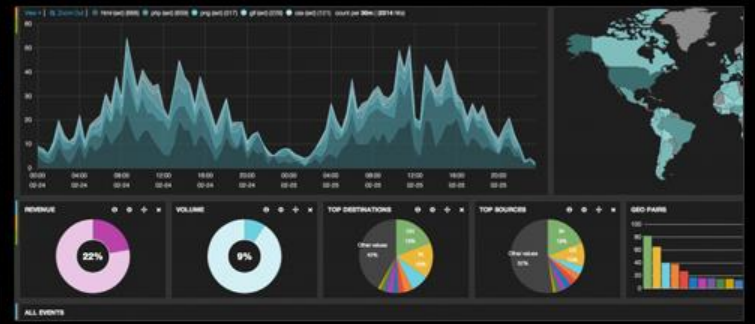
kibana

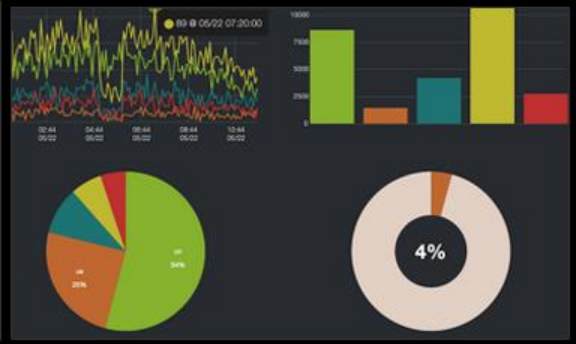

3 events
80.107.84.171
2014-01-22 05:16:10
186.4.183.134
2014-01-22 04:36:57
113.215.32.36
2014-01-22 04:09:46

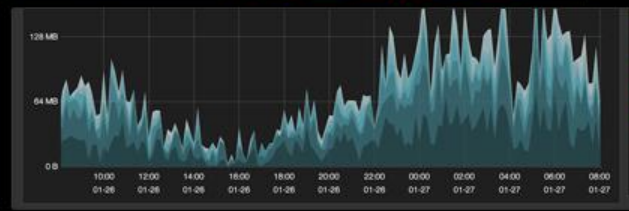

256 B
128 B
0 B


TES PER SECOND BY EXTENSION
html php png gif css bytes total per 1s | (1210 hits)

