Parallel System Monitoring to Improve Automation

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TOW2025 - Lecture

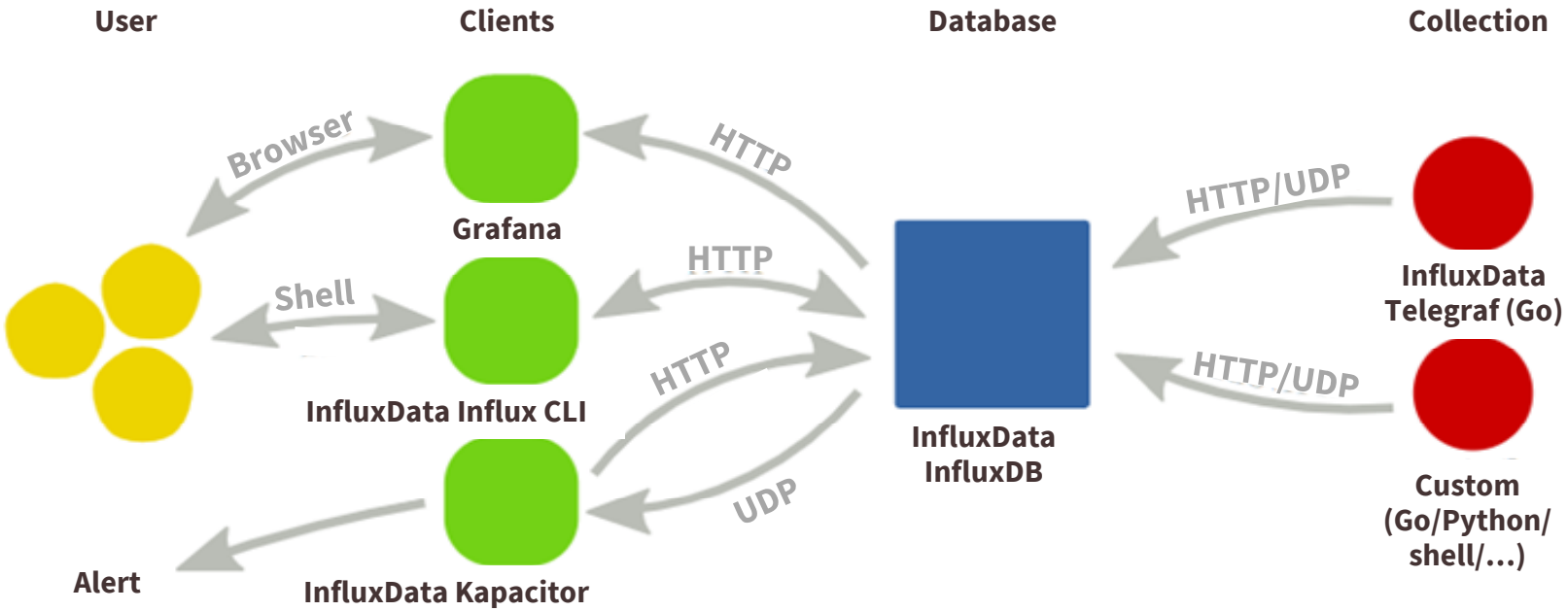
Parallel System Monitoring to Improve Automation

- **System Monitoring**
- Monitoring Implementation
  - Antenna
  - Security
  - Central Monitoring Service
- Potential for IVS stations and network
- IVS Session Monitoring
- IVS Station Administration

System monitoring

Field System In-House Monitoring System

VLBI Station Monitoring and Archival System (MAS)

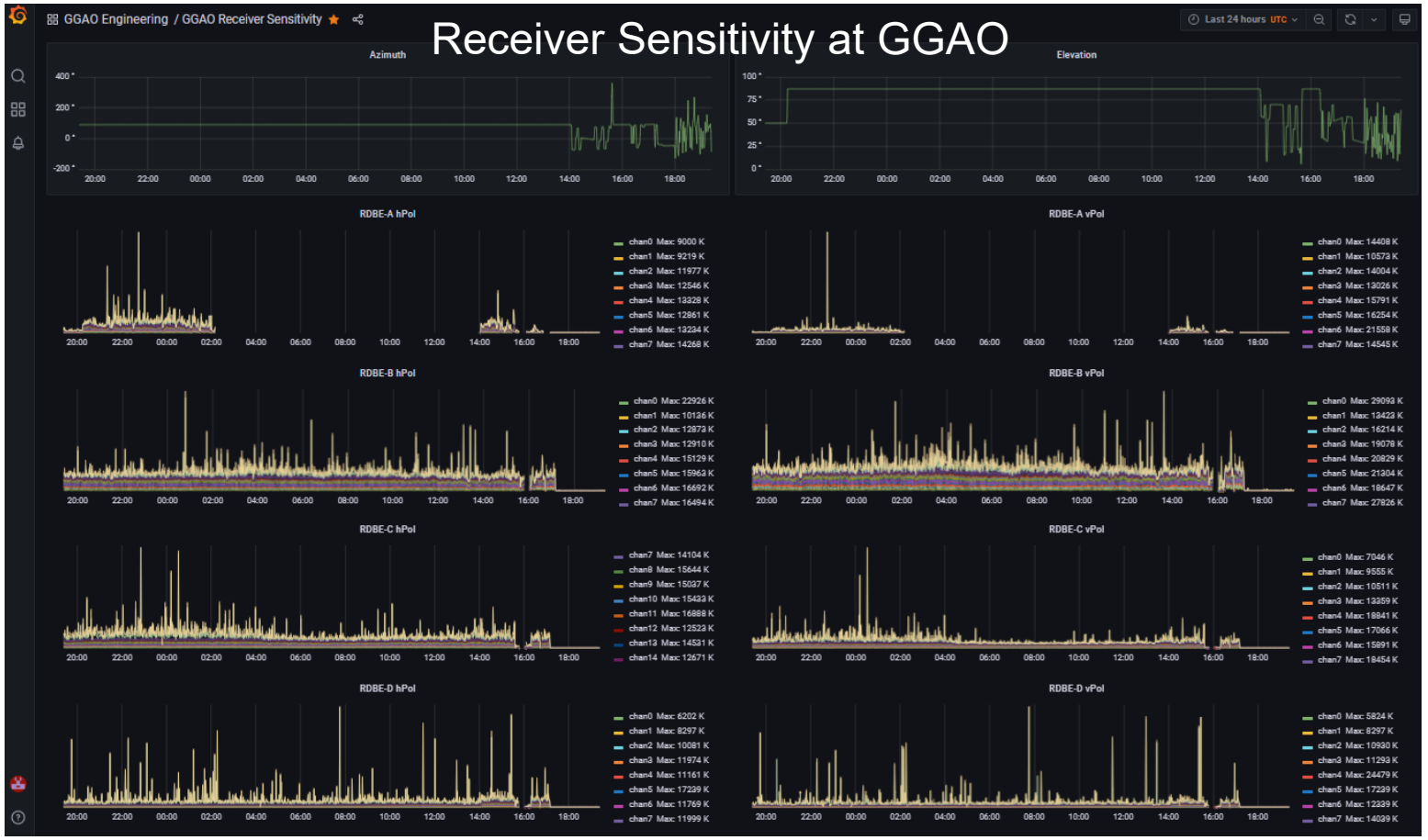


https://nvi-inc.github.io/mas/
https://www.influxdata.com/
https://www.influxdata.com/time-series-platform/telegraf/
https://docs.influxdata.com/influxdb/cloud/reference/cli/influx/
https://www.influxdata.com/time-series-platform/kapacitor/

