# UTILIZING MONITORING AND REPORTING TECHNIQUES IN DATA PROCESSING SYSTEMS TO IMPROVE THE VALUE ADDING OF DATA

**Johanna Senft, Henrike Barkmann, Sven Stönner, Max Wegner**

DLR

# Introduction

- **DLR‘s Remote Sensing Data Center (DFD)** processes daily
  → more than 20 TB of remote sensing data
  → using more than 70 processing chains.

- Processing chains **Input data** of is of varying quality
  → it may be degraded by external and internal influences.

- **DFD’s Monitoring & Reporting System** is needed to ensure:
  → reliable data processing,
  → adequate performance,
  → effective operation,
  → and stable resource usage.

DLR Remote Sensing Data Center, Oberpfaffenhofen

DLR Remote Sensing Data Center, Neustrelitz

# Agenda

- Section I : IMPC and IMPC data process
- Section II: DFD’s Monitoring & Reporting System (DFD M&R)
- Section III: Use cases
- Section IV: Observation Discussion; Conclusion

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# Section I: The IMPC / IMPC data process

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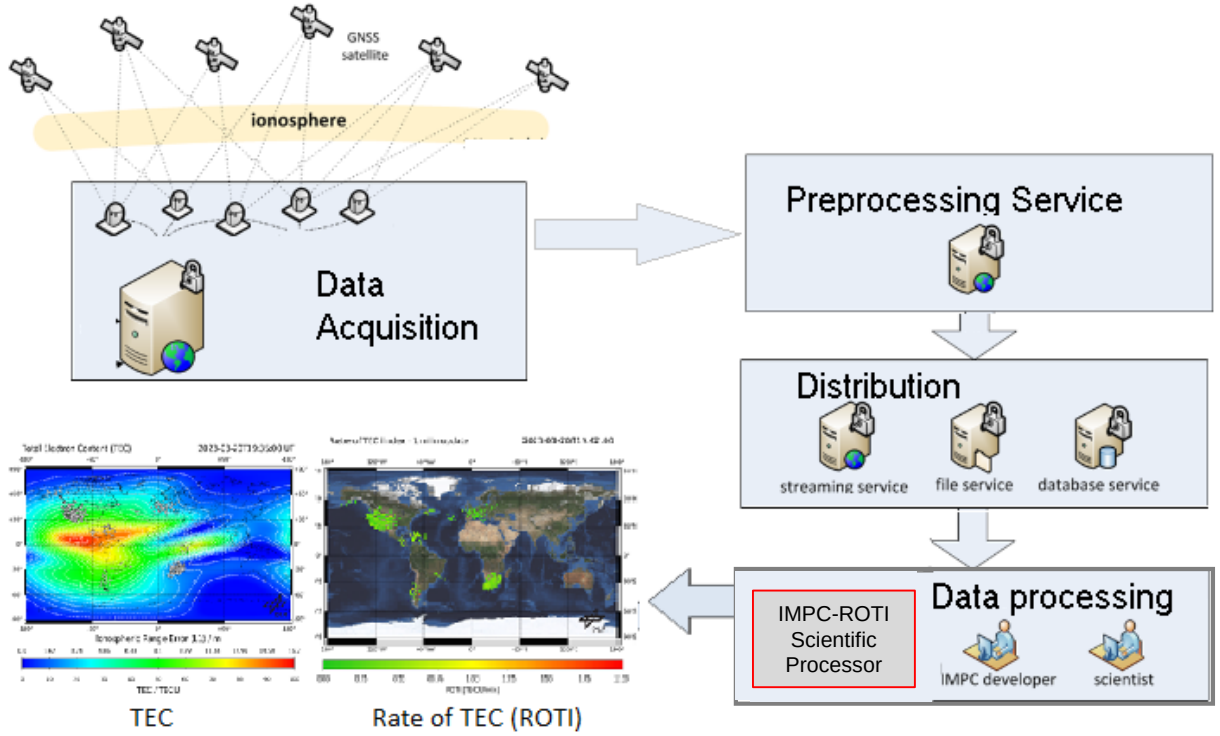

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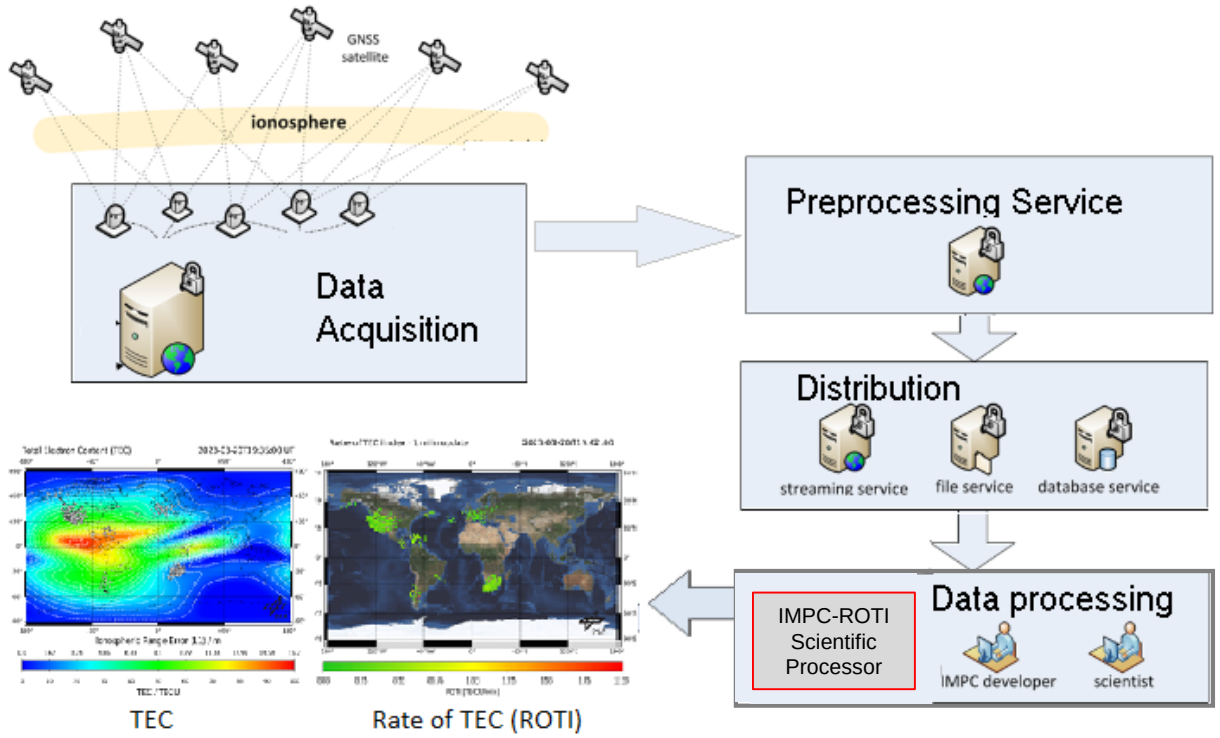
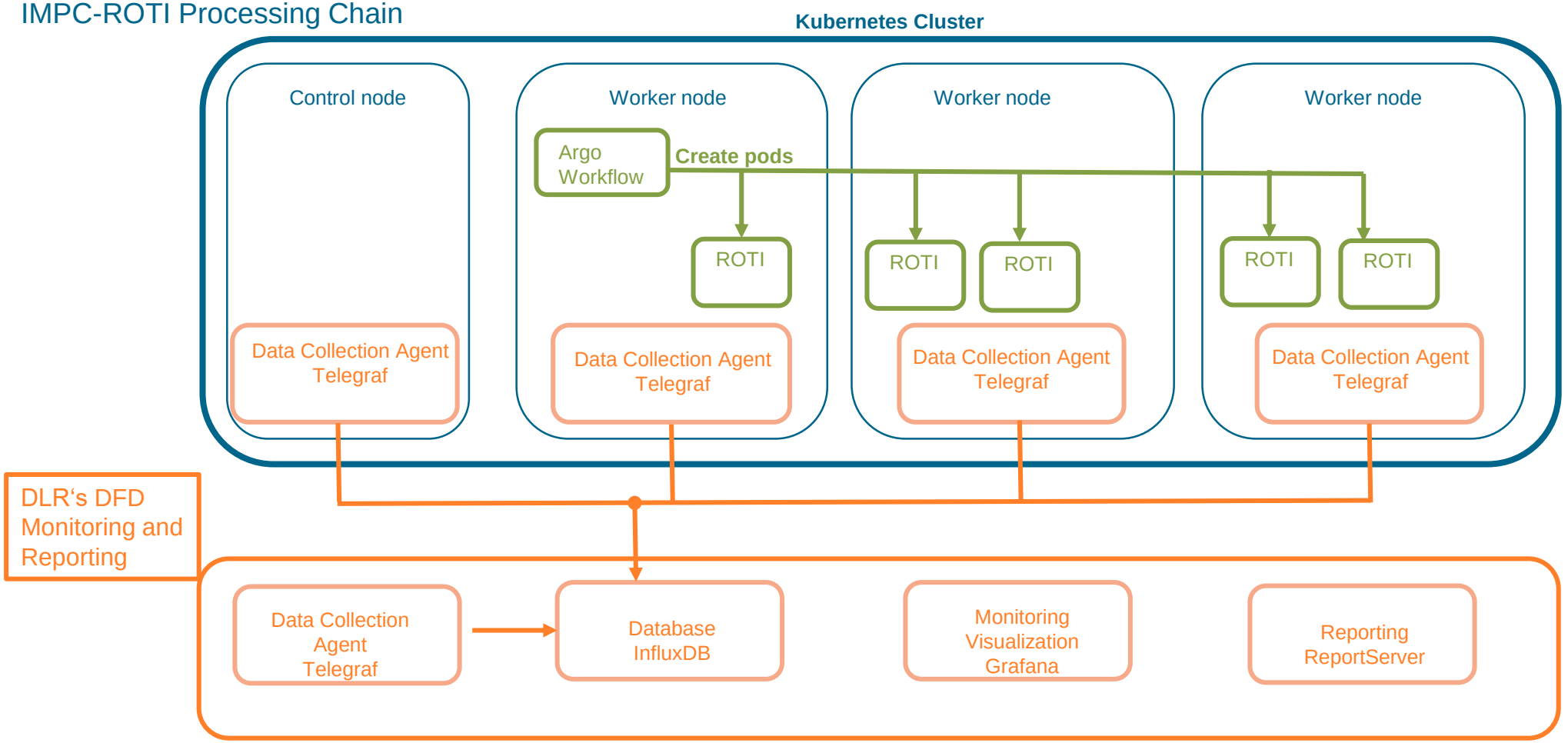



