TOWARDS NEW GENERATION MONITORING

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Motivation: Importance is Growing

- auto-scaling
- accounting
- audit tracking
- debugging
- diagnosis

- fault-detection
- job scheduling
- profiling
- performance analysis
- recovery

Cloud environment

Virtualized simulation environment

Motivation: Emerging Problems

Emergence of **Cloud computing** caused or emphasized problems in monitoring such as:

- Processing speed
- Latency
- Scalability

- Extensibility
- Interoperability
- Security

- Missing functionality

- Massive Virtualization

- Nature and amount of MI

- Inter-cloud advent

- Multi-tenancy
- Predictive monitoring

Problem (missing): Predictive Monitoring / CEP
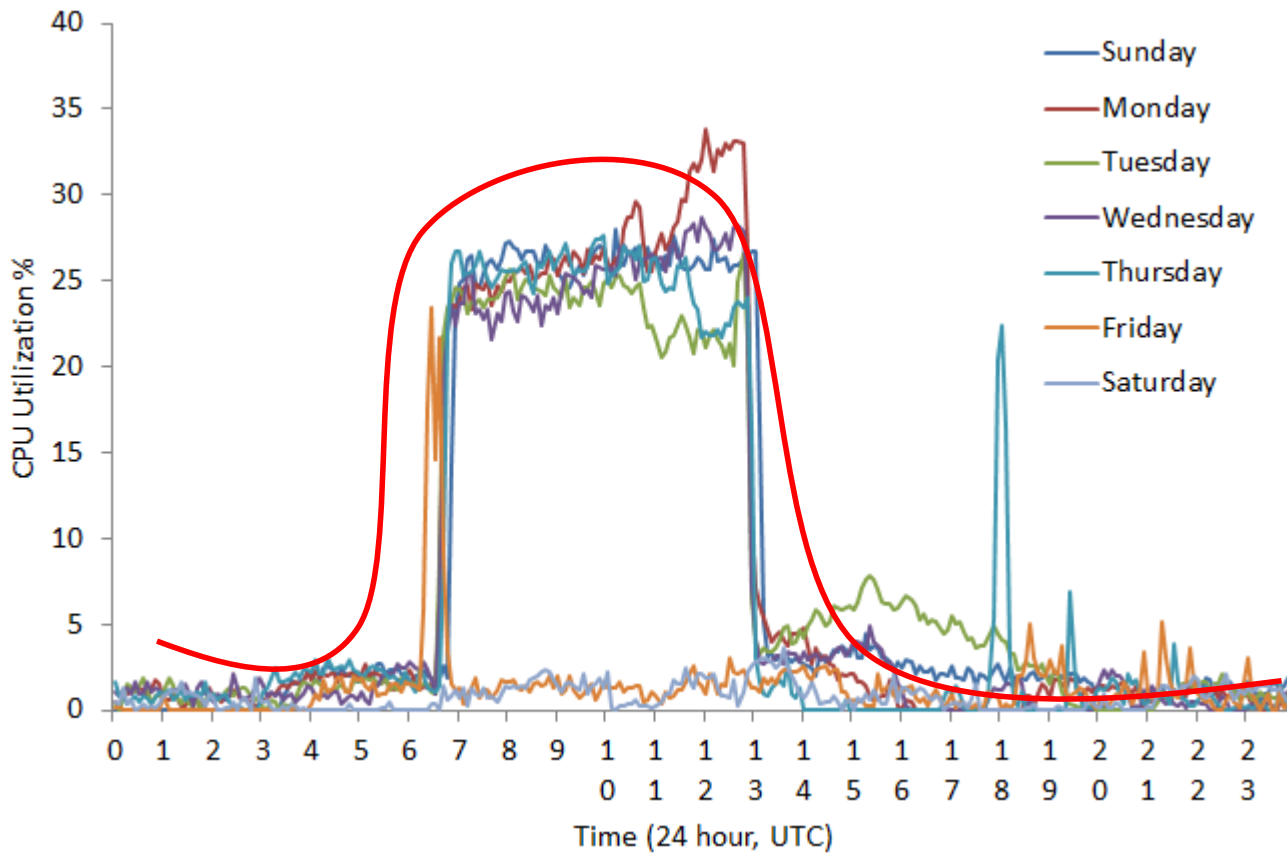
Solution: Unified Representation of MI

- Measurements
- Logs
- Notifications

- Others: Aggregation
- Hard to **process**
- Correlation too **complex**
- Predictive analysis based only on **statistical data**

