

# Introduction

## Network Monitoring and Management

INNOG 6

March 22 -25, 2023



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# Objectives

## Introduce Core Concepts & Terminology

- Network Monitoring & Management
- What & Why we Monitor
- What & Why we Automate
- Uptime Expectations & Calculations
- Baseline Performance & Attack Detection
- What & Why we Manage
- Network Monitoring & Management Tools
- The NOC: Consolidating Systems

# **NOC: Consolidating NMM Systems**

## **NOC = Network Operations Center**

- Coordination of tasks, handling of network related incidents (ticketing system)
- Status of network and services (monitoring tools)
- Where the tools are accessed
- Store of Documentation (wiki, database, repository  
==> network documentation tool(s))

# NOC: Consolidating NMM Systems (contd...)

## NOC Location

- NOC is an organizational concept
- Does not need to be a place, or even a single server
- Remote / Distributed NOC is valid with OOB Management



# Network Monitoring and Management

- Monitoring
  - Check the status of a network
- Management
  - Processes for successfully operating a network
- Automation
  - Technology by which a process or procedure is performed with minimal human assistance.

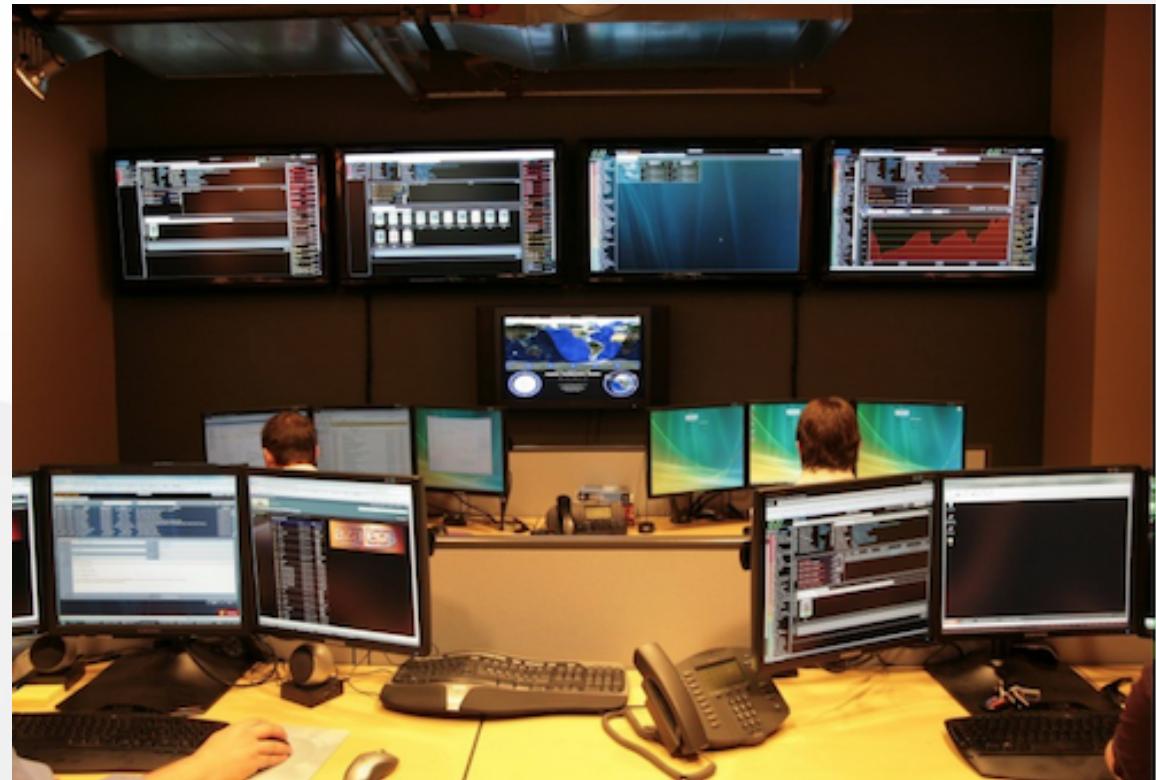
# Monitoring Systems & Services

## Systems

- Routers
- Switches
- Servers

## Services

- DNS
- HTTP
- SMTP
- SNMP



# Why do we Monitor?

- Are Systems and Services Reachable?
- Are they Available?
- What's their Utilisation?
- What's their Performance
  - Round-trip times, throughput
  - Faults and Outages
- Have they been Configured or Changed?
- Are they under Attack?

# Why do we Monitor? (contd...)

- Know when there are problems – before our customers!
- Track resource utilisation, and bill our customers
- To Deliver on Service Level Agreements (SLAs)
  - What does management expect?
  - What do customers expect?
  - What does the rest of the Internet expect?
- To prove we're delivering
  - Have we achieved Five Nines? 99.999%
- To ensure we meet SLAs in the future
  - Is our network about to fail? Become congested?

# Uptime Expectations

- What does it take to deliver 99.9% uptime?
  - Only 44 minutes of downtime a month!
- Need to shut down one hour a week?
  - That's only 99.4% uptime ( $(732-4)/732 = .9945355\dots$ )
- Maintenance might be negotiated in SLAs
- What does it mean that the network is up?
  - Does it work at every location? Every host?
  - Is the network up if it works at the Boss's desk?
  - Should the network be reachable from the Internet?