System monitoring

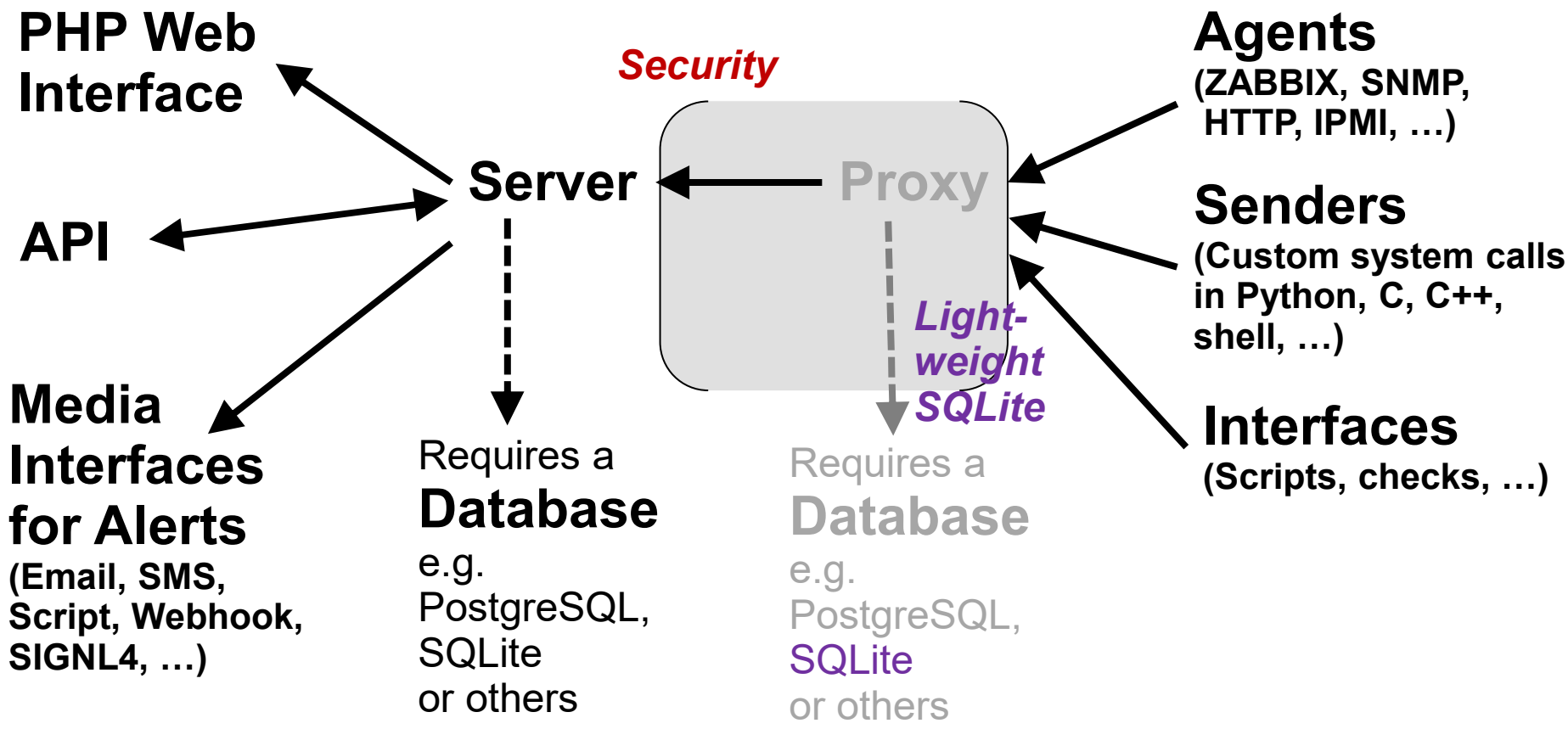
Field System In-House Monitoring System

VLBI Station Monitoring and Archival System (MAS)



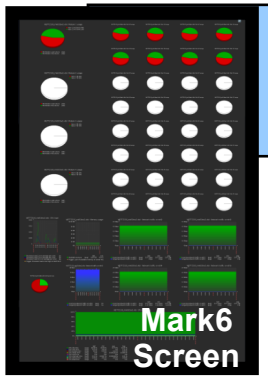
System monitoring

Using ZABBIX as another example



https://www.zabbix.com/documentation/current/en/manual/introduction/about

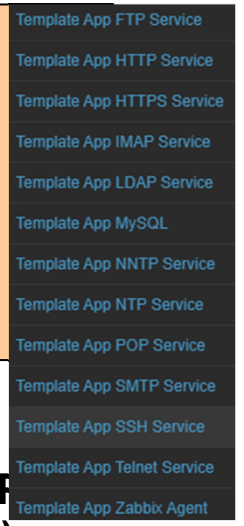
System monitoring



No additional tool for graphical output required

Why ZABBIX?

Many complete templates instead of a zoo of separate plugins



PHP Web Interface

Security

Agents
(ZABBIX, SNMP, HTTP, IPMI, …)

Server

Proxy

API

Grafana
Add-on

Senders
(Custom system calls in Python, C, C++, shell, …)

FIREWALL

Light-weight SQLite

Media Interfaces for Alerts
(Email, SMS, Script, Webhook, SIGNL4, …)

Requires a **Database**
e.g. PostgreSQL, SQLite or others

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e.g. PostgreSQL, SQLite or others

Interfaces
(Script…)

Industrial partners for on-call services

Almost no knowledge about database required

No additional language required, like Go

System monitoring

Interconnecting systems

To existing MAS

PHP Web Interface

API

Grafana
Add-on

Media Interfaces for Alerts
(Email, SMS, Script, Webhook, SIGNL4, …)

Server

Requires a **Database**
e.g. PostgreSQL, SQLite or others

Security

Proxy

Light-weight SQLite

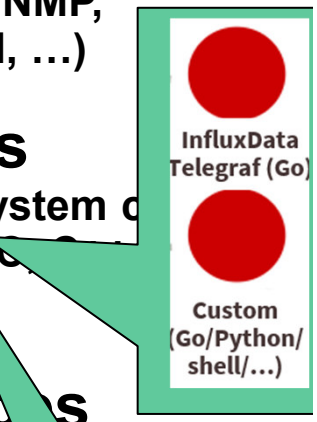
Requires a **Database**
e.g. PostgreSQL, SQLite or others

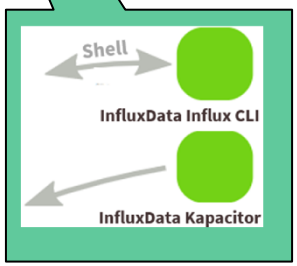
From existing MAS

Agents
(ZABBIX, SNMP, HTTP, IPMI, …)

Senders
(Custom system c… in Python, C… shell, …)

Interfac…s
(Scripts, che…s, …)





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System monitoring

Monitoring Systems Overview

- VLBI Station Monitoring and Archival System (MAS) & FS Display Server: NASA FS
- eRemteCtrl & ZABBIX & SysMon: Wettzell Observatory
- “MoniCA”, “openMoniCA”: Australia Telescope National Facility and AuScope geodetic VLBI Telescopes
- Radboud Radio Lab VLBI monitor: EVN, mm-VLBI
- …