- Daily more than 50 GiB ionosphere data are processed and archived
- Including 2888 ROTI, 288 TEC products
- 1588 products for GNSS users

# Section I: The IMPC / IMPC data process

## System architecture

IMPC-ROTI Processing Chain



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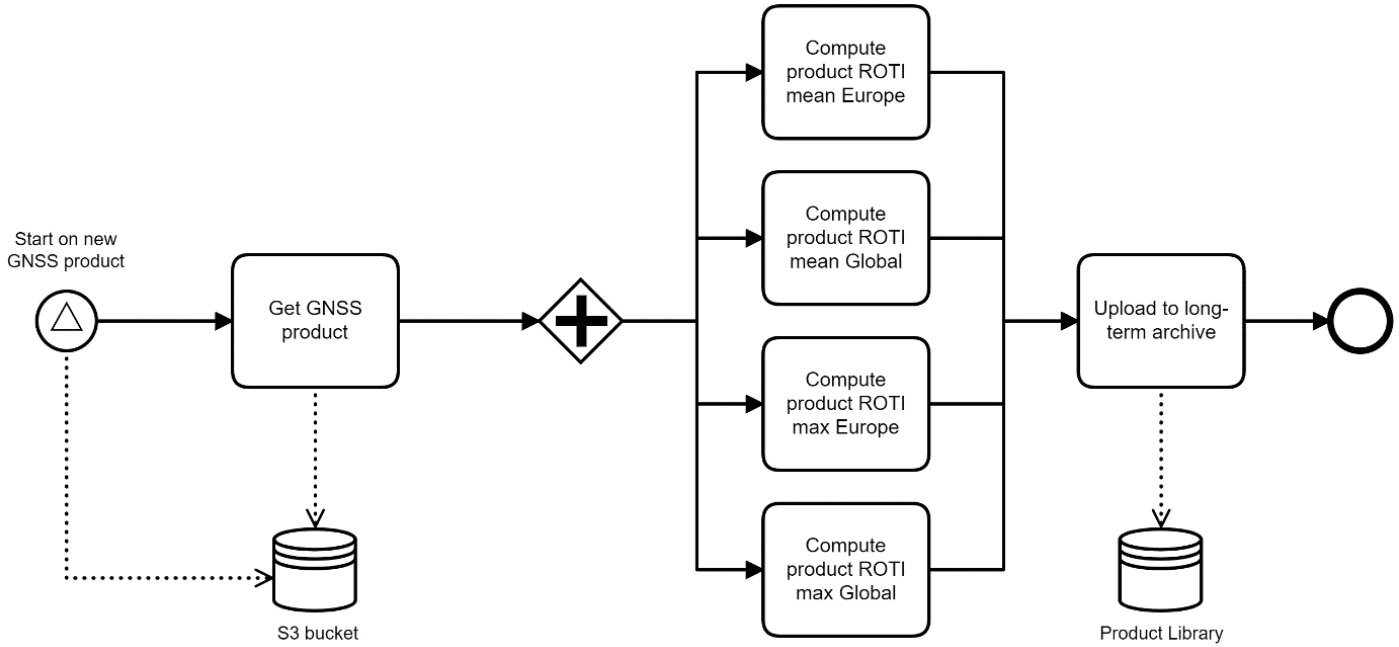