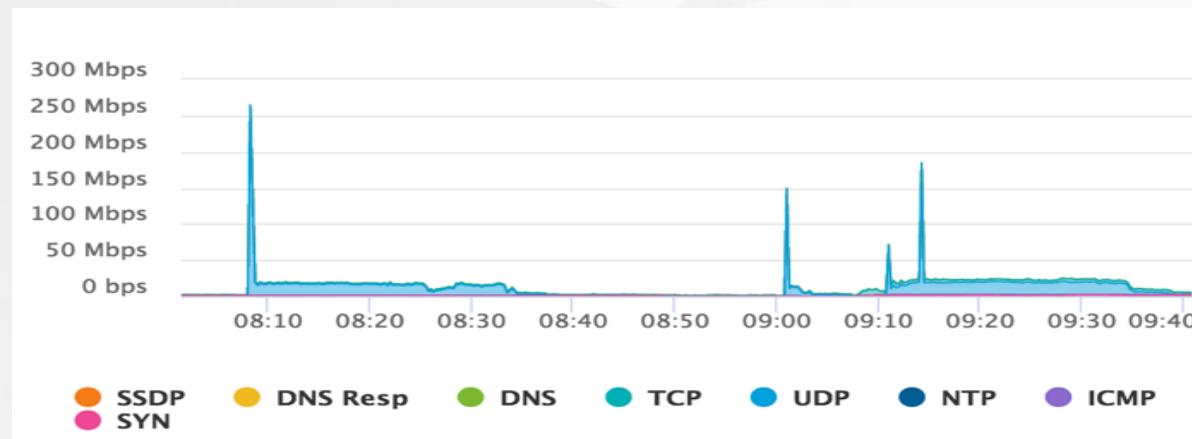
# Establishing a Baseline

- Monitoring can be used to Establish a Baseline
- Baseline = What's normal for your network?
  - Typical latency across paths
  - Jitter across paths
  - Load on links
  - Percent Resource Utilisation
  - Typical amounts of noise
    - Network scans & random attacks from the Internet
    - Dropped packets
    - Reported errors or failures

# Detecting Attacks

- Deviation from baseline can mean an attack
- Are there more flows than usual?
- Is the load higher on some servers or services?
- Have there been multiple service failures?

These things could mean an attack



# What do we Manage?

- Asset management: What equipment have we deployed?
  - What software is it running
  - What's its configuration (hardware & software)
  - Where is it installed
  - Do we have spares?
- Incident management: fault tracking and resolution
- Change management: Are we satisfying user requests?
  - Installing, moving, adding, or changing things
- Staff management

# Why do we Manage?

- To ensure we meet business requirements for service level, incident response times etc
- To make efficient use of our resources (including staff)
- To learn from problems and make improvements to reduce future problems
- To plan for upgrades, and make purchasing decisions with sufficient lead time

# Network Monitoring Tools

- Availability: [Nagios](#)
  - for servers, services, routers, switches, environment
- Reliability: [Smokeping](#)
  - connection health, rtt, service response time, jitter
- Performance: [LibreNMS](#), [cacti](#)
  - traffic, port utilisation, cpu, RAM, disk, processes

Integration & overlap exists between these programs!

# Network Management Tools

- Ticket Systems: [osTicket](#), [RT](#)
  - Manage provisioning & support
- Configuration Management: [RANCID](#)
  - Track router configurations
- Network Documentation: [Netbox](#), [Netdot](#)
  - Inventory, Location, Ownership of Network Assets

Integration & overlap exists between these programs!