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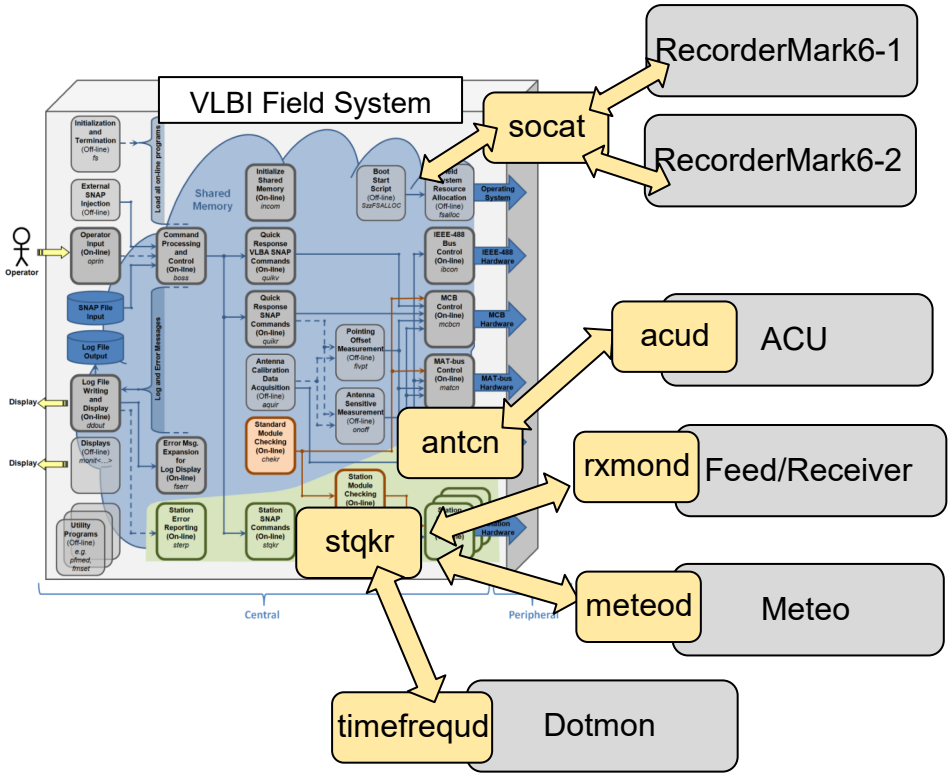
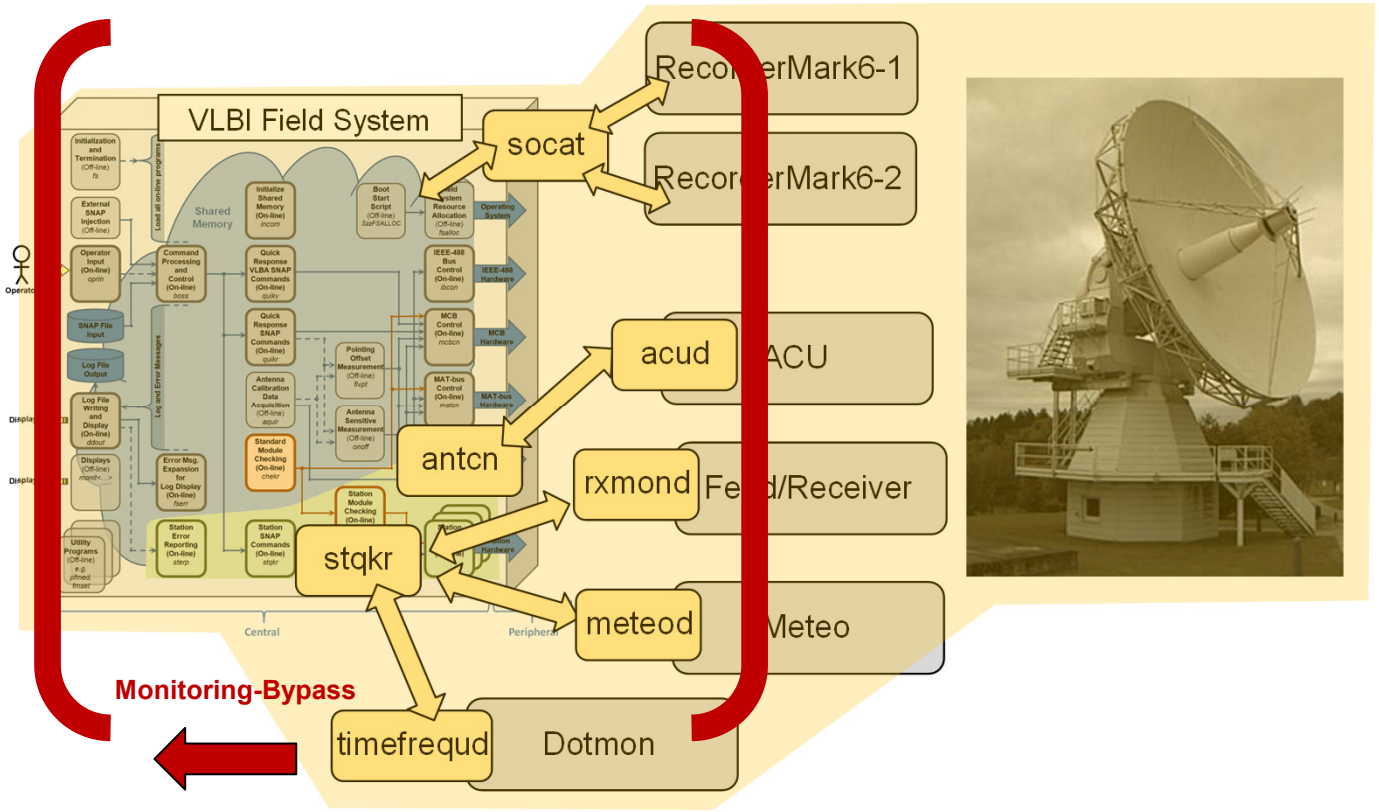
Parallel System Monitoring to Improve Automation

- System Monitoring
- **Monitoring Implementation**
  - **Antenna**
  - Security
  - Central Monitoring Service
- Potential for IVS stations and network
- IVS Session Monitoring
- IVS Station Administration