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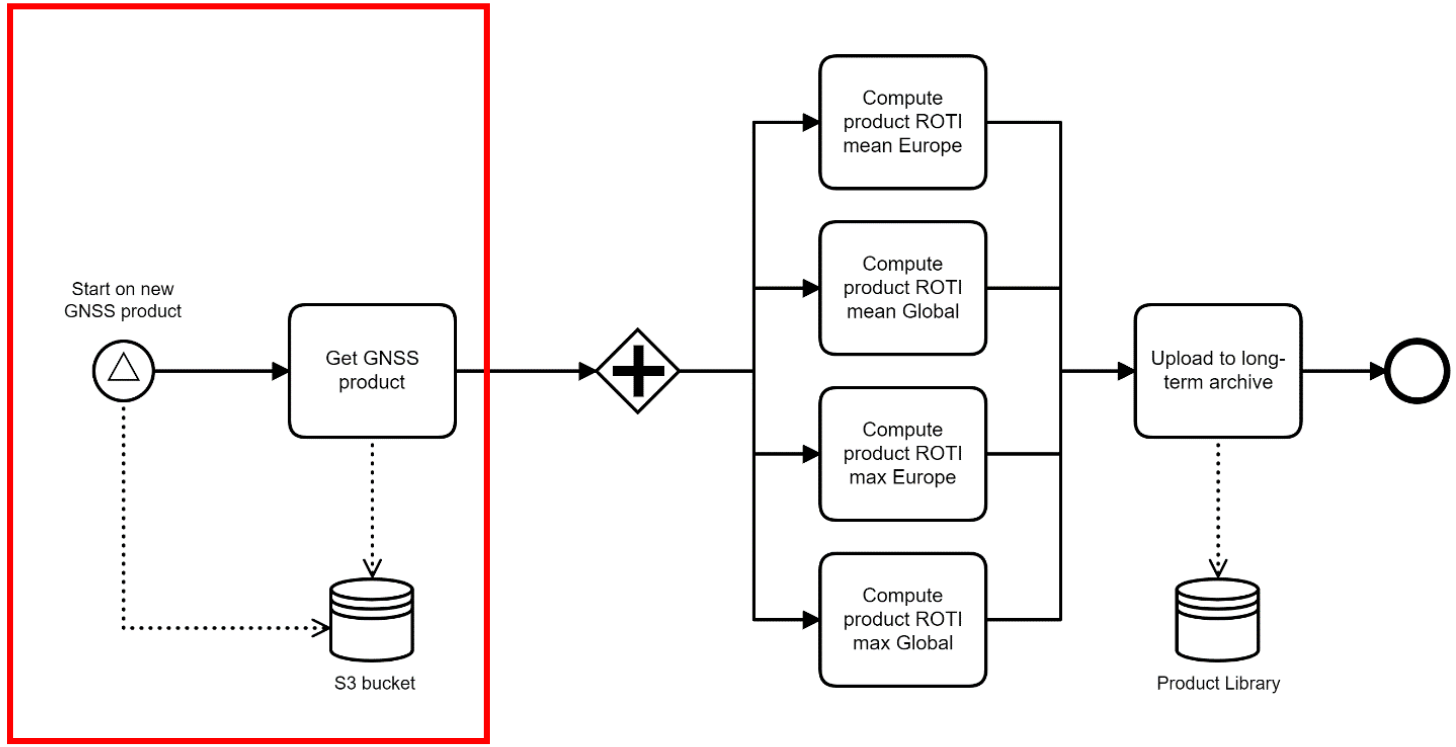

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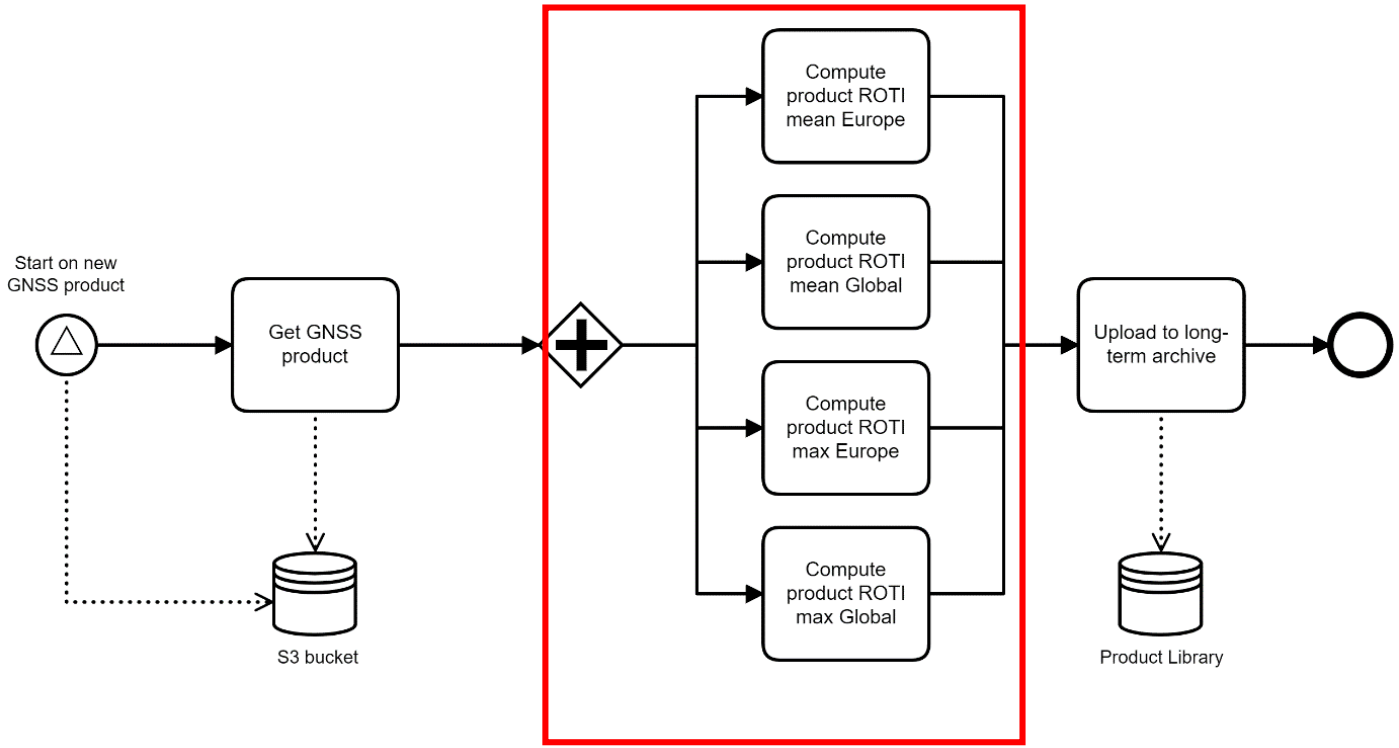

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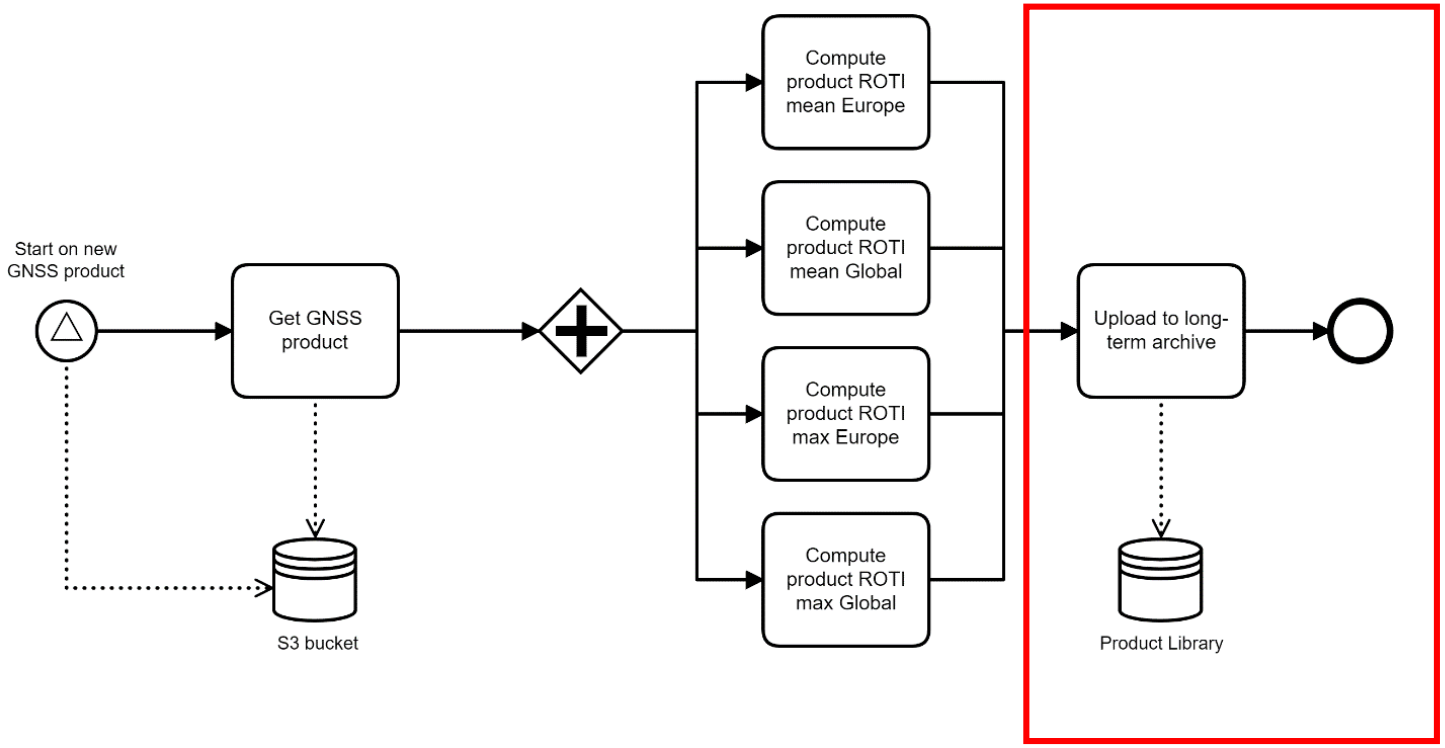
- Transfer data into a long-term archive
- Upload data to a remote data sink.