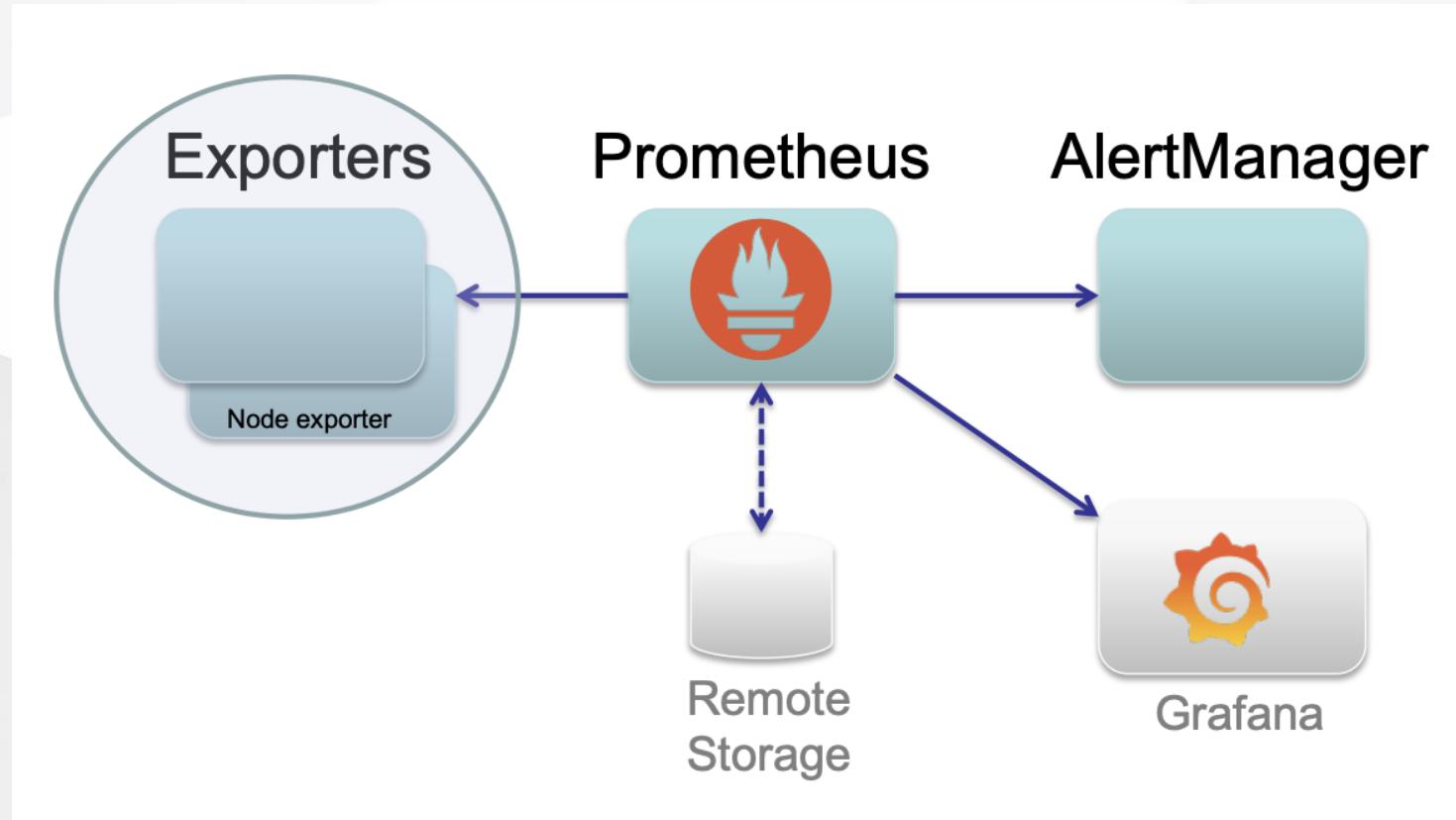
# A few Open Source NMM Tools

Performance	Change Management	Net Management	Ticketing	Utilities
flowc	Mercurial	Cacti	RT	SNMP
mrtg	RANCID	LibreNMS	Trac	Perl
NetFlow	CVS	Nagios	Redmine	Ping
NfSen	Subversion	OpenNMS		Python
ntop	git	Zabbix		
RRDTool	SNORT	Netdot		
SmokePing	Nessus	IPplan		

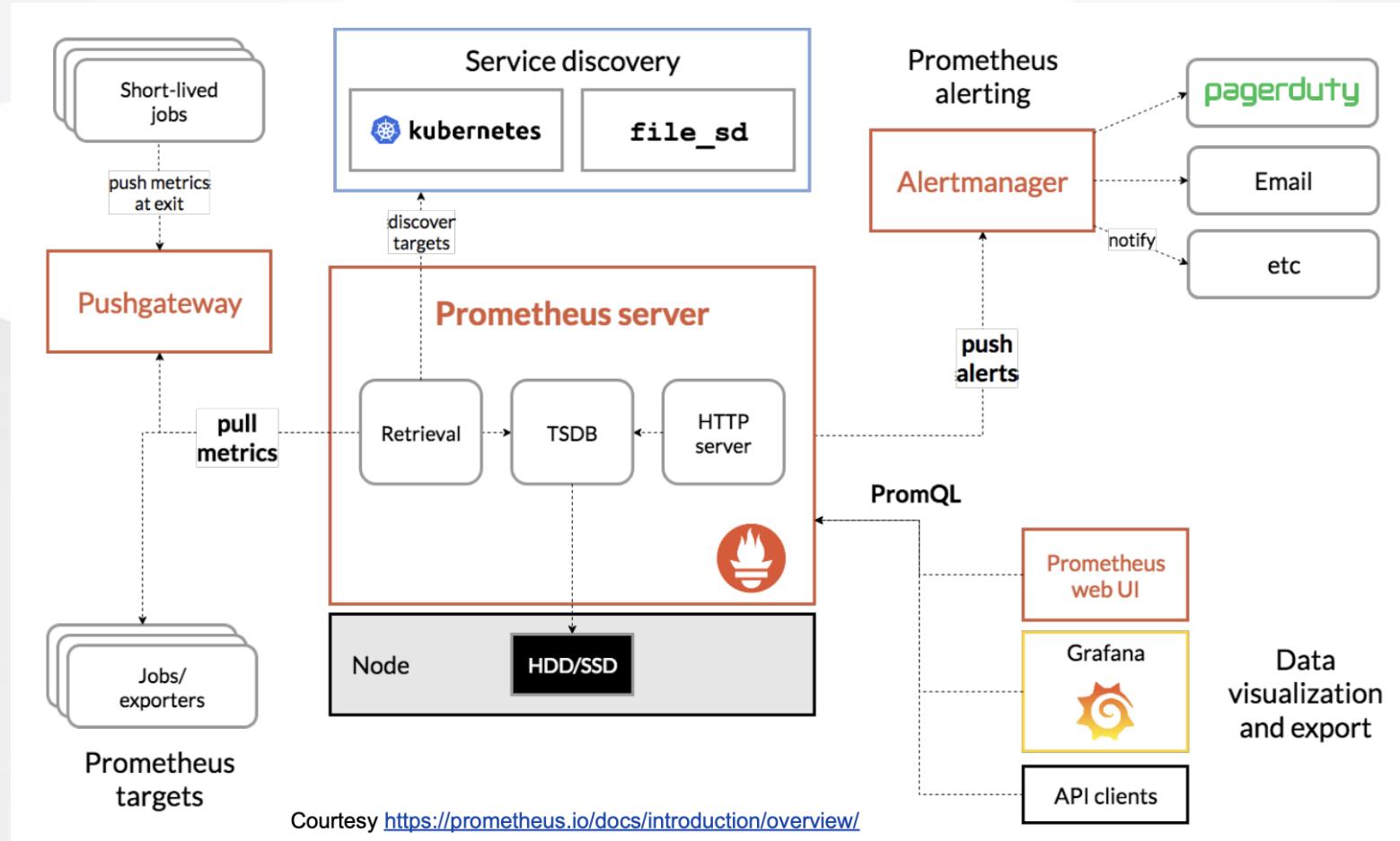
# Mordern Scalable NMM stacks

- Present day network measurement “Stacks” are a group of software components that work together to form a monitoring and management solution.
- Typical stacks include (more or less):
  - Mechanism(s) to push data to a data store (agents, protocols, both)
  - A time series or NoSQL data store
  - An engine to query the data store and present results in a graphical format in a dashboard format.
  - A built-in or separate alerting component that works with the data store
  - Note that many components are interchangeable between stacks