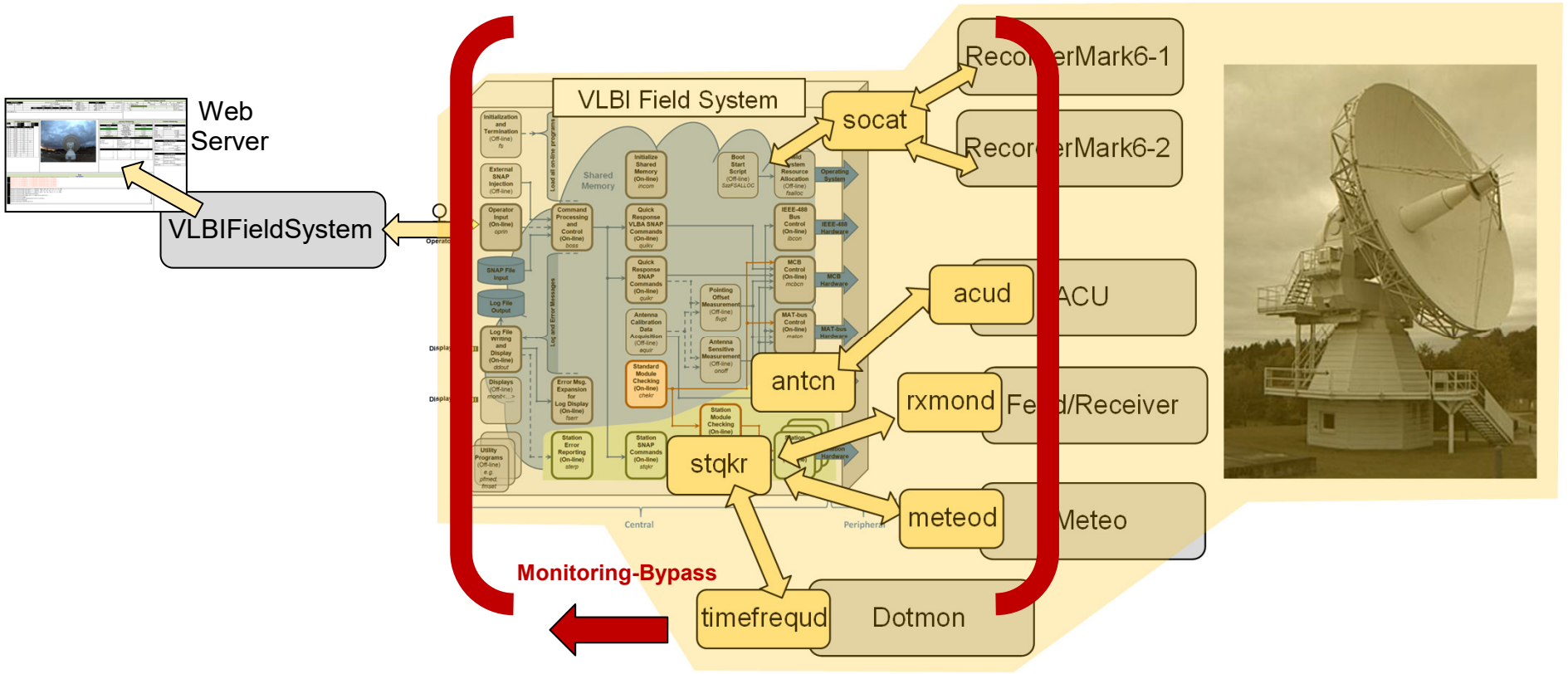
Monitoring Implementation - antenna



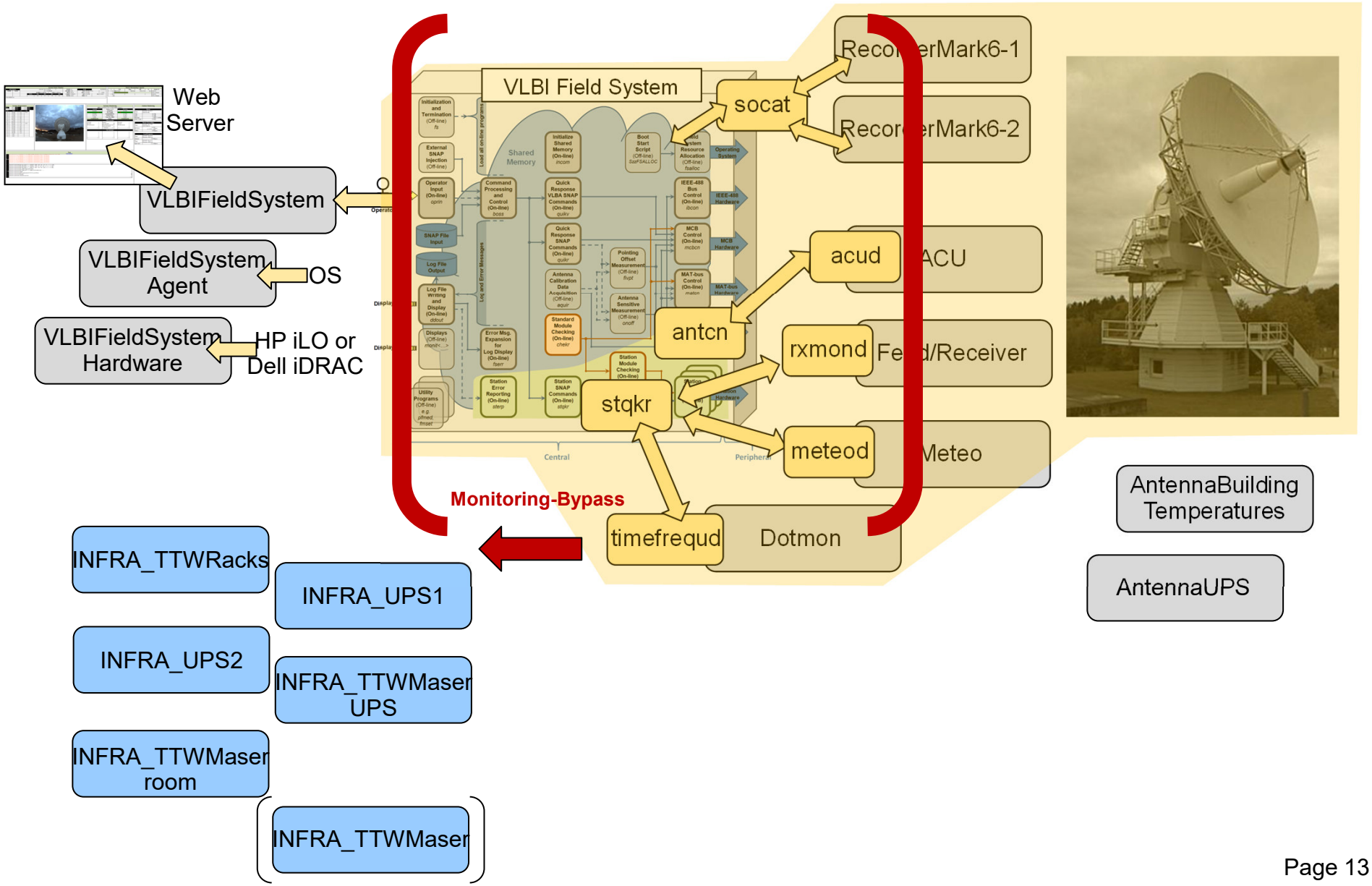
Monitoring Implementation - antenna



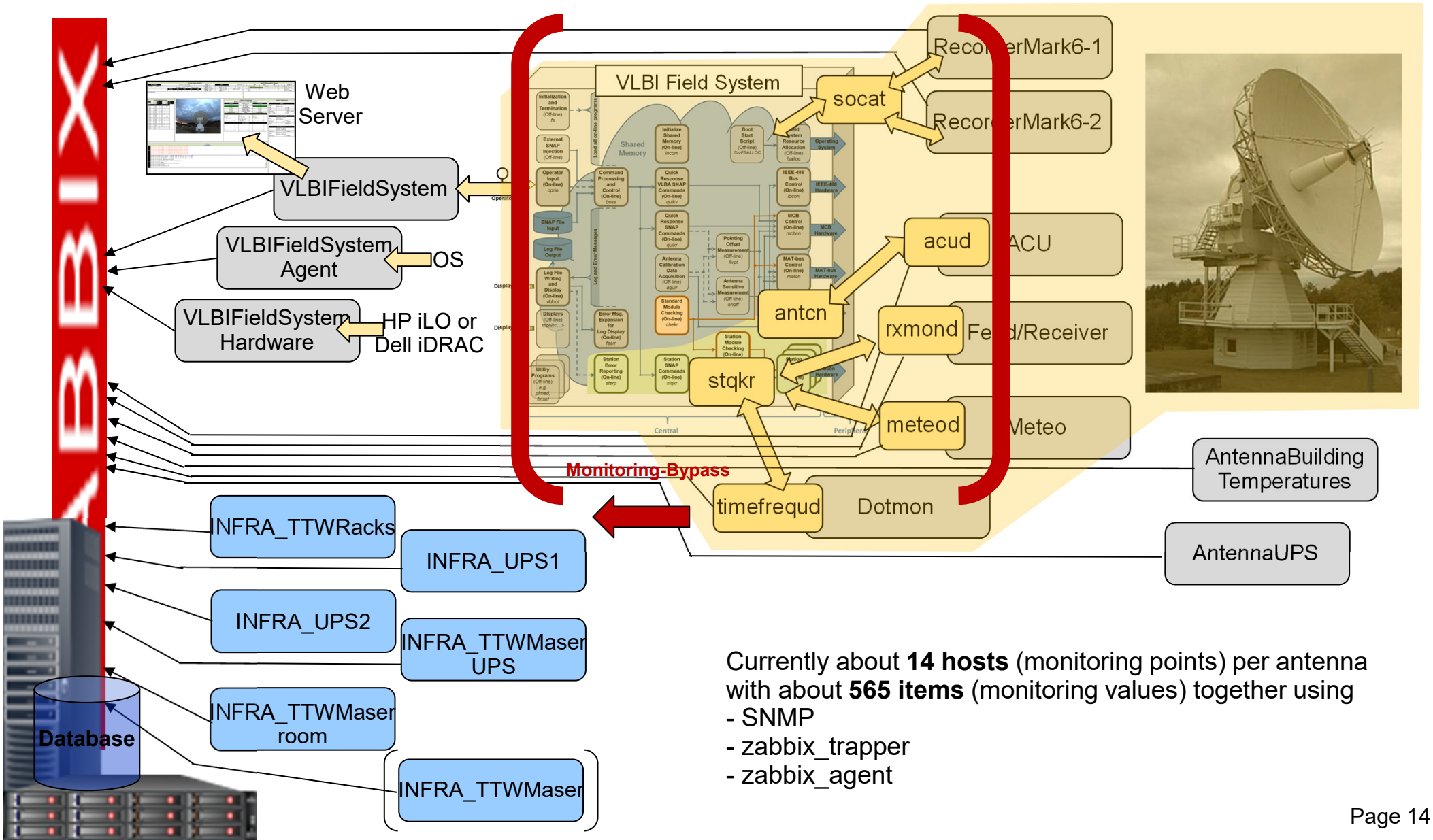
Monitoring Implementation - antenna



Monitoring Implementation - antenna