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Requires Monitoring and Reporting to ensure:

- well-functioning
- performance
- overall data quality

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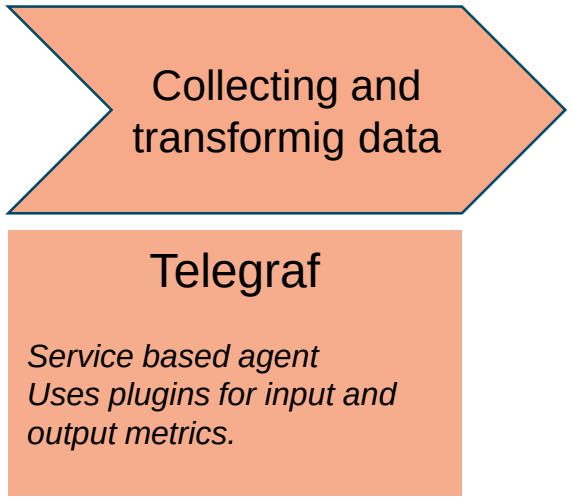

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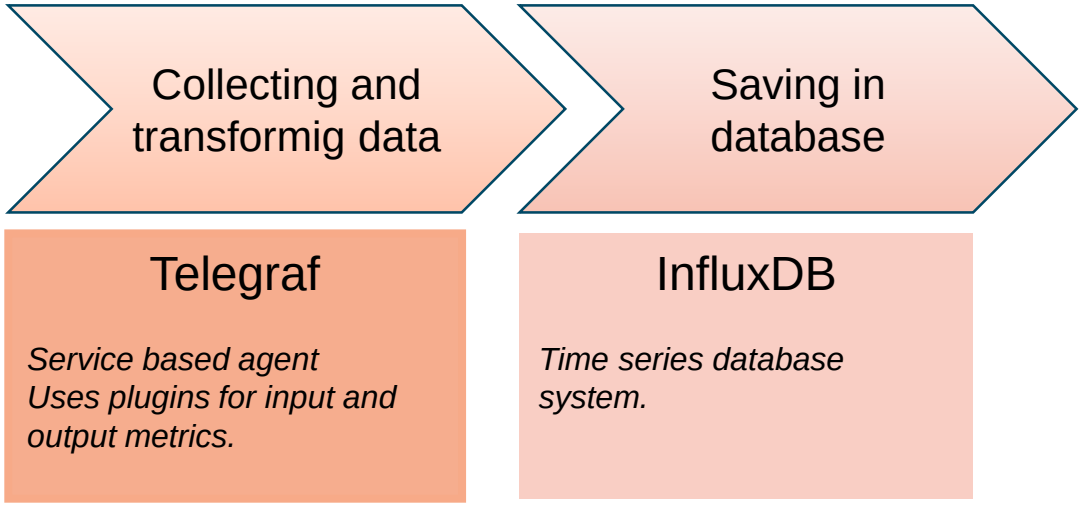

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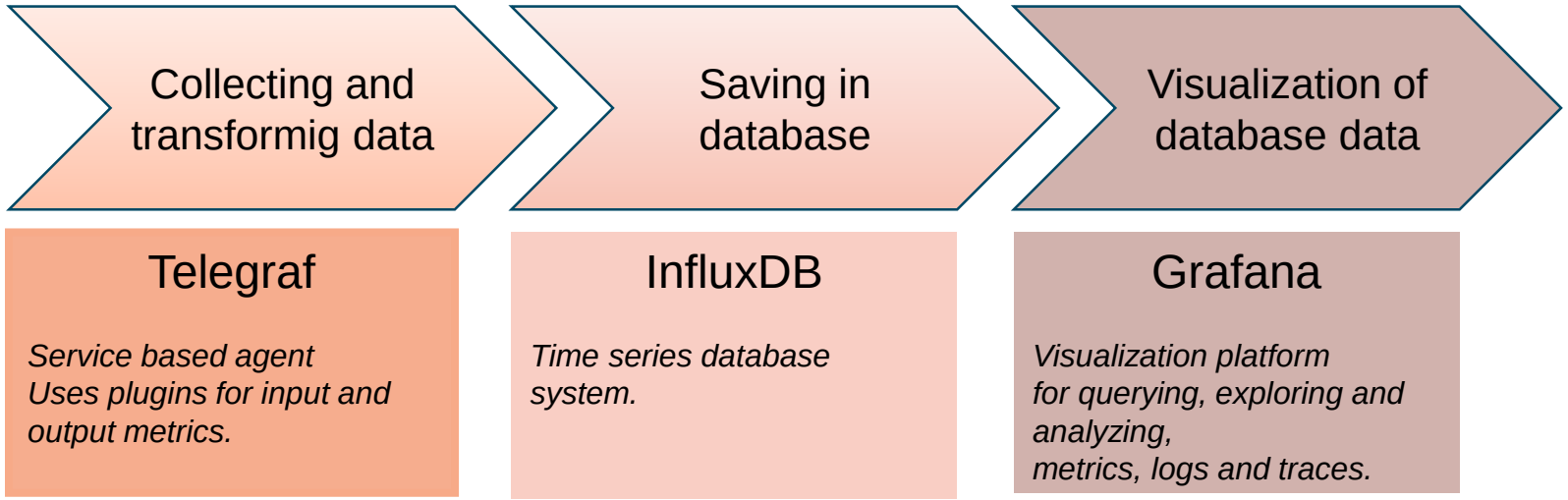

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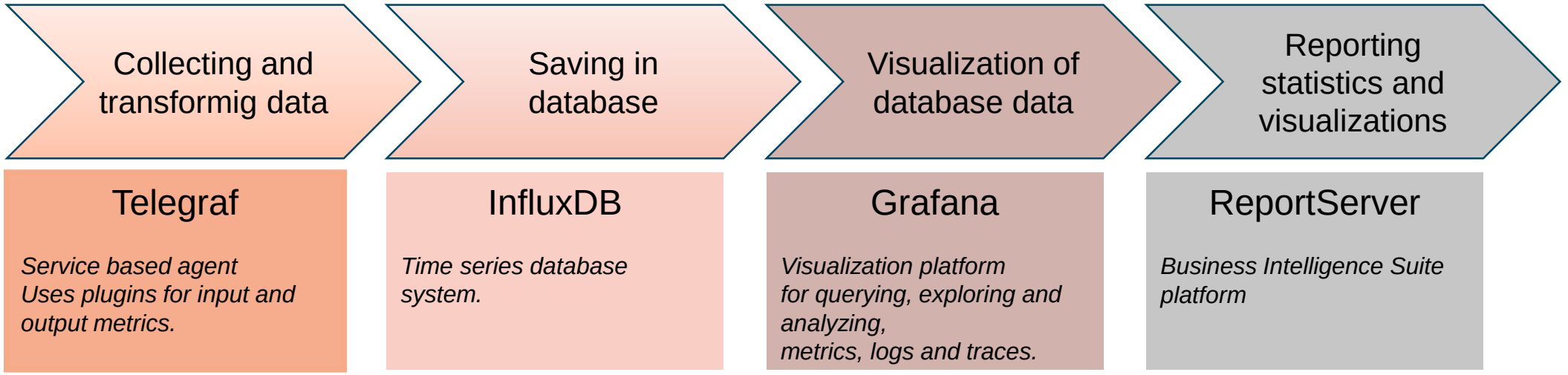