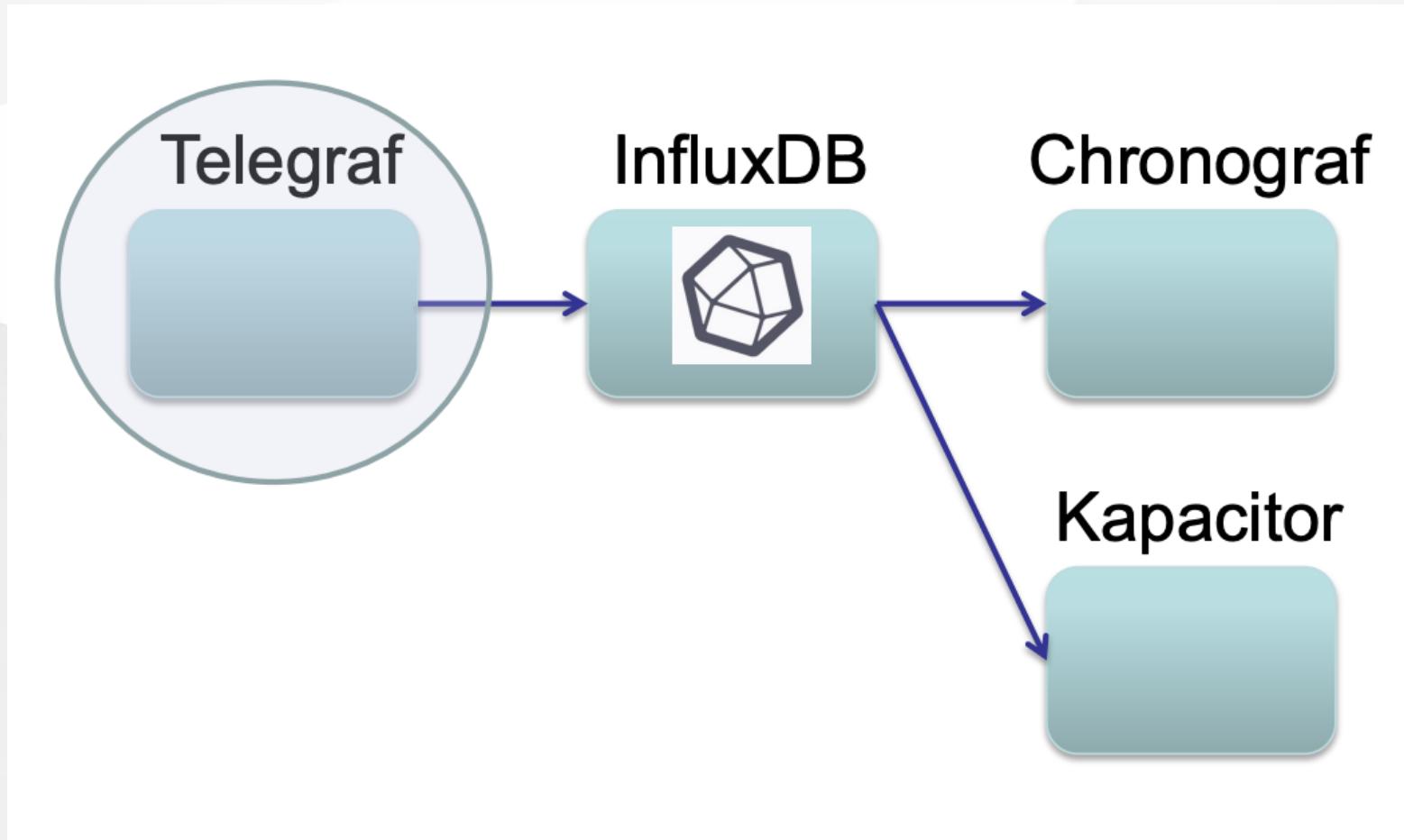
# Prometheus



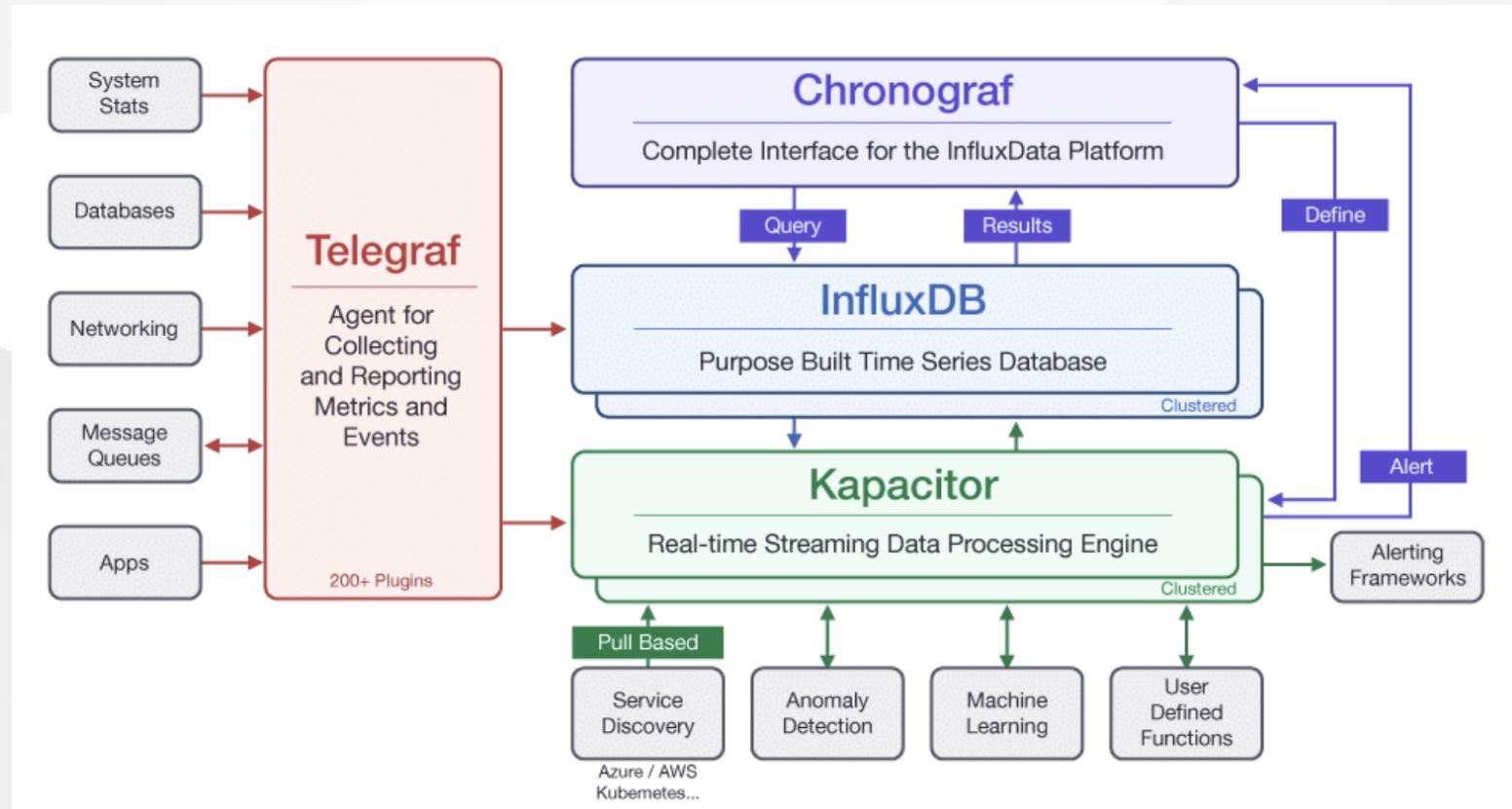