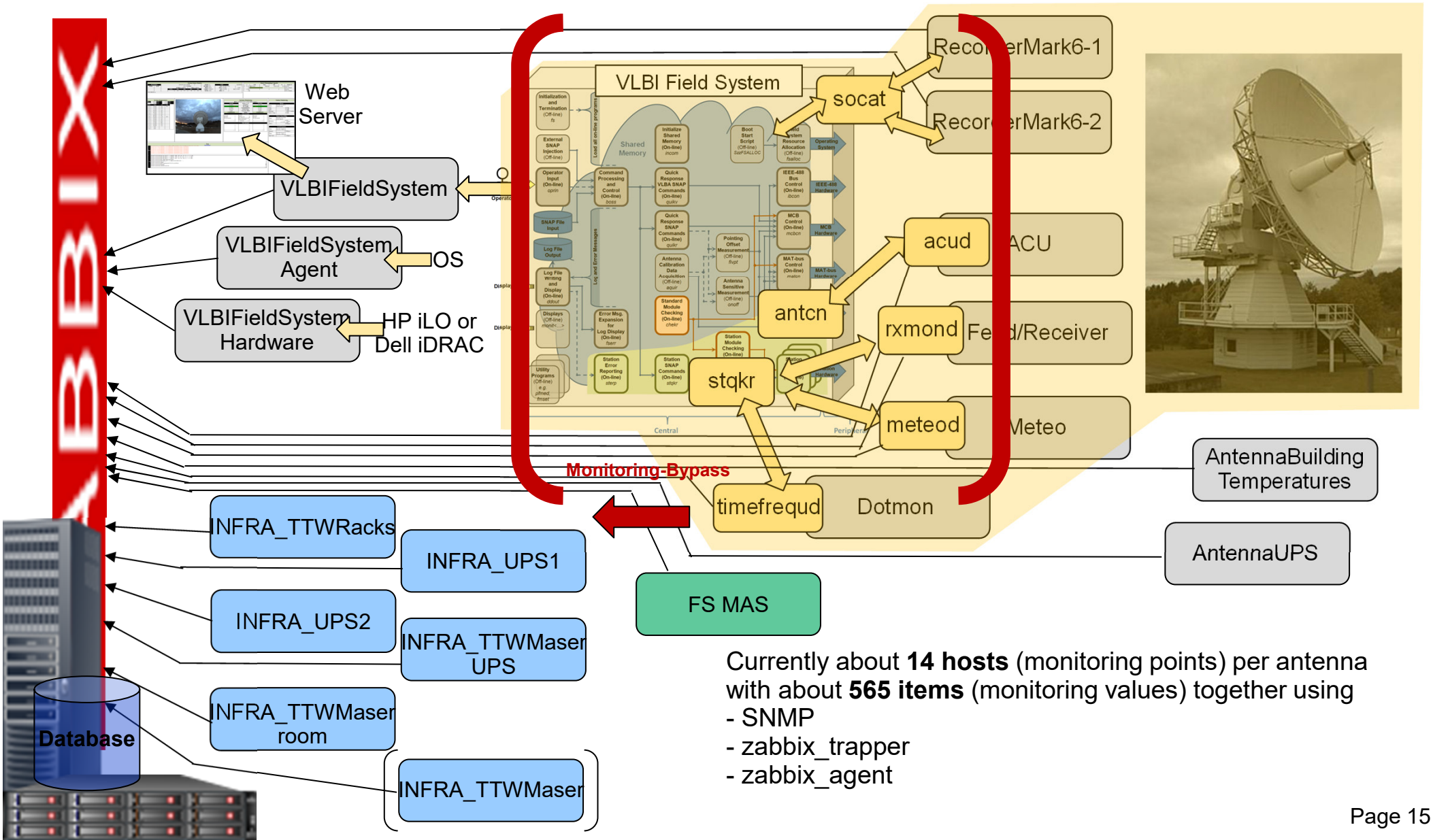


Monitoring Implementation - antenna



Currently about **14 hosts** (monitoring points) per antenna with about **565 items** (monitoring values) together using
- SNMP
- zabbix_trapper
- zabbix_agent