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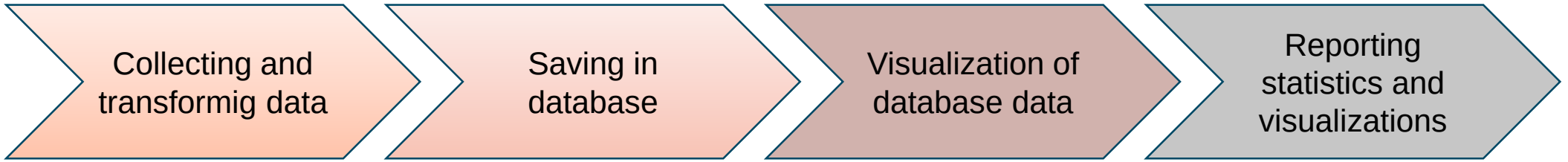


## Telegraf

*Service based agent*
*Uses plugins for input and output metrics.*

**Application IMPC-ROTI**

*Collects:*

- *system metrics,*
- *Kubernetes metrics*
- *Argo-WF metrics*
- *Saves metrics directly in Database*

## InfluxDB

*Time series database system.*

## Grafana

*Visualization platform for querying, exploring and analyzing, metrics, logs and traces.*

## ReportServer

*Business Intelligence Suite platform*

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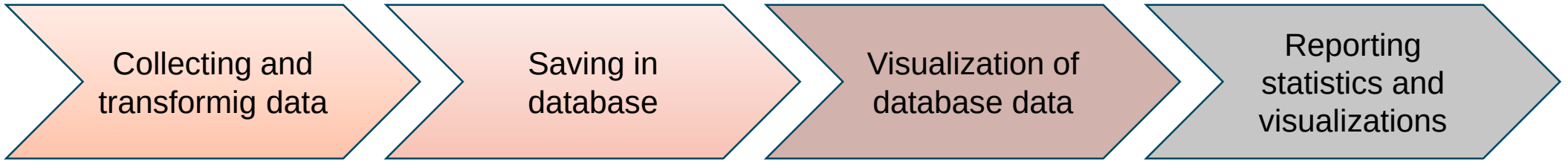


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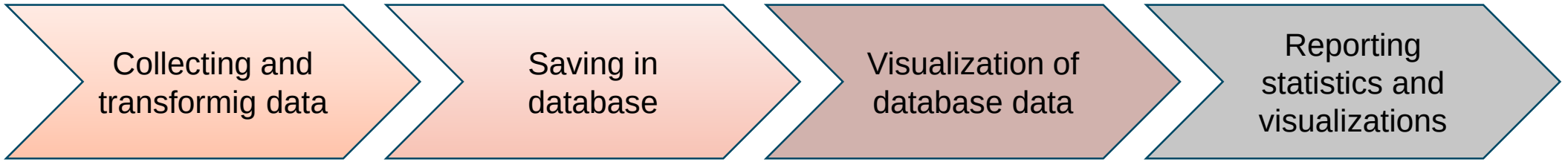


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*Displays collected data in an operator friendly manner*
- *Quick Overview Dashboard*
- *WF Status Dashboard*
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- *Kubernetes Dashboard*

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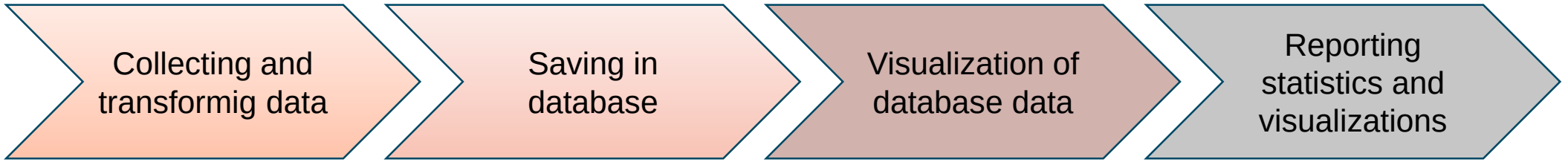


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## ReportServer

*Business Intelligence Suite platform*

**Application IMPC-ROTI**

*Compiles reports by querying Influx-DB:*
- *System Usage Report*
- *System Error Report*
- *Resources Report*

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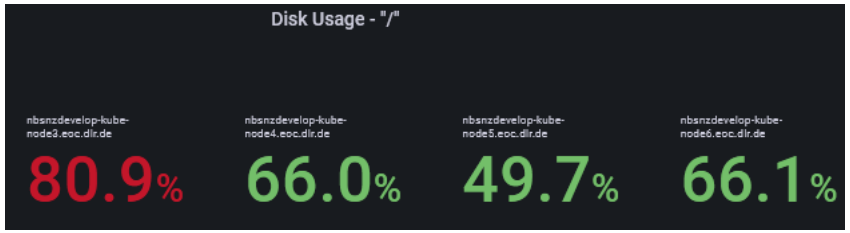

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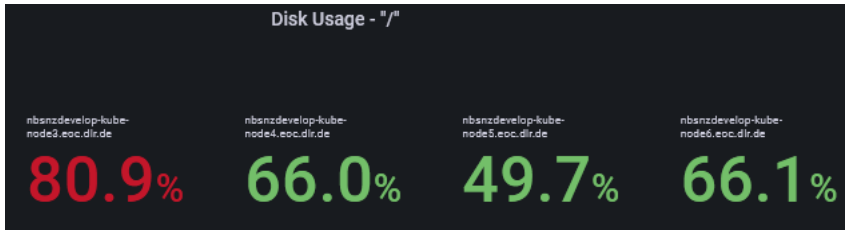


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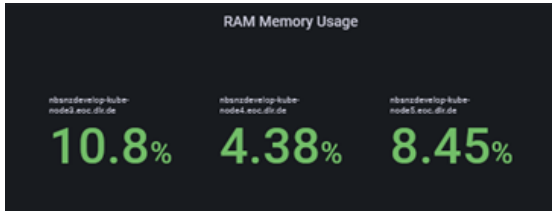

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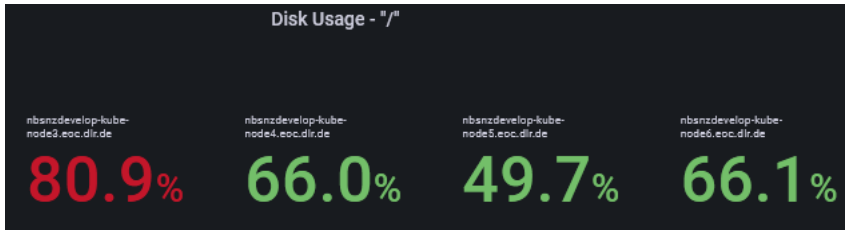


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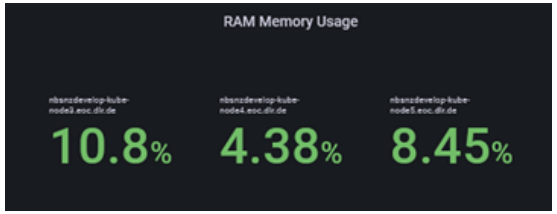


Operator alarms

System crash can be averted

Reporting: system usage, ressources report

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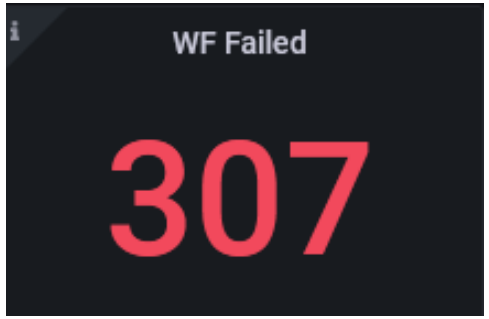