# Prometheus workflow



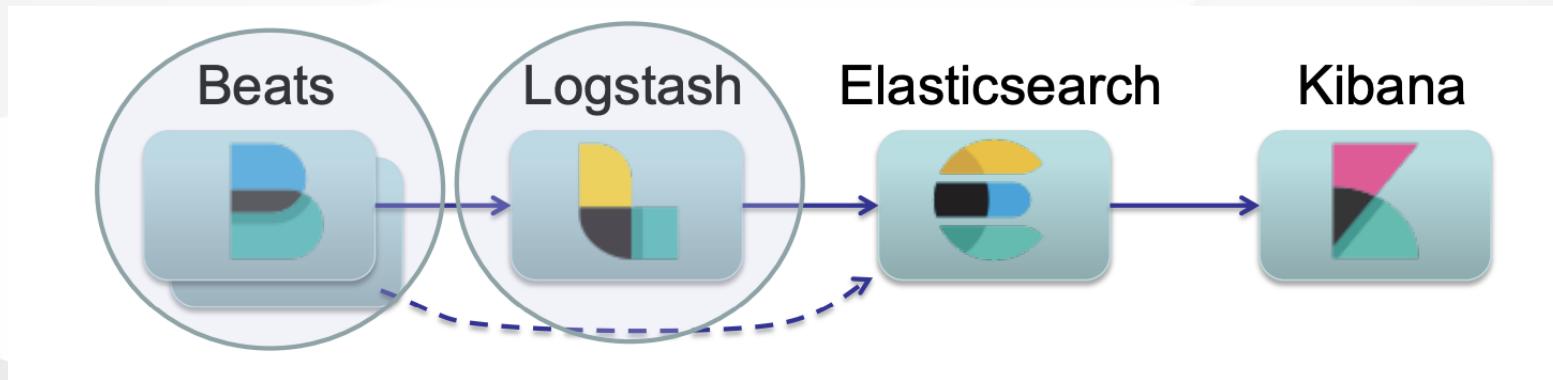
# InfluxDB TICK



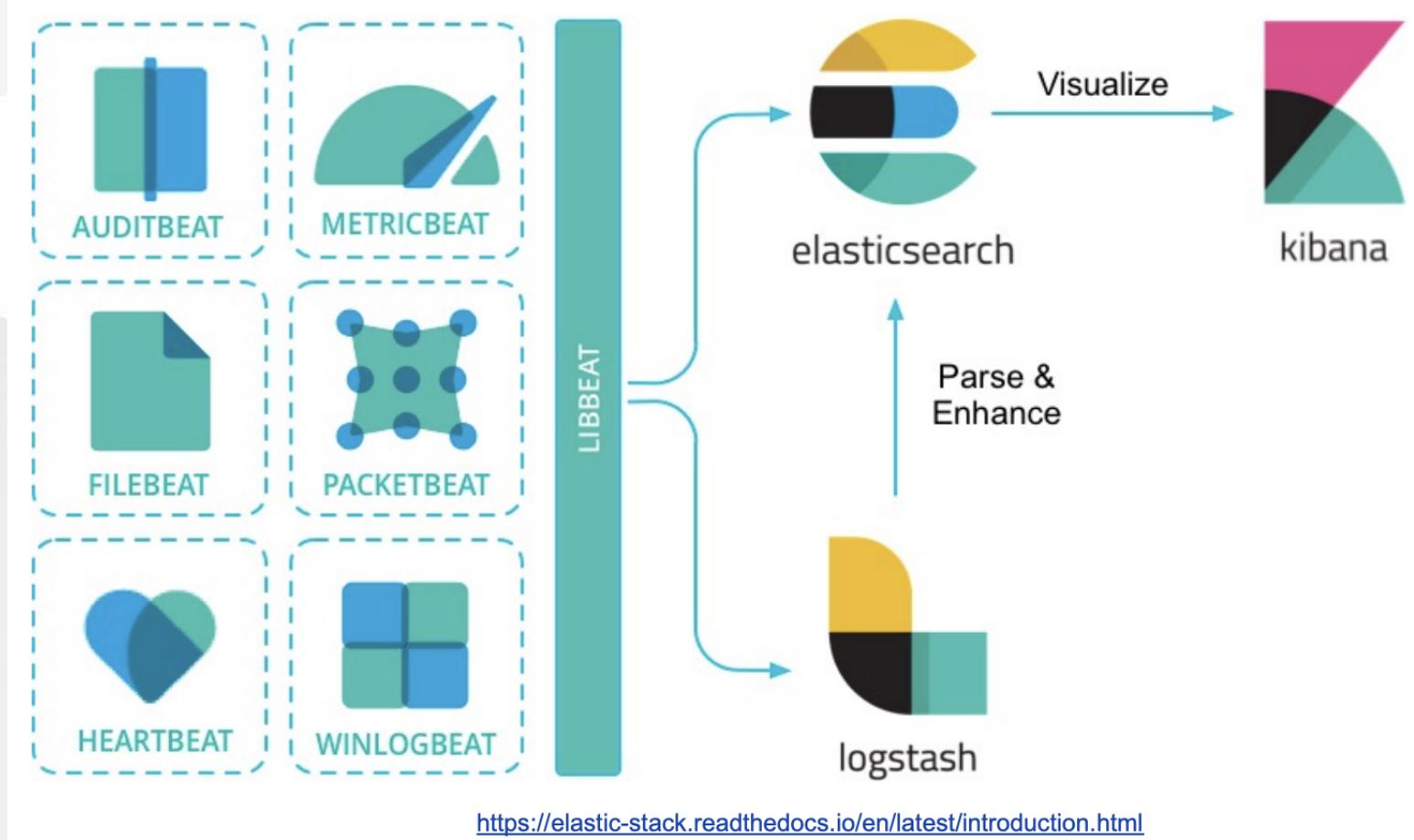