Monitoring Implementation - antenna



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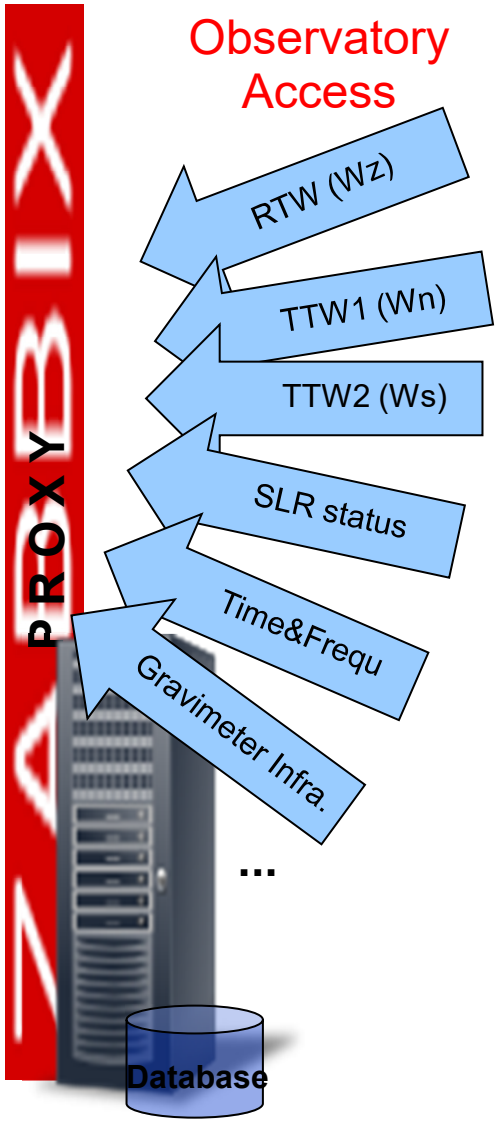
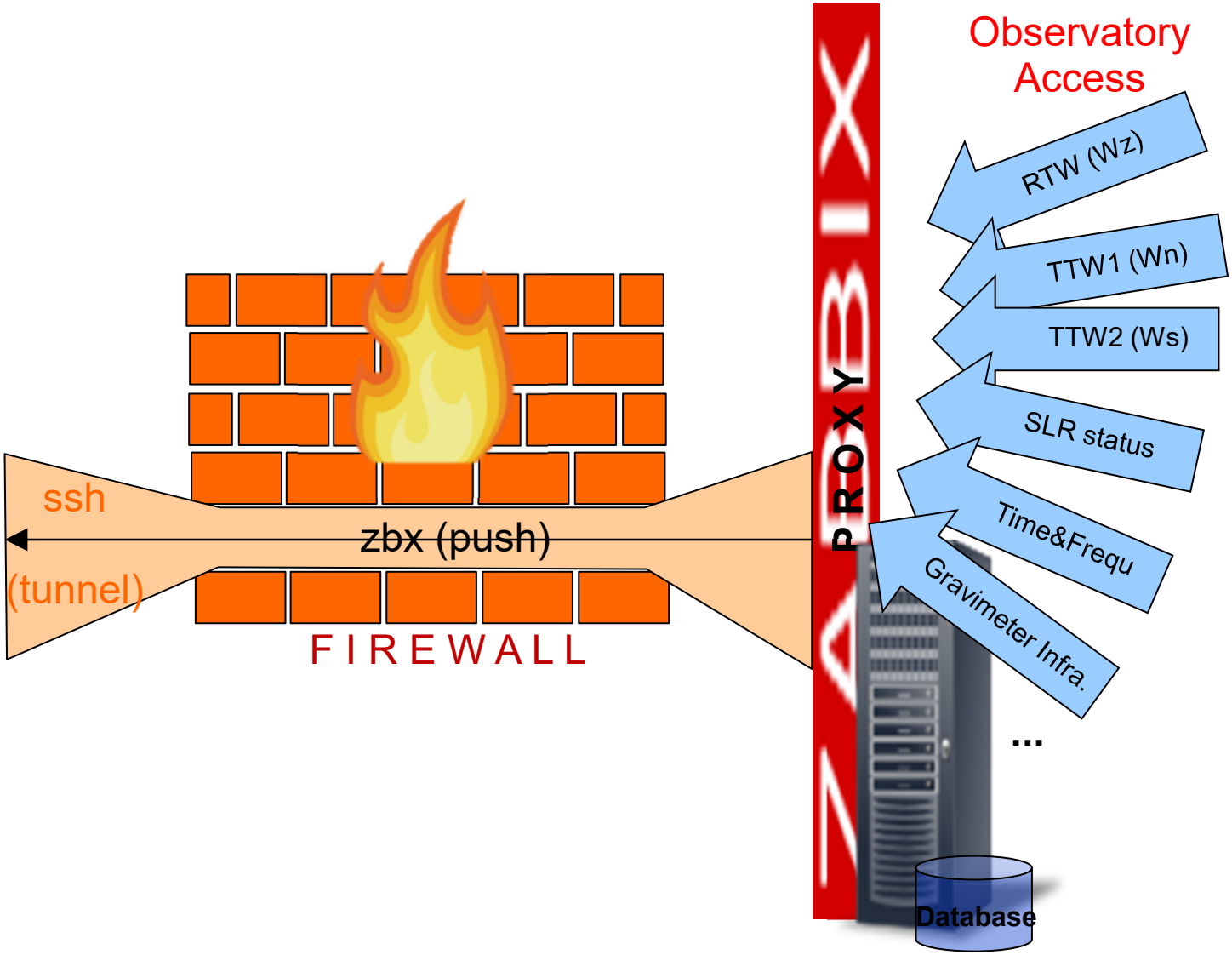
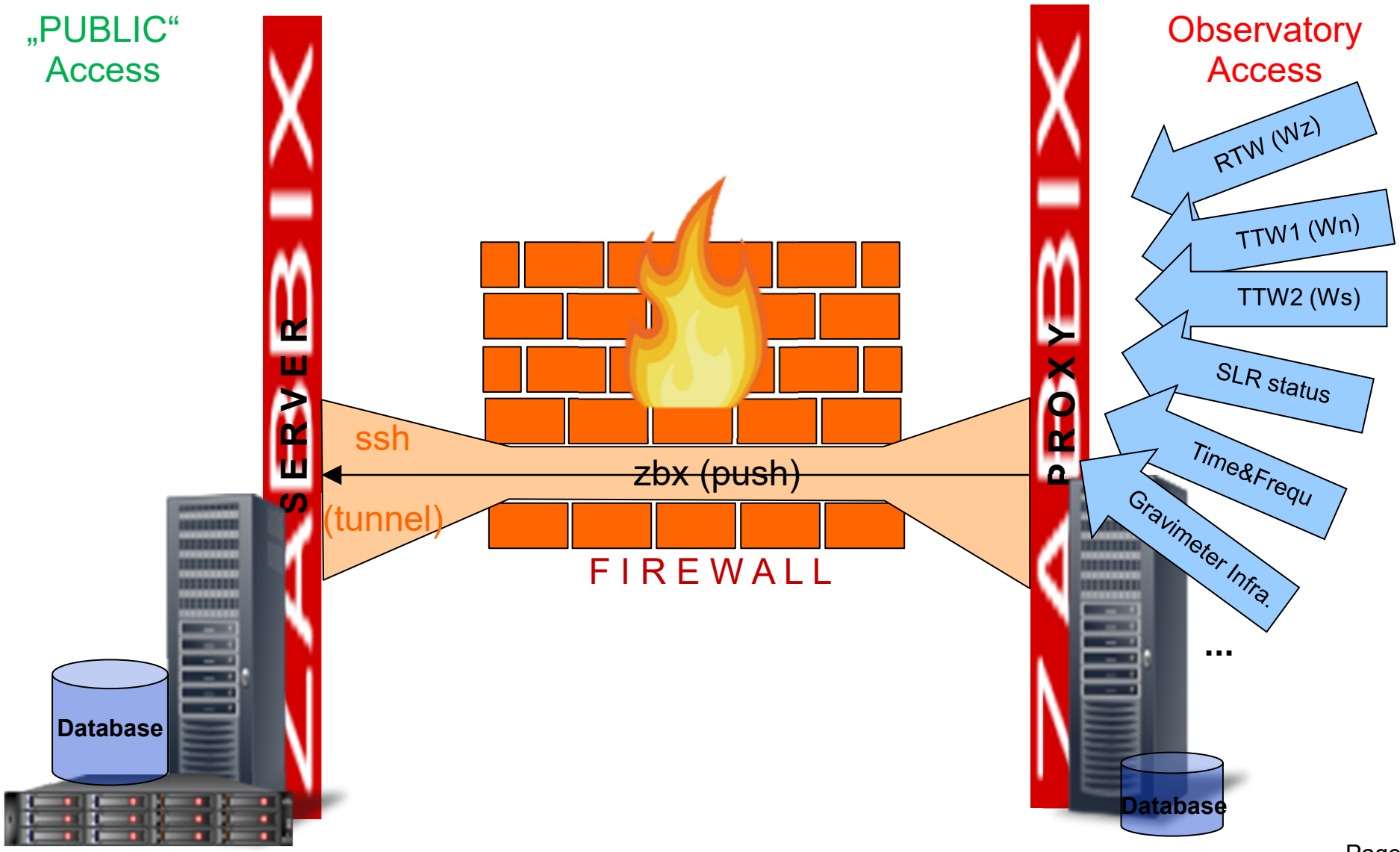
Monitoring Implementation - security