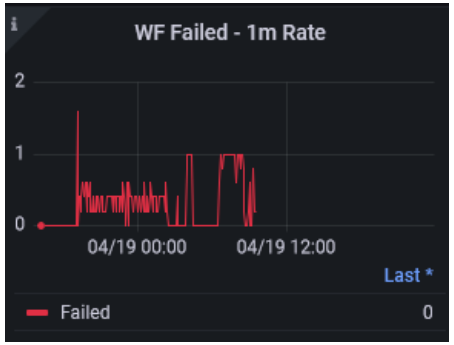

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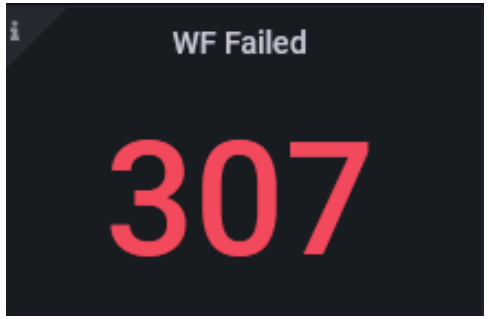
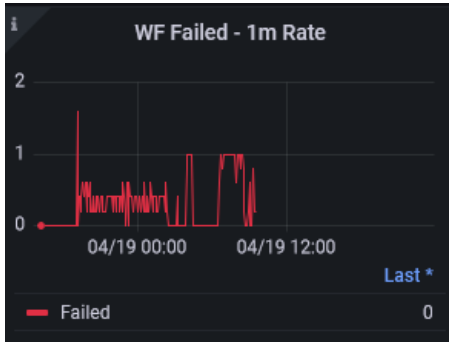
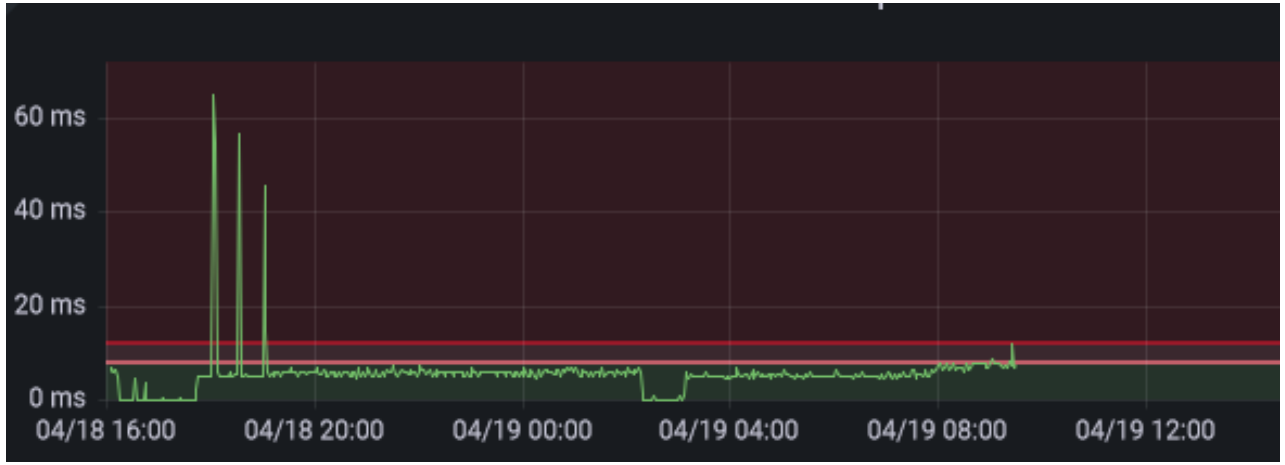



## Workflow Duration of operation



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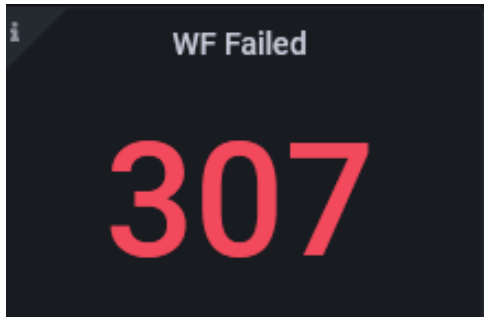


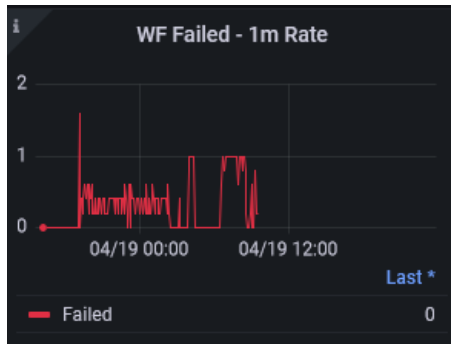


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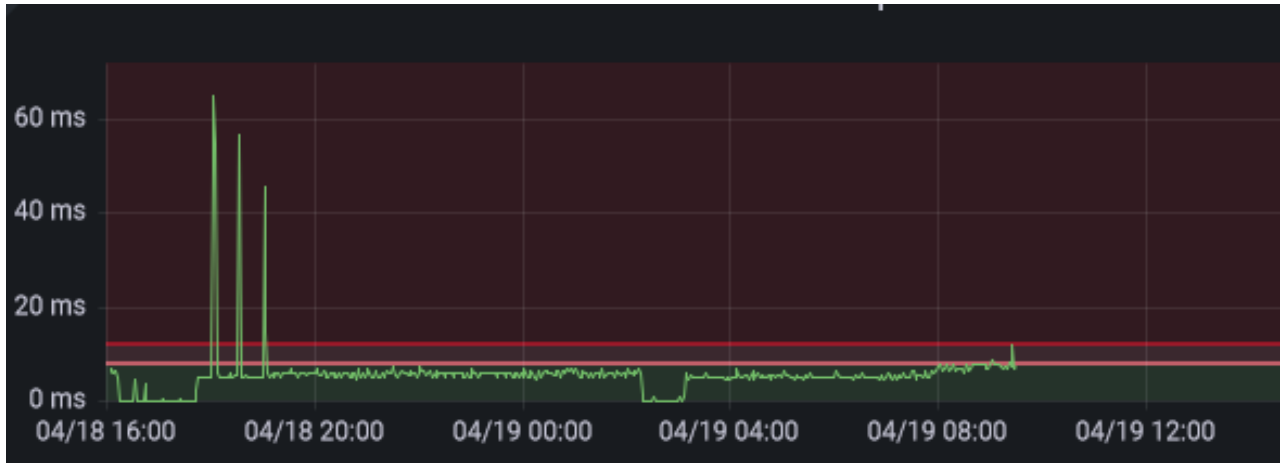


Operator alarms

Recognize performance problems caused by new processing products

Reporting: system error, ressources report

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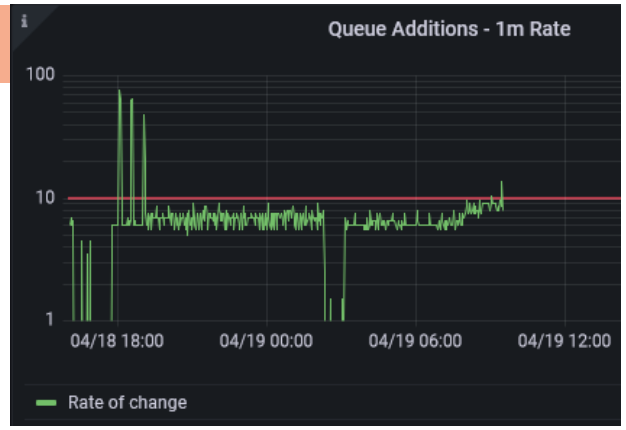