# InfluxDB TICK Details



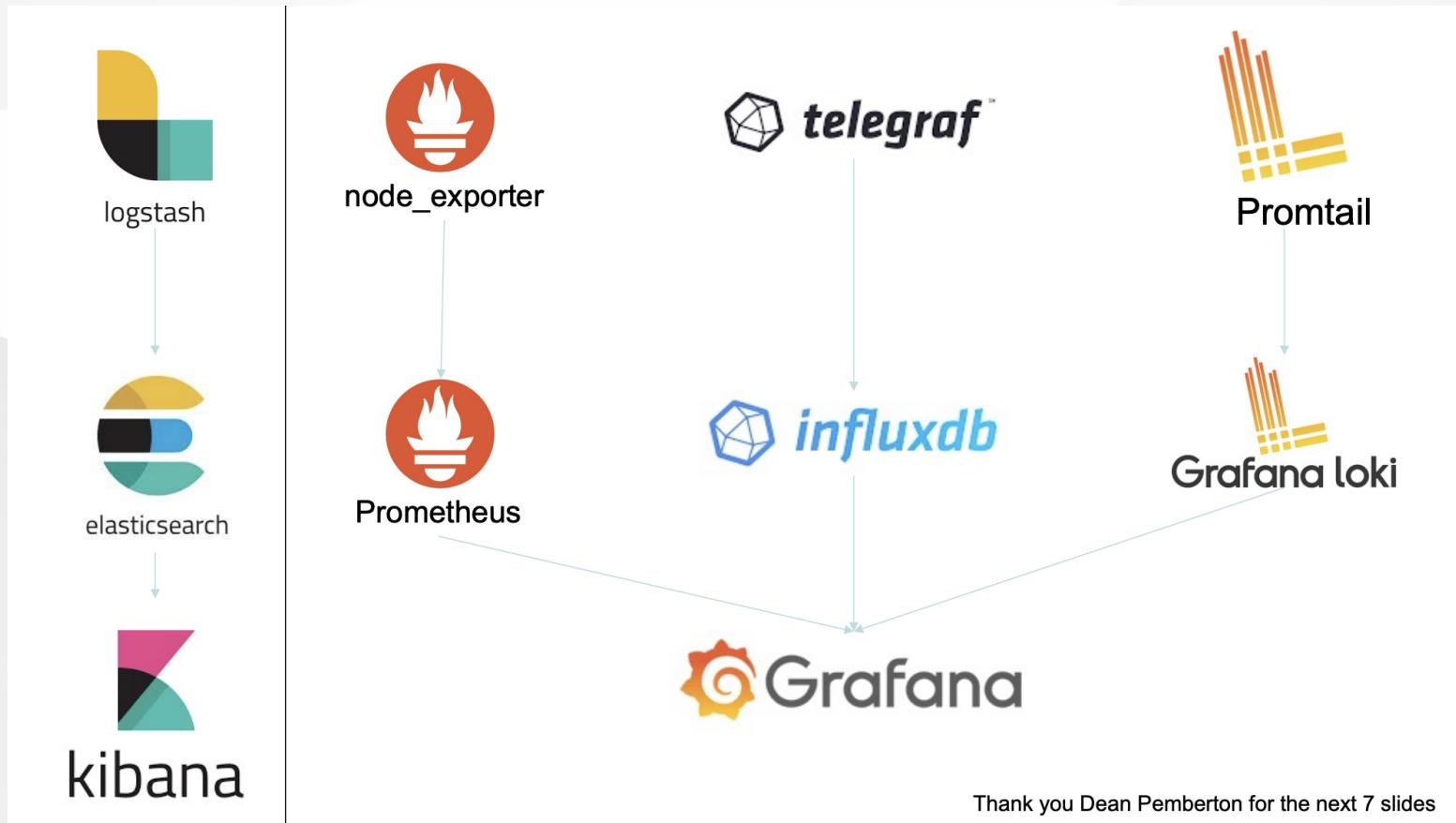
# Elastic Stack (ELK)