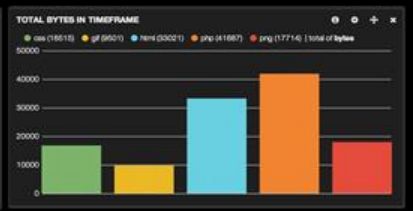

Images
Term
Count
Action

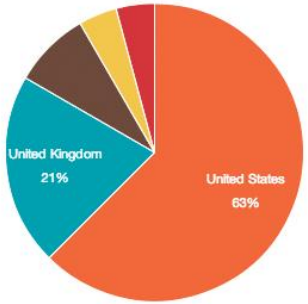



4%

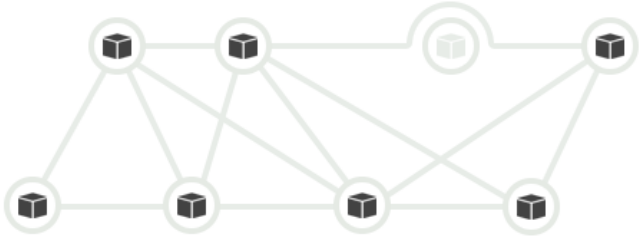



Query
Value
CN 2.12TB
IN 1.80TB
US 890.58GB
ID 368.20GB
PK 307.11GB
BR 311.67GB
RU 285.68GB
BD 262.30GB

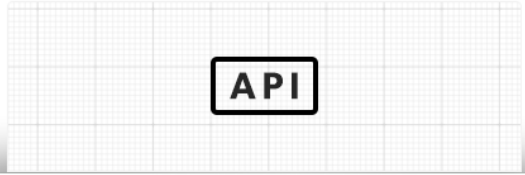

TOTAL BYTES IN TIMEFRAME



Real-Time
Advanced Analytics

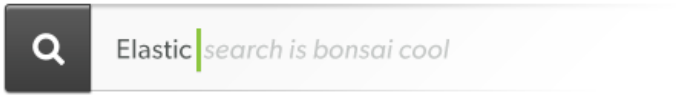


High Availability



Developer-Friendly,
RESTful API

Schema-Free



Full-Text Search

Build on top of
Apache Lucene

- File
- TCP
- UDP
- HTTP
- WebSocket
- Syslog
- IRC
- IMAP

- Grok
- GeoIP
- Filetr
- Tags
- DNS
- Aggregate
- JSON
- XML

- Elasticsearch
- Graphite
- Nagios
- Riemann
- DataDog
- Redis
- Riak
- MongoDB


LOG
logstash
ELASTIC SEARCH
kibana

```
S3_ACCESS_LOG %{WORD:owner} %{NOTSPACE:bucket} \[%{HTTPDATE:timestamp}\] %{IP:clientip}
%{NOTSPACE:requester} %{NOTSPACE:request_id} %{NOTSPACE:operation} %{NOTSPACE:key}
(?:"%{S3_REQUEST_LINE}"|-) (?:%{INT:response:int}|-) (?:-|%{NOTSPACE:error_code}) (?:%{INT:bytes:int}|-)
(?:%{INT:object_size:int}|-) (?:%{INT:request_time_ms:int}|-) (?:%{INT:turnaround_time_ms:int}|-) (?:%{QS:referrer}|-)
(?:"?%{QS:agent}"?|-) (?:-|%{NOTSPACE:version_id}) ELB_URIPATHPARAM
%{URIPATH:path}(?:%{URIPARAM:params})?

ELB_URI %{URIPROTO:proto}://(?:%{USER}(?::[^@]*)?@)?(?:%{URIHOST:urihost})?(?:%{ELB_URIPATHPARAM})?

ELB_REQUEST_LINE (?:%{WORD:verb} %{ELB_URI:request}(?:
HTTP/%{NUMBER:httpversion})?|%{DATA:rawrequest})

ELB_ACCESS_LOG %{TIMESTAMP_ISO8601:timestamp} %{NOTSPACE:elb} %{IP:clientip}:%{INT:clientport:int}
(?:(%{IP:backendip}:?:%{INT:backendport:int})|-) %{NUMBER:request_processing_time:float}
%{NUMBER:backend_processing_time:float} %{NUMBER:response_processing_time:float} %{INT:response:int}
%{INT:backend_response:int} %{INT:received_bytes:int} %{INT:bytes:int} "%{ELB_REQUEST_LINE}

CISCOFW106001 %{CISCO_DIRECTION:direction} %{WORD:protocol} connection %{CISCO_ACTION:action} from
%{IP:src_ip}/%{INT:src_port} to %{IP:dst_ip}/%{INT:dst_port} flags %{GREEDYDATA:tcp_flags} on interface
%{GREEDYDATA:interface}

CISCOFW106006_106007_106010 %{CISCO_ACTION:action} %{CISCO_DIRECTION:direction} %{WORD:protocol}
(?:from|src) %{IP:src_ip}/%{INT:src_port}(\(%{DATA:src_fwuser}\))? (?:to|dst)
%{IP:dst_ip}/%{INT:dst_port}(\(%{DATA:dst_fwuser}\))? (?:on interface %{DATA:interface}|due to
%{CISCO_REASON:reason})
```

```
class LoggedInEvent
{
    string     Name
    IPAddress  Address
    string[]   Roles
}
```

APP

```
String.Format(
 "User {0} logged in
  from {1}
  with {2} roles", … )
```