➔ Shift to Event-based Monitoring

Problem (performance): Logging

- Syslog
  - `Nov 21 17:27:53 HANNIBAL MyProgram[13163]: Program started...`
  - `Apr 12 14:17:01 cd CRON[14368]: (root) CMD ( cd / && run-p...`

- Apache Tomcat
  - `6.5.2012 13:03:07 org.apache.catalina.core.ApplicationContext`
    `INFO: ContextListener: contextInitialized()`

- Apache Common Log Format
  - `[Wed Oct 11 14:32:52 2000] [error] [client 127.0.0.1] clie...`

Problem (performance): Logging

- ## Syslog
  - `Nov 21 17:27:53 HANNIBAL MyProgram[13163]: Program started...`
  - `Apr 12 14:17:01 cd CRON[14368]: (root) CMD ( cd / && run-p...`

- ## Apache Tomcat
  - `6.5.2012 13:03:07 org.apache.catalina.core.ApplicationContext`
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- ## Apache Common Log Format
  - `[Wed Oct 11 14:32:52 2000] [error] [client `**`127.0.0.1`**`] clie...`

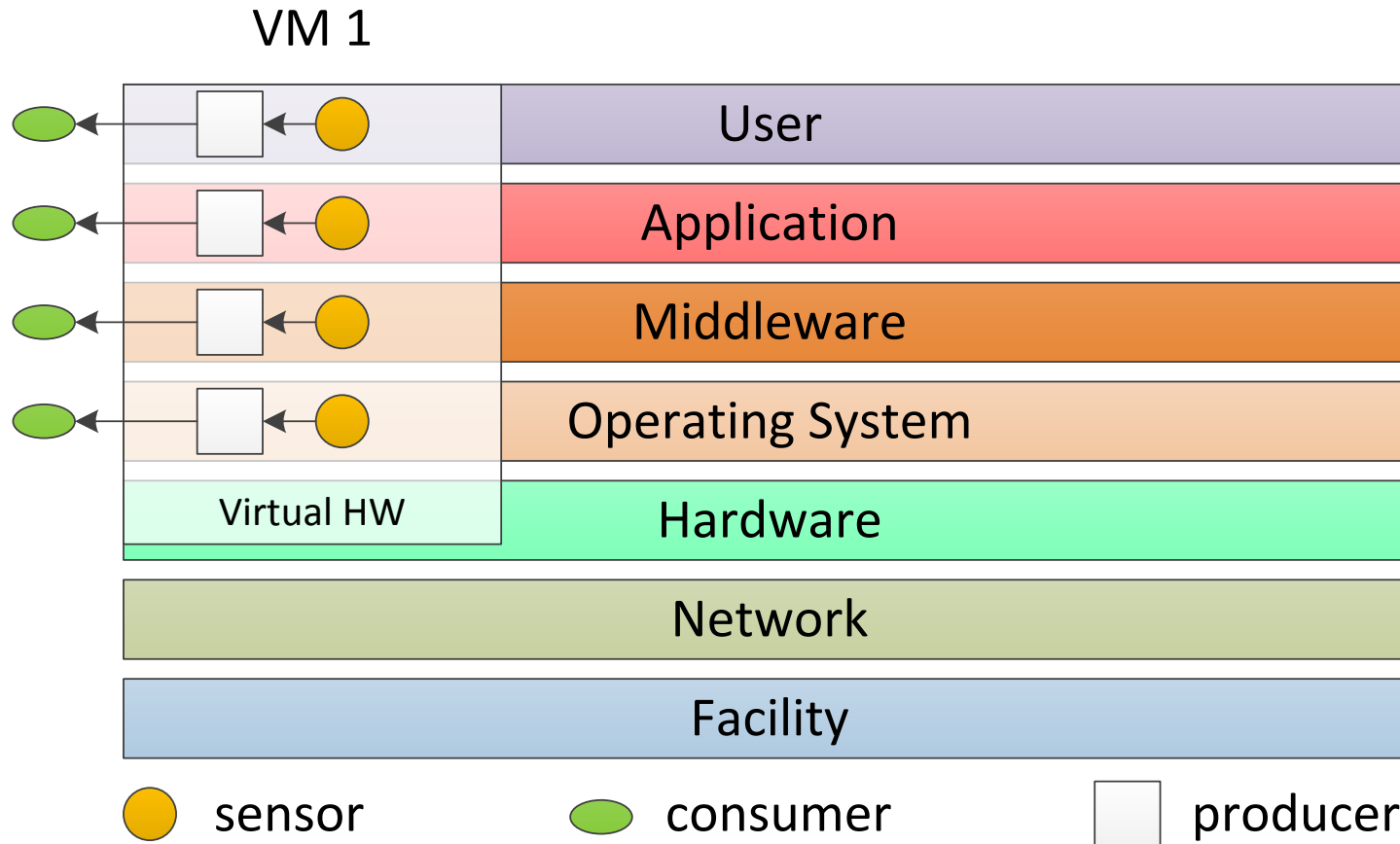# Solution: Extensible data format

- Standardized

- Self-describing

- Extensible schema

- Structured

- Compact

- Hard to **process**
  - Complex regular expressions
  - Expensive
  - Data mining
- Hard to **maintain**
  - Data structure update
- Not self-describing
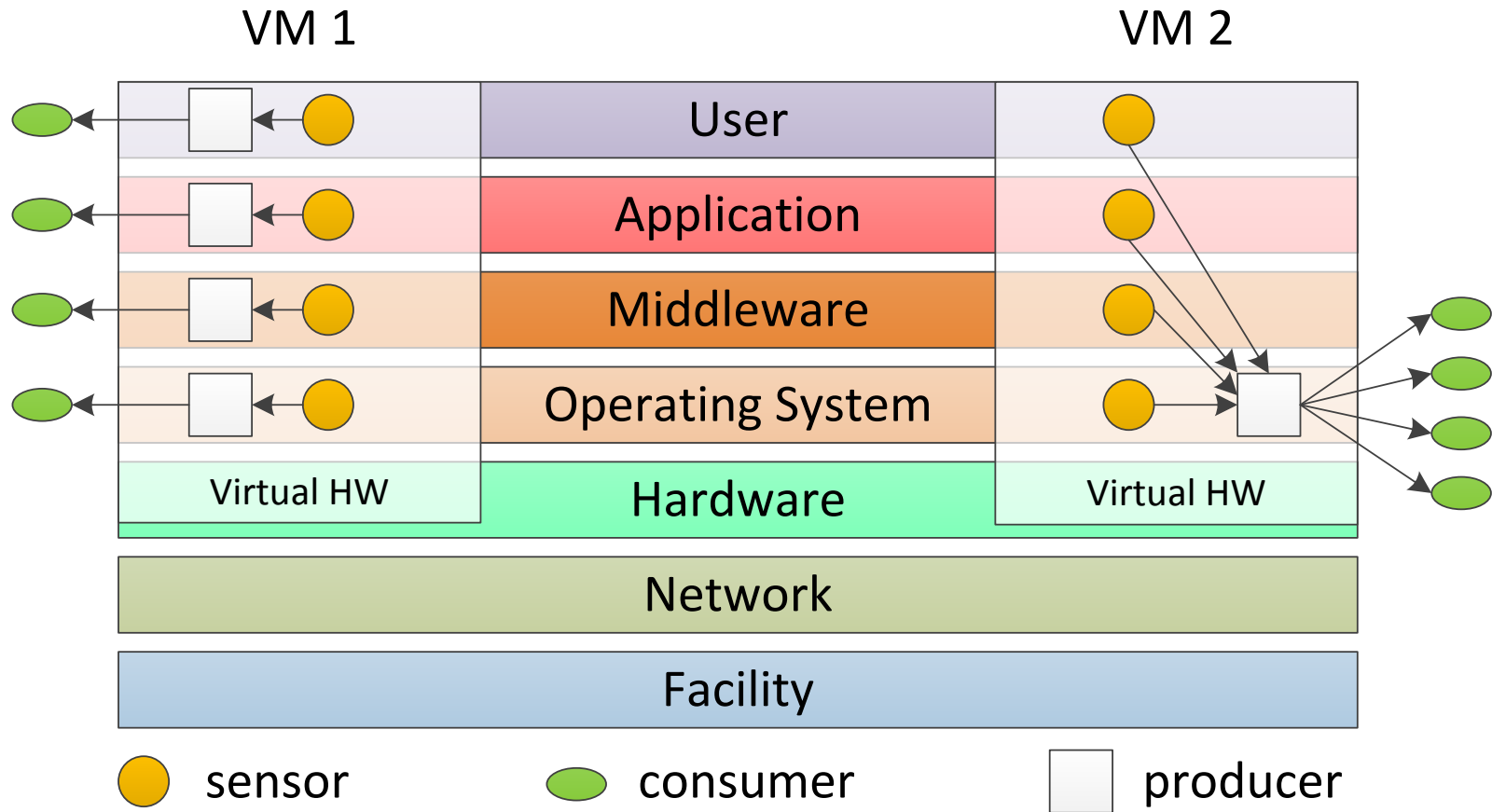 - Limited metadata