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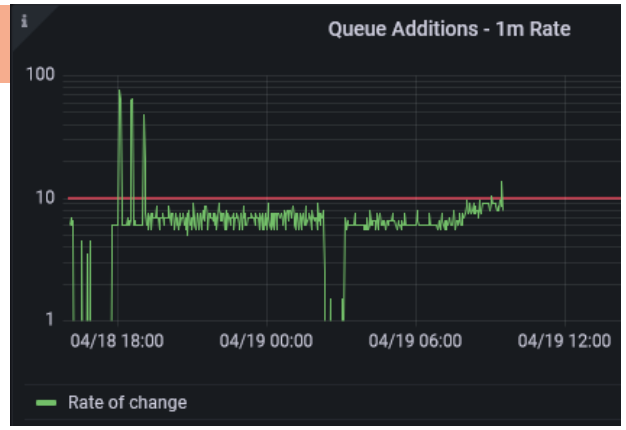
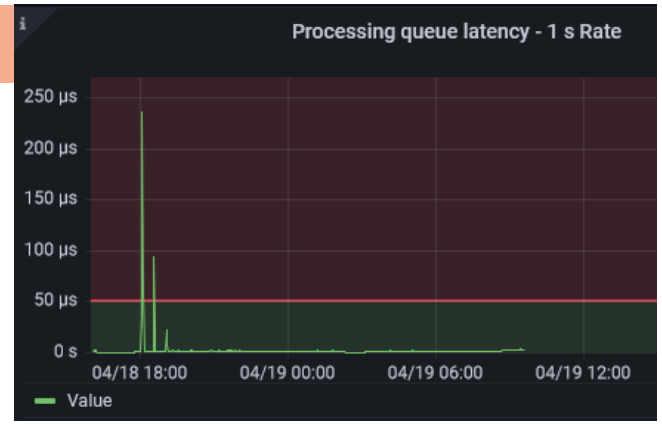



## WF-Queue Latency



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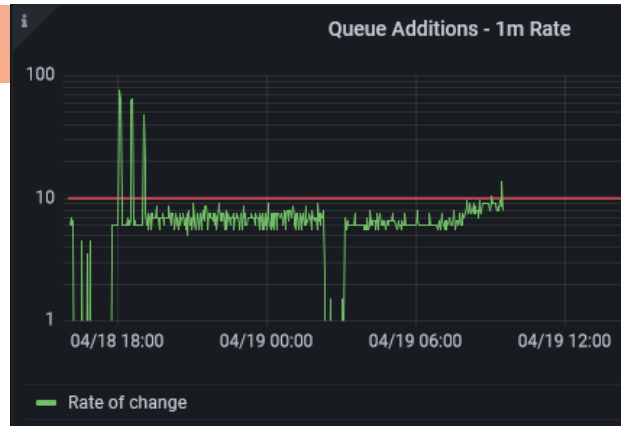


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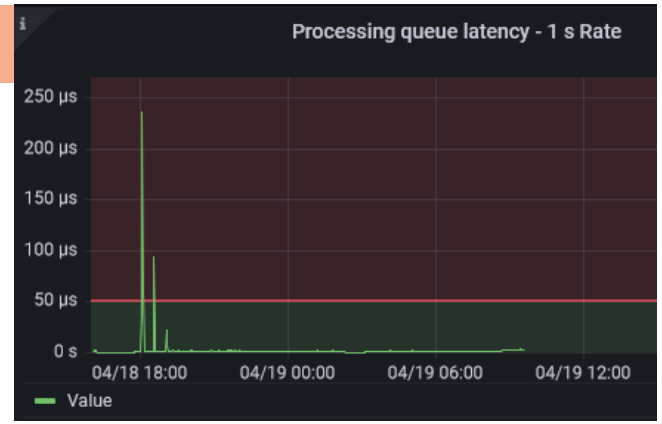


## Operator alarms

Bottlenecks are identified quickly

Reporting: system error, system usage, ressources report

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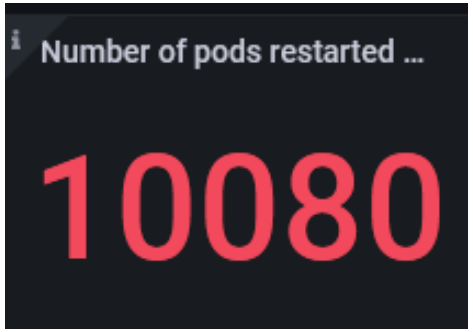

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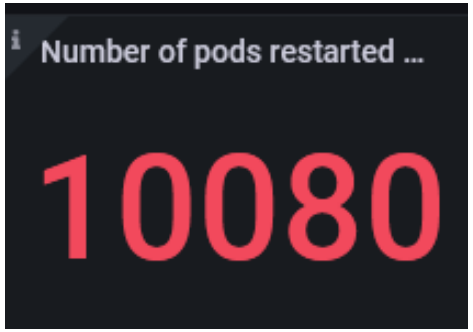


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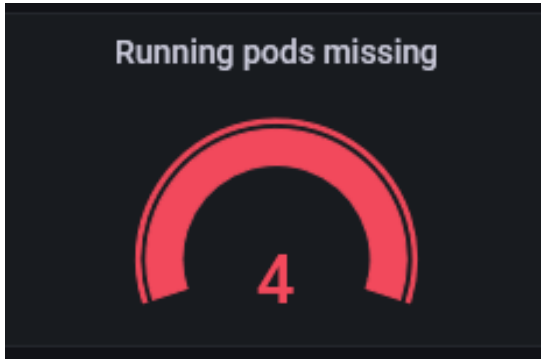

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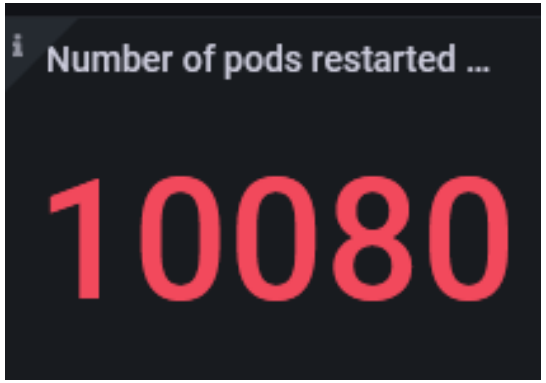


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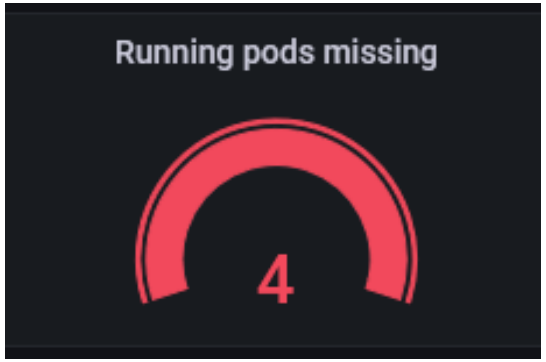


Operator alarms

Provide a stable operation between system components

Reporting: system error, system usage, ressources report

# Section III: Use cases: Reports

## System Usage Report

| CPU- , Memory-, Disk-Usage | Designed for operators |
|---|---|

| Time | node1 | node2 | node3 | node4 | node5 | node6 | node7 |
|---|---|---|---|---|---|---|---|
| 17.04.2023 00:01 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:02 | 16,20% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
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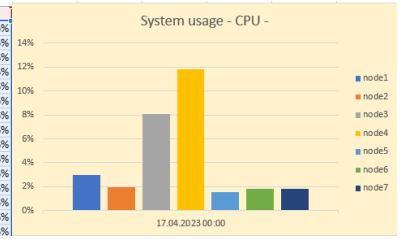
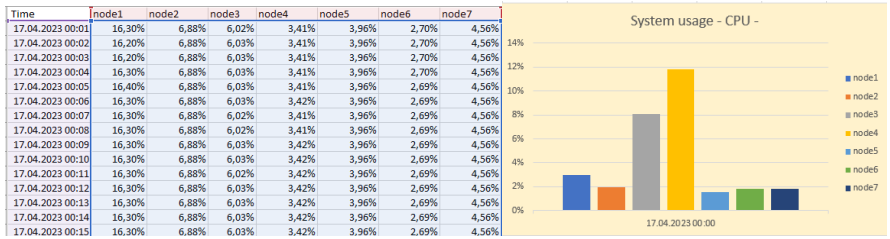
| 17.04.2023 00:06 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:07 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:08 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:09 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:10 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:11 | 16,30% | 6,88% | 6,02% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:12 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:13 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:14 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:15 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |



# Section III: Use cases: Reports

## System Usage Report

| | |
|---|---|
| CPU- , Memory-, Disk-Usage | Designed for operators |



| Time | node1 | node2 | node3 | node4 | node5 | node6 | node7 |
|---|---|---|---|---|---|---|---|
| 17.04.2023 00:01 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:02 | 16,20% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:03 | 16,20% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:04 | 16,30% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:05 | 16,40% | 6,88% | 6,03% | 3,41% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:06 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:07 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:08 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,69% | 4,56% |
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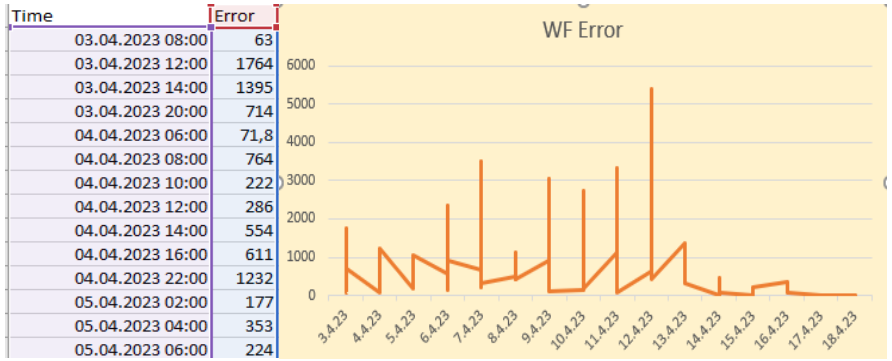
| 17.04.2023 00:12 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:13 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:14 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:15 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |



## System Error Report

| | |
|---|---|
| Occured failures and errors | Designed for developers |



| Time | Error |
|---|---|
| 03.04.2023 08:00 | 63 |
| 03.04.2023 12:00 | 1764 |
| 03.04.2023 14:00 | 1395 |
| 03.04.2023 20:00 | 714 |
| 04.04.2023 06:00 | 71,8 |
| 04.04.2023 08:00 | 764 |
| 04.04.2023 10:00 | 222 |
| 04.04.2023 12:00 | 286 |
| 04.04.2023 14:00 | 554 |
| 04.04.2023 16:00 | 611 |
| 04.04.2023 22:00 | 1232 |
| 05.04.2023 02:00 | 177 |
| 05.04.2023 04:00 | 353 |
| 05.04.2023 06:00 | 224 |

# Section III: Use cases: Reports

## System Usage Report

CPU- , Memory-, Disk-Usage

Designed for operators

| Time | node1 | node2 | node3 | node4 | node5 | node6 | node7 |
|---|---|---|---|---|---|---|---|
| 17.04.2023 00:01 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:02 | 16,20% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:03 | 16,20% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:04 | 16,30% | 6,88% | 6,03% | 3,41% | 3,96% | 2,70% | 4,56% |
| 17.04.2023 00:05 | 16,40% | 6,88% | 6,03% | 3,41% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:06 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:07 | 16,30% | 6,88% | 6,02% | 3,41% | 3,96% | 2,69% | 4,56% |
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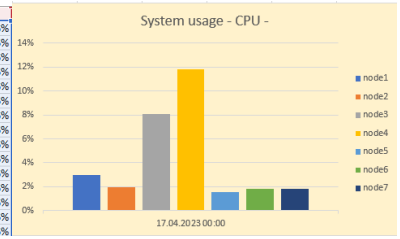
| 17.04.2023 00:09 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:10 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:11 | 16,30% | 6,88% | 6,02% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:12 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:13 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:14 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |
| 17.04.2023 00:15 | 16,30% | 6,88% | 6,03% | 3,42% | 3,96% | 2,69% | 4,56% |




## System Error Report

Occured failures and errors

Designed for developers

| Time | Error |
|---|---|
| 03.04.2023 08:00 | 63 |
| 03.04.2023 12:00 | 1764 |
| 03.04.2023 14:00 | 1395 |
| 03.04.2023 20:00 | 714 |
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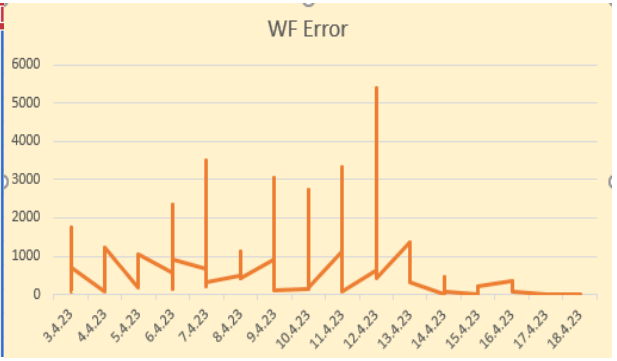
| 05.04.2023 06:00 | 224 |




## Ressources Report

Used ressources
Good future planning instrument for introduction of new products

Designed for project leaders, system and software developer

# Agenda

- Section I : IMPC and IMPC data process
- Section II: DFD’s Monitoring & Reporting System (DFD M&R)
- Section III: Use cases
- Section IV: Observation Discussion; Conclusion

**UTILIZING MONITORING AND REPORTING TECHNIQUES IN DATA PROCESSING SYSTEMS TO IMPROVE THE VALUE ADDING OF DATA**

# Section IV: Observation, Discussion

## Benefits

- By impeding system overload
- By increasing system stability
- By improving system performance
- By detecting bottleneck

# Section IV: Observation, Discussion

## Benefits

- By impeding system overload
- By increasing system stability
- By improving system performance
- By detecting bottleneck

- Increased system reliability
- Faster troubleshooting
- Data throughput optimization
- Reduced operation efforts
- Improved data consistency
- Improved data quality
- Reliable planning information

# Section IV: Observation, Discussion

## Drawbacks

**monitoring complex systems**

- creates a large amount of data
- strain the system load,
- strain the application capacity,
- strain the data traffic,
- are memory consuming

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## Drawbacks

**monitoring complex systems**

- creates a large amount of data
- strain the system load,
- strain the application capacity,
- strain the data traffic,
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- Slow down the entire system
- Reducing data quality
- Worst-case lead to system crash

# Section IV: Observation, Discussion

**Carefully consider**

- The amount of collected monitoring metrics
- The retention policy of stored data
- The data cardinality in databases

## Drawbacks

**monitoring complex systems**

- creates a large amount of data
- strain the system load,
- strain the application capacity,
- strain the data traffic,
- are memory consuming

- Slow down the entire system
- Reducing data quality
- Worst-case lead to system crash

# Section IV: Observation, Discussion

## Outlook - future development

- Introduction of user defined *Custom Metrics;* specific for each application.
- Monitor Log-Errors by introduction of log-shipment and log-files analyzing
- Extension of DFD M&R procedures to components outside the Kubernetes Cluster

# Section IV: Conclusion

Application of DFD M&R to a complex data processing system

can improve essentially all data processing chains.

Careful configuration and implementation is paramount to the successful use of the DLR DFD Monitoring and Reporting System.