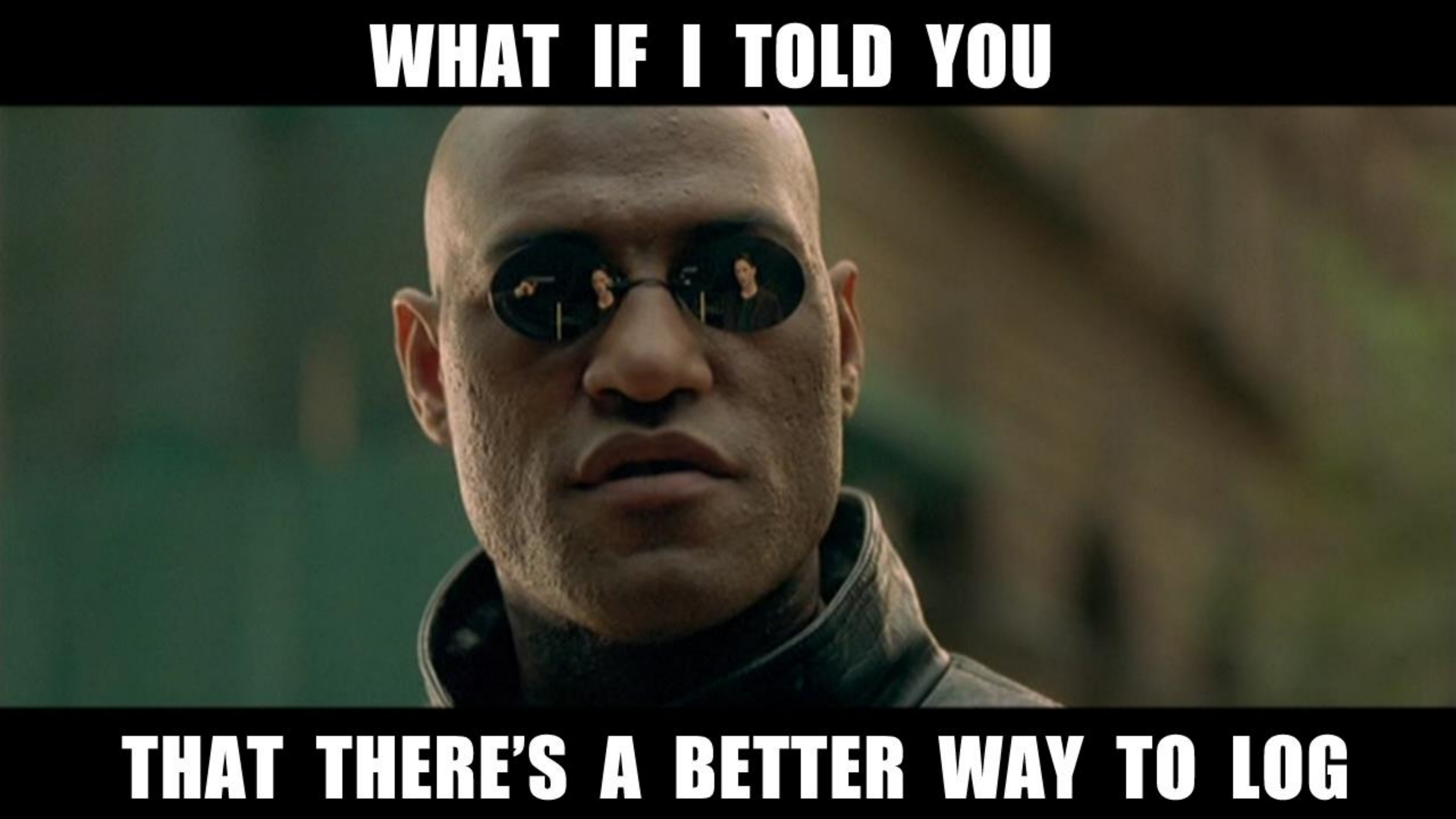
Log

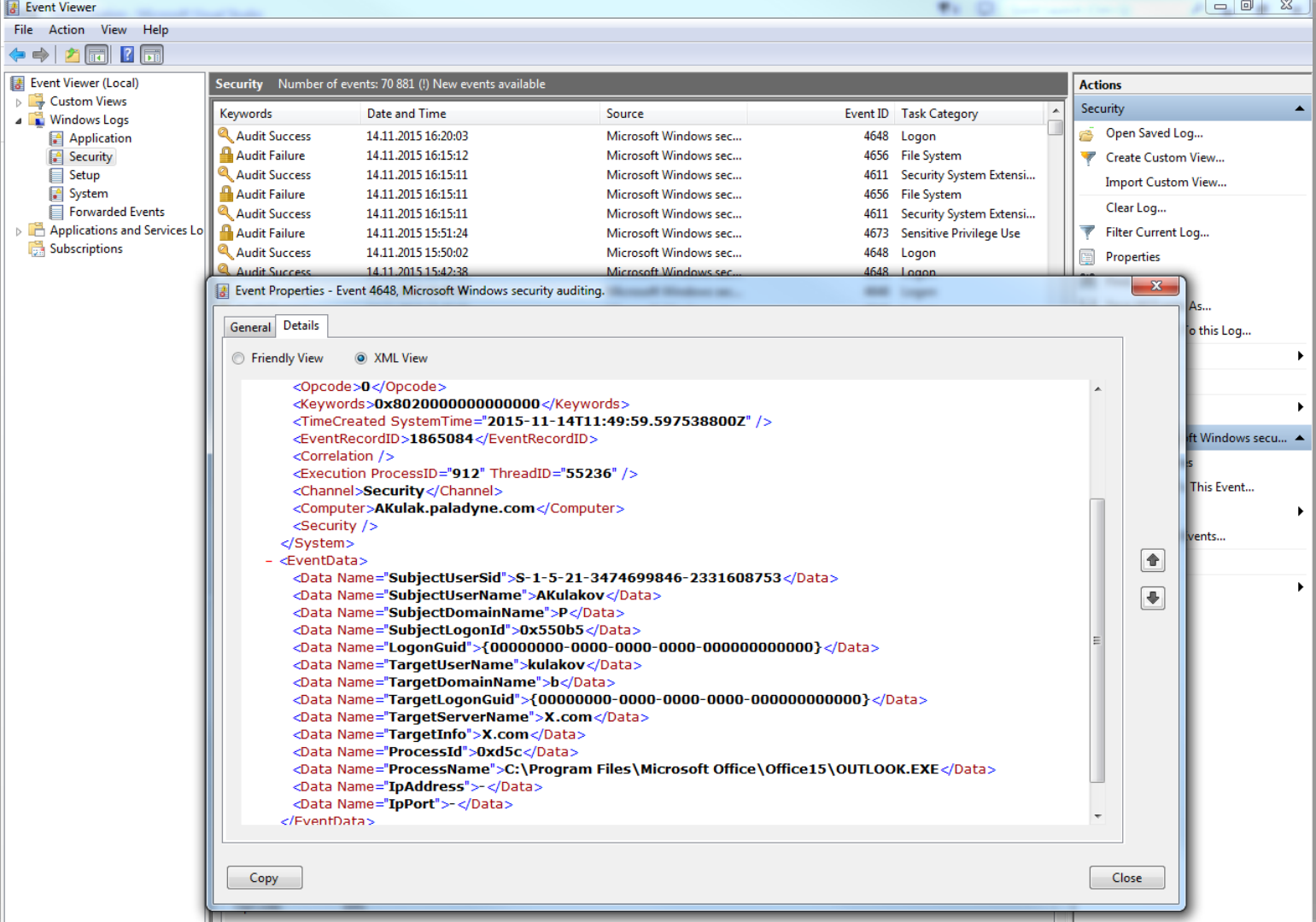
```
{
    string   Name
    string   Address
    string[] Roles
}
```