- Others: Abstraction

Solution: JSON Encoding

```
{'Event':{
    'id':16051986,
    'occurrenceTime':'2012-04-11T08:25:13.129Z',
    'hostname':'Lykomedes.fi.muni.cz',
    'type':'org.apache.httpd.request.GET',
    'application':'Apache Server',
    'process':'httpd',
    'processId':4219,
    'severity':1,
    'http://httpd.apache.org/v2.4/events.jsch':{
            'resource':'/apache_pb.gif',
            'protocol':'HTTP/1.0'
            'response':200
    }
}}
```

Problem (missing): Multi-tenancy

VM 1

	User
	Application
	Middleware
	Operating System
Virtual HW	Hardware
	Network
	Facility

sensor   consumer   producer

J. Spring. Monitoring cloud computing by layer, part 1. Security Privacy, IEEE, 9(2), 2011.

Problem (missing): Multi-tenancy

Solution: Compliance with Requirements

- Concurrency
- Isolation
- Integrity
- Proof-of-origin

VM 2

Virtual HW

producer
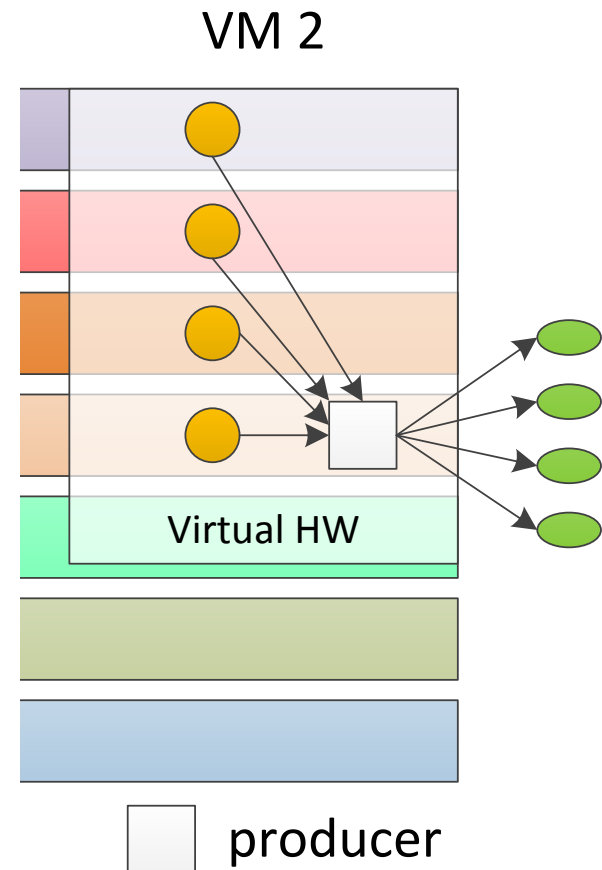
Research Results to date

- **Towards Multi-Tenant and Interoperable Monitoring of Virtual Machines in Cloud**

- 12th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC 2012). Workshop on Management of Resources and Services in Cloud and Sky Computing, 2012 [pre-print]

- Experimental prototype (**Ngmon**)

Paper summary

- Requirements
  - Multi-tenancy
  - Unified Representation of Monitoring Information
  - Extensible data format
  - Standard delivery channel

- Design and implementation of **Ngmon** – monitoring daemon
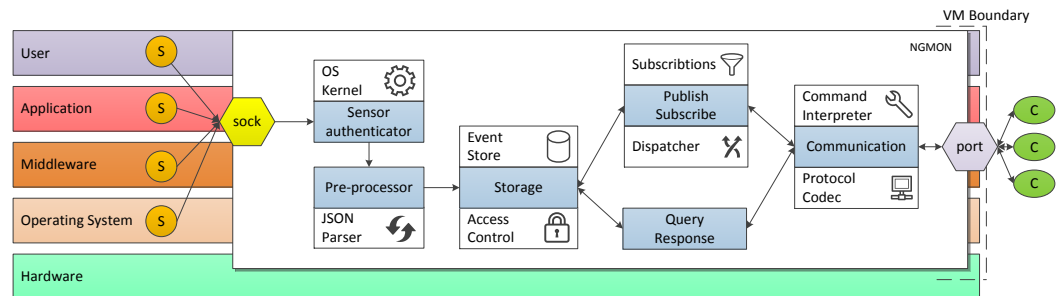
Dissertation topic motivation