Monitoring Implementation - security



Monitoring Implementation - security



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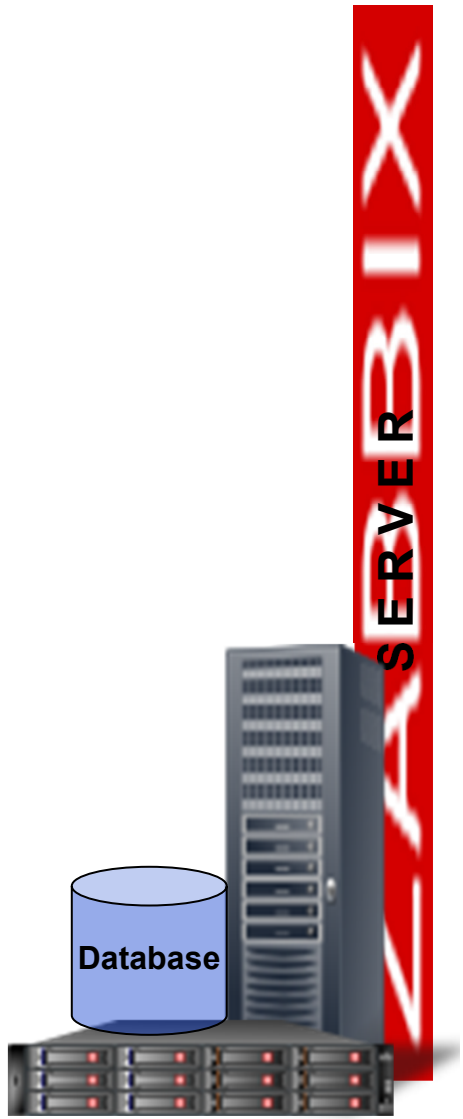
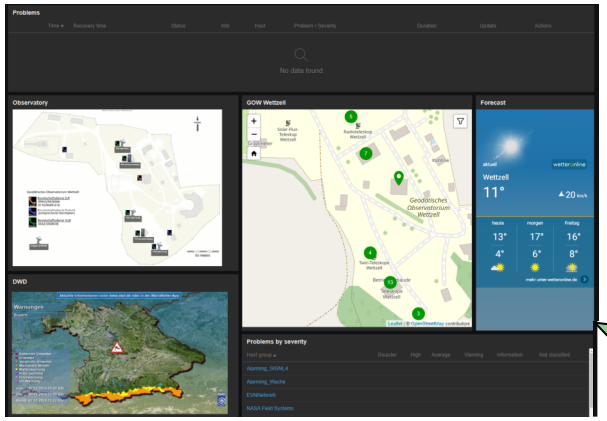
Monitoring Implementation – Central Monitoring Service



Monitoring Implementation – Central Monitoring Service



Host
Graphs &
Trends

Station
Monitoring

Host Monitoring

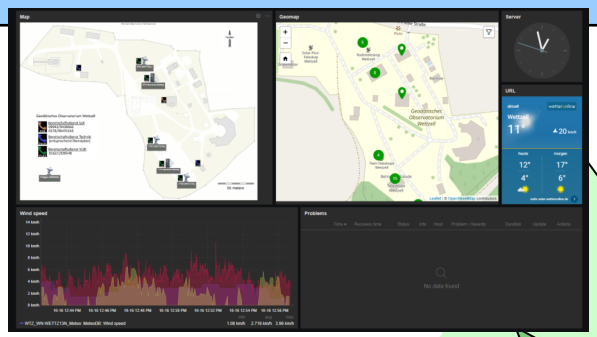
WTZ_WN-WETTZ13N_ACU
WTZ_WN-WETTZ13N_AntennaBuildingTemperatur
WTZ_WN-WETTZ13N_AntennaUPS
WTZ_WN-WETTZ13N_Feed
WTZ_WN-WETTZ13N_Meteo
WTZ_WN-WETTZ13N_VLBIFieldSystem
WTZ_WN-WETTZ13N_VLBIFieldSystemAgent
WTZ_WN-WETTZ13N_VLBIFieldSystemHardware

Monitoring

Database

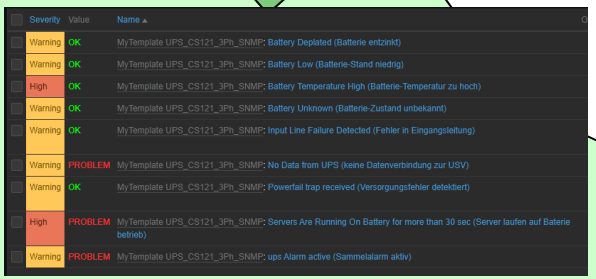
ZA SERVER BIX

Monitoring Implementation – Central Monitoring Service



Operator
Alerting

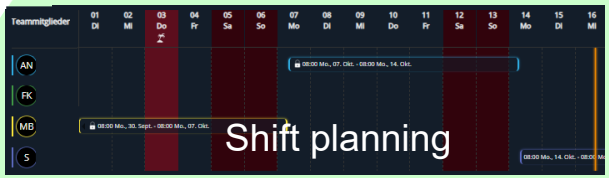
Guard
Alerting

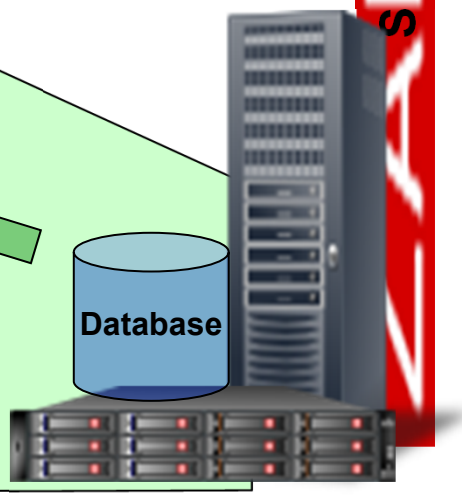


On-Call
Service
Alerting

Monitoring

Alerting





Monitoring Implementation – Central Monitoring Service

python **Script "ZabbixAPI.py"**

Sample call: seamless request for specific time interval

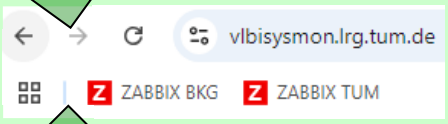
```
python.exe ZabbixAPI.py -C config_evn.ini -L
-H YEBES_000_NASAFieldSystem  -K ERC.PRESSURE
-TS "2022-03-15 18:15:00" -TE "2022-03-15 18:30:00"
```

#Date	Unixtime	Nanosec	Value
2025-03-31 14:25:00	1743431100	963381000	-0.072
2025-03-31 14:25:00	1743431100	912588000	-0.067
2025-03-31 14:25:00	1743431100	862274000	0.068
2025-03-31 14:25:00	1743431100	811883000	0.064
2025-03-31 14:25:00	1743431100	760880000	0.034
2025-03-31 14:25:00	1743431100	710419000	-0.077
2025-03-31 14:25:00	1743431100	659566000	-0.004
2025-03-31 14:25:00	1743431100	609072000	0.029
2025-03-31 14:25:00	1743431100	558074000	-0.121
2025-03-31 14:25:00	1743431100	507805000	-0.048
2025-03-31 14:25:00	1743431100	456899000	0.103
2025-03-31 14:25:00	1743431100	406291000	0.288
2025-03-31 14:25:00	1743431100	355294000	0.034