ES

Logstash

User Guest logged in from 127.0.0.1 with [Admin, God] roles


WHAT IF I TOLD YOU
THAT THERE'S A BETTER WAY TO LOG


Event Viewer
File Action View Help
Event Viewer (Local)
Custom Views
Windows Logs
Application
Security
Setup
System
Forwarded Events
Applications and Services Lo
Subscriptions
Security Number of events: 70 881 (!) New events available
Keywords Date and Time Source Event ID Task Category
Audit Success 14.11.2015 16:20:03 Microsoft Windows sec... 4648 Logon
Audit Failure 14.11.2015 16:15:12 Microsoft Windows sec... 4656 File System
Audit Success 14.11.2015 16:15:11 Microsoft Windows sec... 4611 Security System Extensi...
Audit Failure 14.11.2015 16:15:11 Microsoft Windows sec... 4656 File System
Audit Success 14.11.2015 16:15:11 Microsoft Windows sec... 4611 Security System Extensi...
Audit Failure 14.11.2015 15:51:24 Microsoft Windows sec... 4673 Sensitive Privilege Use
Audit Success 14.11.2015 15:50:02 Microsoft Windows sec... 4648 Logon
Actions
Security
Open Saved Log...
Create Custom View...
Import Custom View...
Clear Log...
Filter Current Log...
Properties
Event Properties - Event 4648, Microsoft Windows security auditing.
General Details
Friendly View XML View
<Opcode>0</Opcode>
<Keywords>0x8020000000000000</Keywords>
<TimeCreated SystemTime="2015-11-14T11:49:59.597538800Z" />
<EventRecordID>1865084</EventRecordID>
<Correlation />
<Execution ProcessID="912" ThreadID="55236" />
<Channel>Security</Channel>
<Computer>AKulak.paladyne.com</Computer>
<Security />
</System>
- <EventData>
<Data Name="SubjectUserSid">S-1-5-21-3474699846-2331608753</Data>
<Data Name="SubjectUserName">AKulakov</Data>
<Data Name="SubjectDomainName">P</Data>
<Data Name="SubjectLogonId">0x550b5</Data>
<Data Name="LogonGuid">{00000000-0000-0000-0000-000000000000}</Data>
<Data Name="TargetUserName">kulakov</Data>
<Data Name="TargetDomainName">b</Data>
<Data Name="TargetLogonGuid">{00000000-0000-0000-0000-000000000000}</Data>
<Data Name="TargetServerName">X.com</Data>
<Data Name="TargetInfo">X.com</Data>
<Data Name="ProcessId">0xd5c</Data>
<Data Name="ProcessName">C:\Program Files\Microsoft Office\Office15\OUTLOOK.EXE</Data>
<Data Name="IpAddress">-</Data>
<Data Name="IpPort">-</Data>
</EventData>
Copy
Close

Structure log

- Windows Event Log
- Event Tracing for Windows (ETW)
- Semantic Logging Application Block (SLAB)
- Microsoft.Framework.Logging (ASP.NET)
- Splunk, Graylog2

name=Guest, address=127.0.0.1, role=Admin

Serilog

Serilog is built with powerful structured event data in mind

```
String.Format(
  "User {0} logged in from {1} with {2} roles",
  Name, Address, Roles)
```

Serilog

```
Log.Information(
  "User {UserName} logged in
   from {RemoteAddress}
   with {SecurityRoles} roles",
  Name, Address, Roles)
```

Event

```
{
  EventType = UserLoggedIn
  UserName = "Guest"
  RemoteAddress = "127.0.0.1"
  SecurityRoles = ["Admin", …]
}
```

Structured Data

- Simple, Scalar Values
- Collections
- Dictionaries
- Objects
- String format specifier
- Stringification and Destructuring