# Elastic Stack (ELK) Details

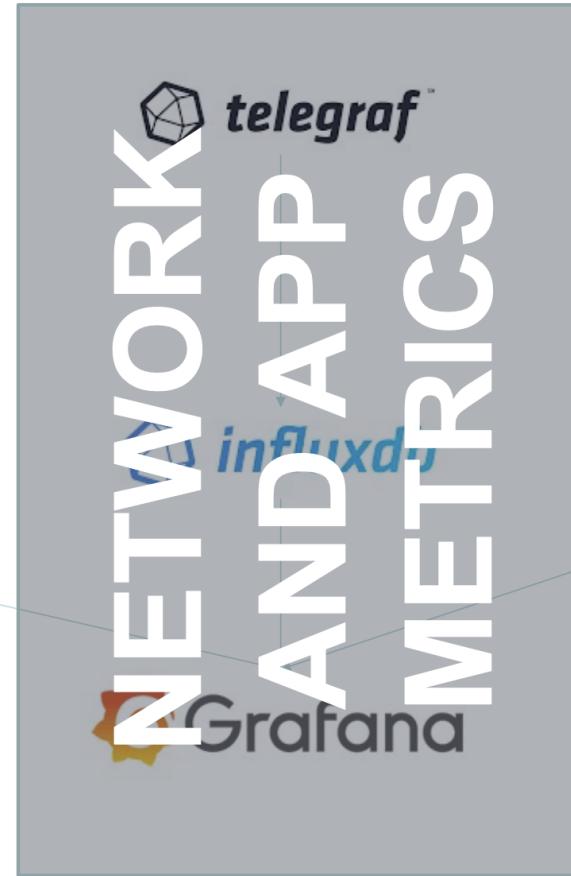


# Comparision

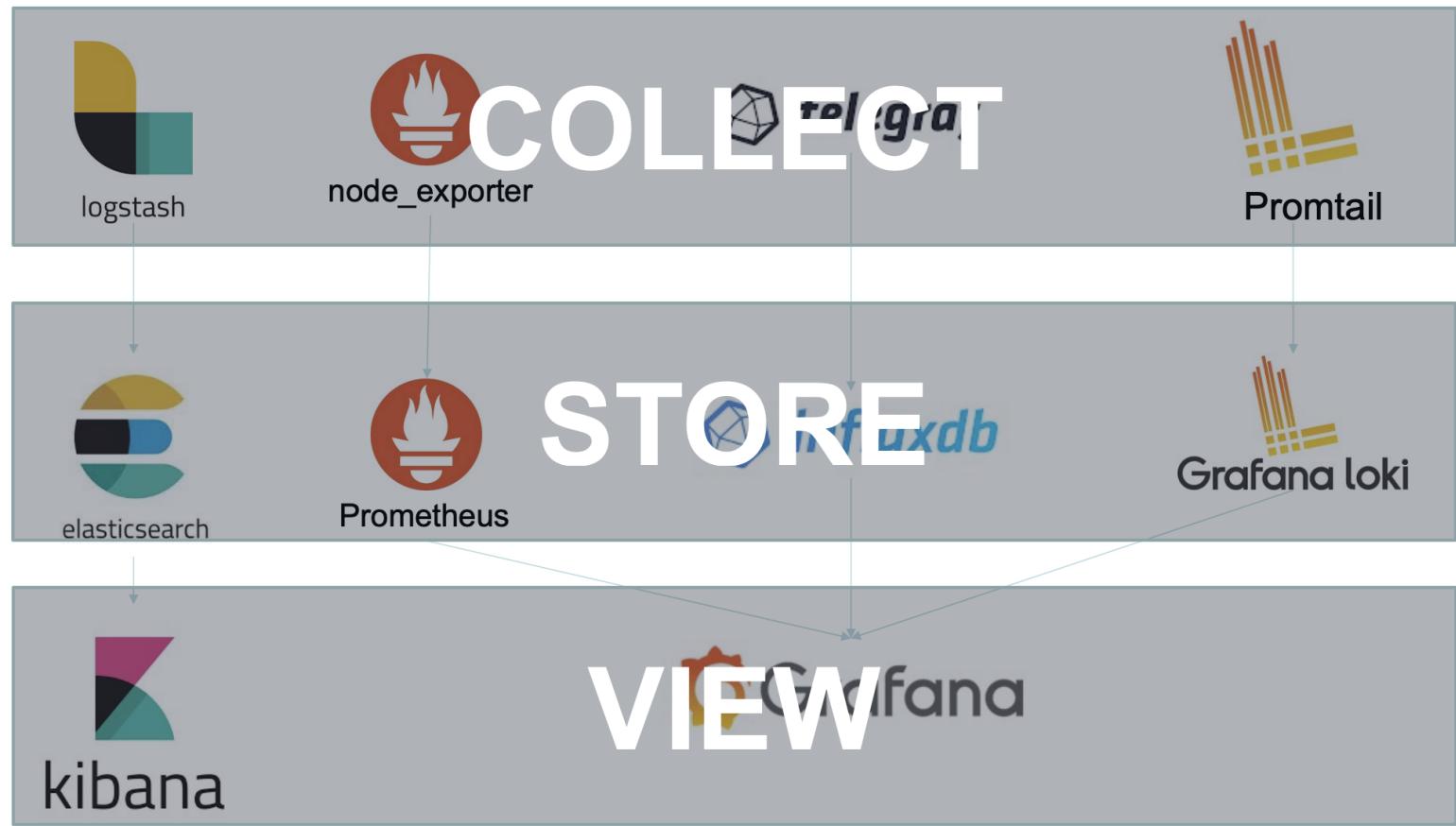


Thank you Dean Pemberton for the next 7 slides

# Usages



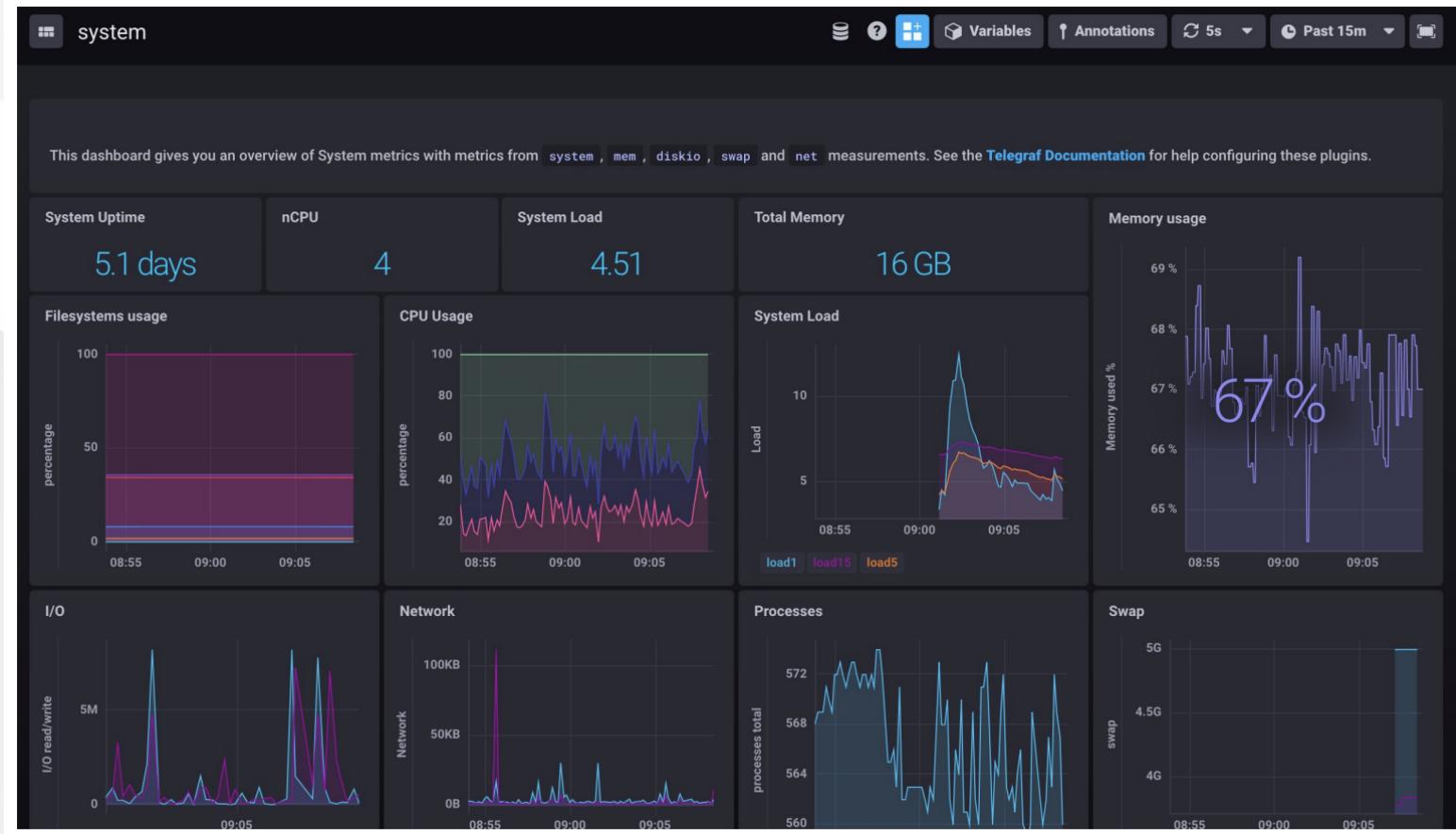
# Layers



# Grafana Dashboard



# Chronograf Dashboard



# NMM Review

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- Uptime Expectations & Calculations
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- Network Attack Detection
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