- Many problems emerged with advent of Cloud computing

- Respective solutions strongly influence each other

- Monitoring needs to be re-designed from ground up

- All requirements (problems) must be met and properly balanced

Short-comings / Requirements

- Processing speed
- Latency
- Scalability
- Network overhead

- Extensibility
- Interoperability
- Maintainability

- Additional functionality
  - Multi-tenancy
  - Complex Event Processing + Predictive Analysis

Methods:

- Experiment

- Comparative study

- Proof-of-concept

- Exp. / Comp. study

Monitoring process and architecture

- **Production**
- Processing
- **Distribution**
- Consumption
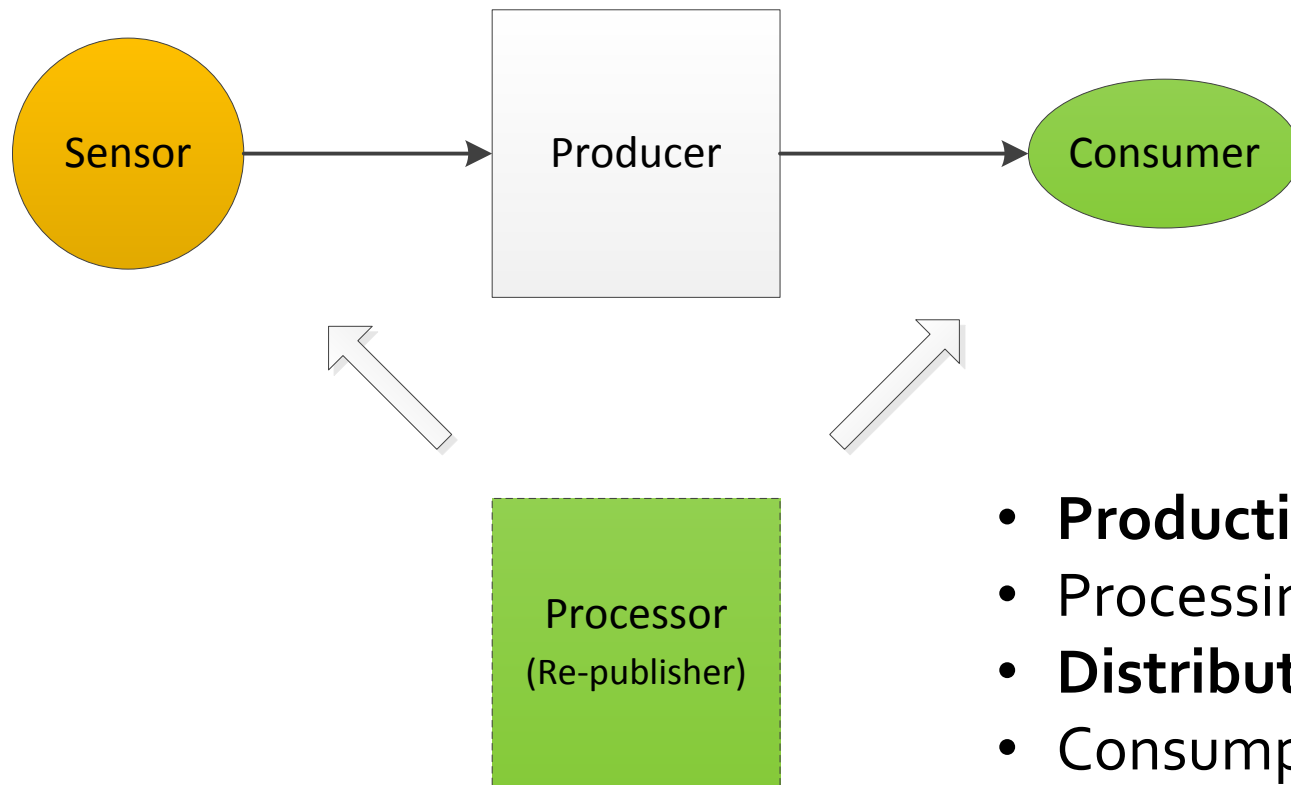
M. Mansouri-Samani. *Monitoring of Distributed Systems*. University of London, 1995.
B Tierney, R Aydt, D Gunter, W Smith, and M Swany. *A grid monitoring architecture*. 2002.

Dissertation Goal: New Generation Monitoring Architecture

- High-level architecture
  - Refinement of GMA (Sensor, Producer, Dist. channel)
  - Focus on current short-comings and in turn focus on general state-of-the-art in related areas
  - Functional and Non-Functional Requirements
- Mid-level architecture
  - Internal design
  - Protocols
  - Data formats
  - Algorithms
- Prototype
  - Proof-of concept / Experimentations
  - Algorithm optimizations