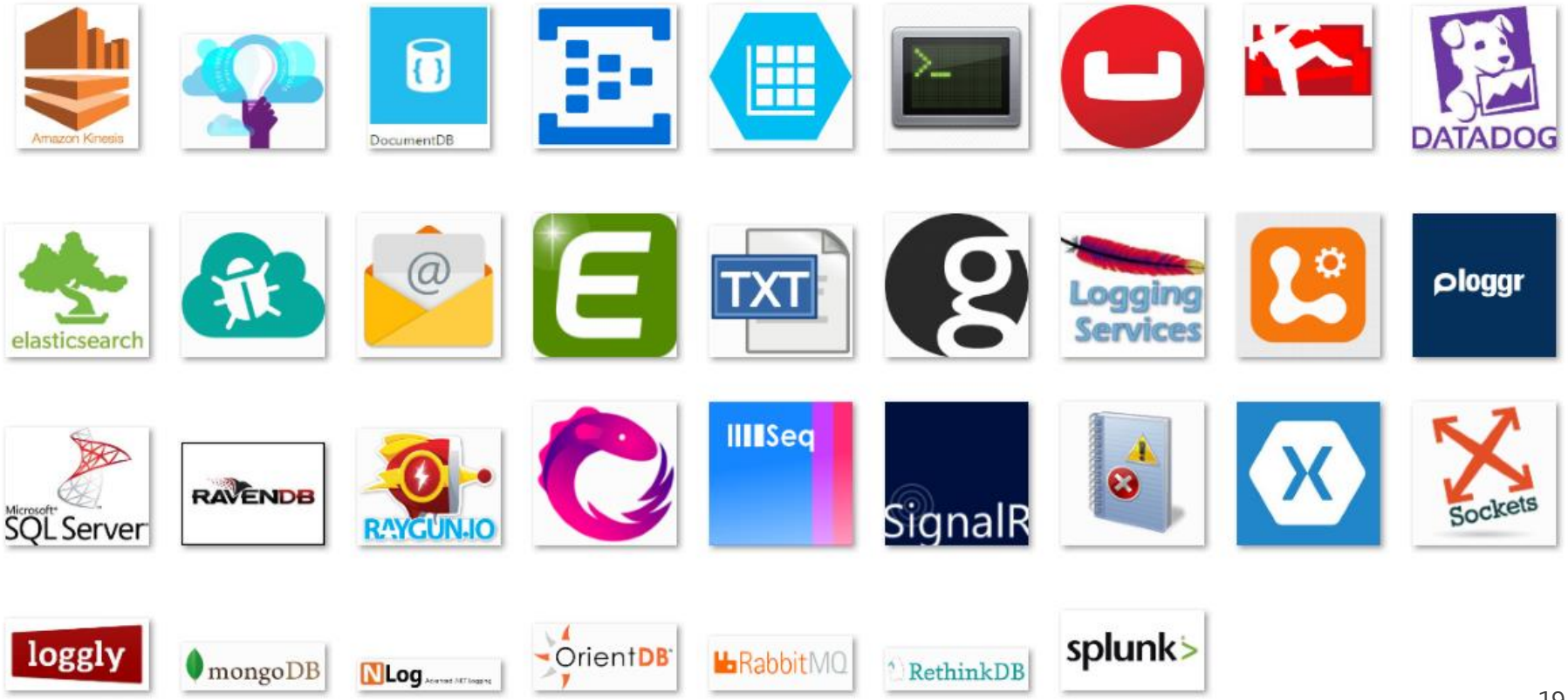
Enrichment

- MachineName
- UserName
- ProcessId
- ThreadId
- ASP ClientHostIP
- ASP UserAgent

LogContext

```
public class RequestContextMiddleware
{
    public async Task Invoke(IDictionary<string, object> environment)
    {
        using (LogContext.PushProperty("RequestId", Guid.NewGuid()))
        {
            await next(environment);
        }
    }
}
```

Sinks


Amazon Kinesis
DocumentDB
DATADOG
elasticsearch
TXT
Logging Services
ploggr
Microsoft SQL Server
RAVENDB
RAYGUN.IO
IIISeq
SignalR
Sockets
loggly
mongoDB
NLog
OrientDB
RabbitMQ
RethinkDB
splunk>

Demo powered by

Serilog

PowerShell

GraphViz

Demo powered by

Microsoft® SQL Server®

Serilog

Seq

- Quick install
- Built with .NET
- C#-like queries over structured data
- Filters and dashboards
- Lightweight but powerful
- HTTP API
- Seq Apps

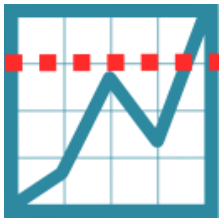
Demo powered by

Seq  Serilog

Seq Apps

- FirstOfType
- Timeout
- Thresholds
- FileArchive
- Replication

- Email
- YouTrack
- Slack
- HipChat








In conclusion

In conclusion

elastic

InfluxDB

Grafana

loggly

RAYGUN.IO

splunk>

Graphite

ploggr

Resources

- Serilog (serilog.net)
- Seq (getseq.net)
- Nicholas Blumhardt (nblumhardt.com)

- FSharp (github.com/destructurama/fsharp)
- JavaScript (github.com/structured-log/structured-log)

Resources

- Anatoly.Kulakov@outlook.com
- twitter.com/KulakovT
- github.com/AnatolyKulakov
- SpbDotNet.org