(Seamless) Data API

PNG-image extraction

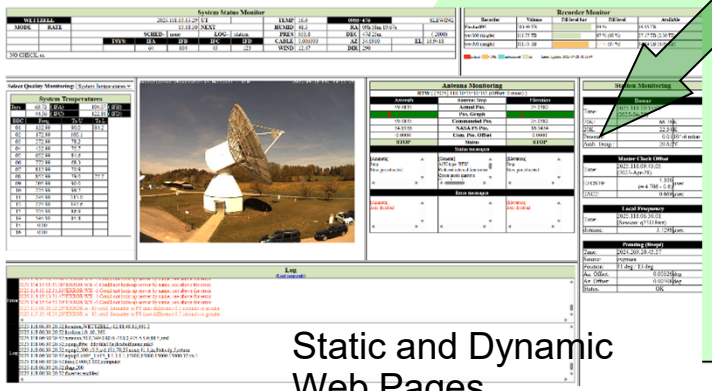
Web Content



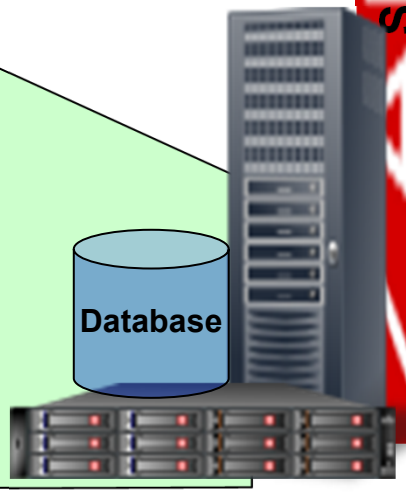
Monitoring

Alerting

Web Presentation

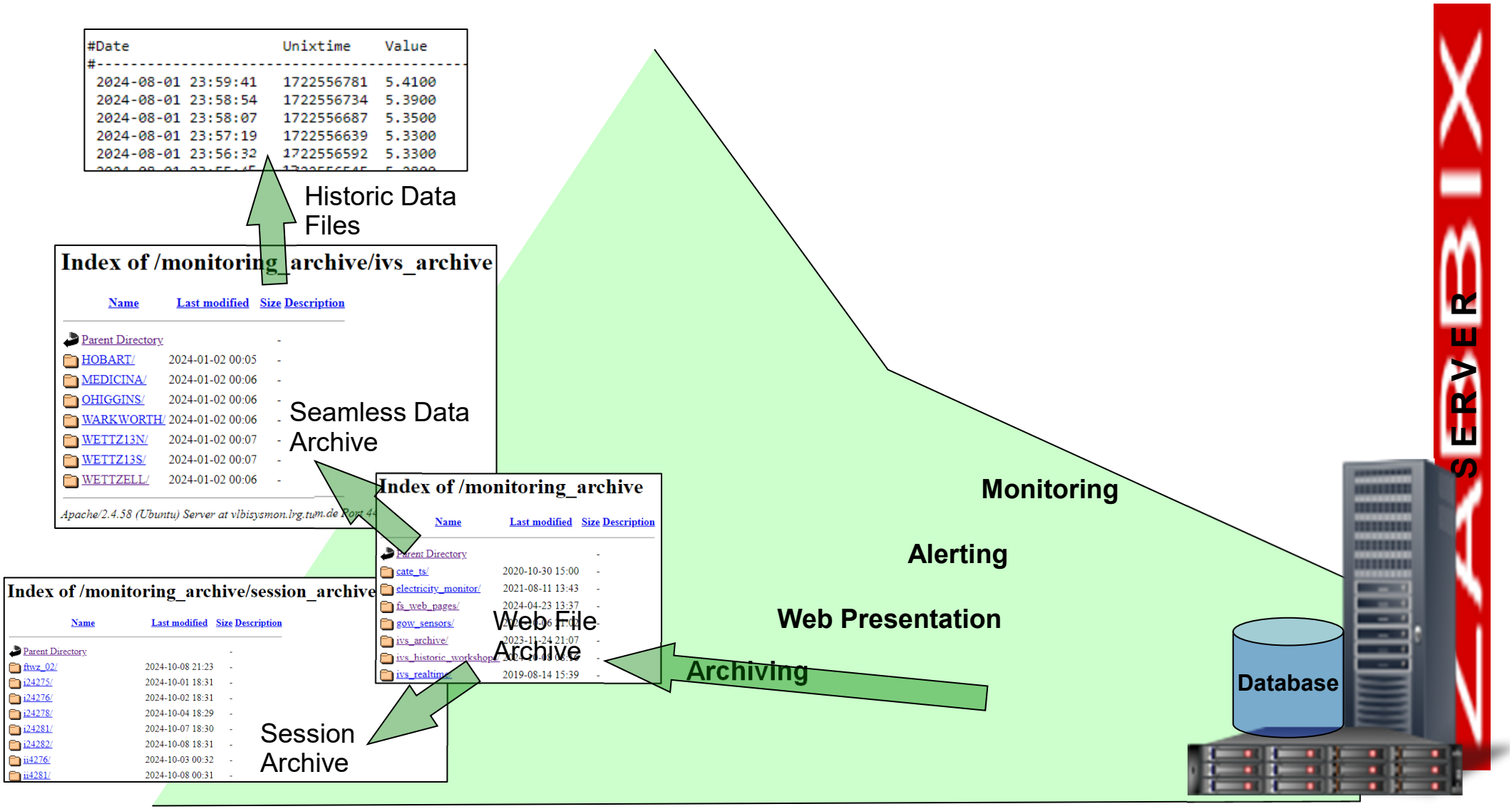


Static and Dynamic Web Pages



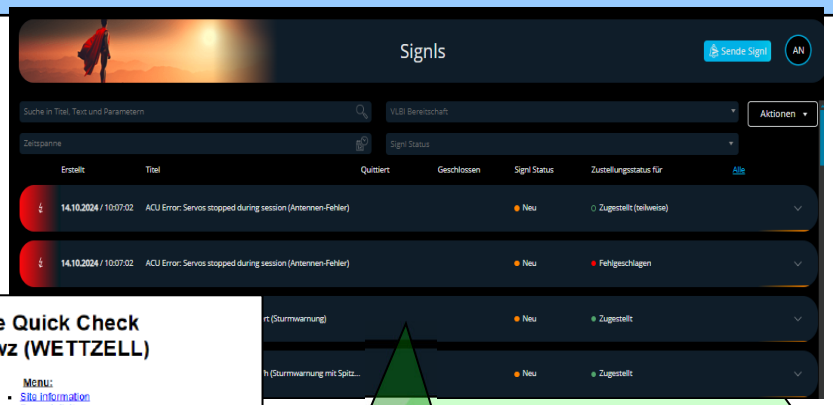
SERVER LINUX

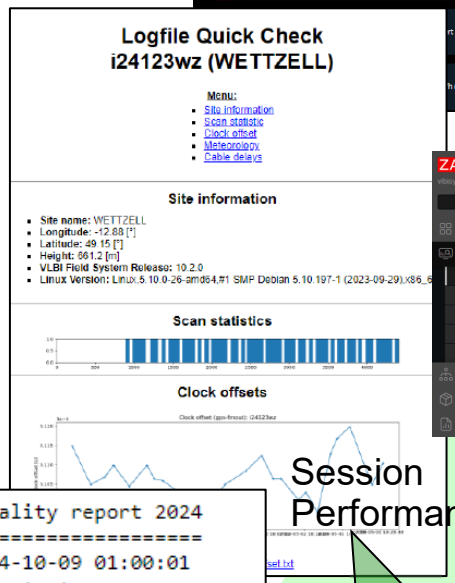
Monitoring Implementation – Central Monitoring Service

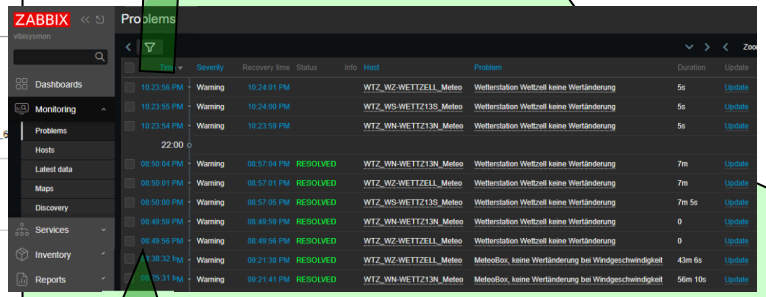


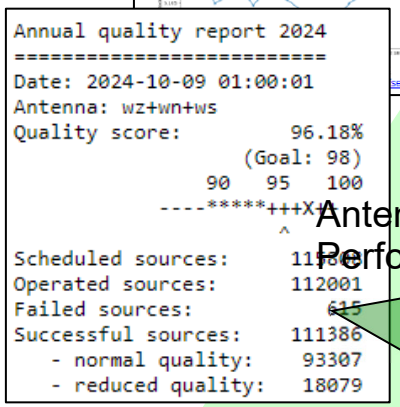
Monitoring Implementation – Central Monitoring Service

Operating times of the on-call services









Session Performance

Error, Alerting and Troubleshooting Performance

Antenna Performance

Reports

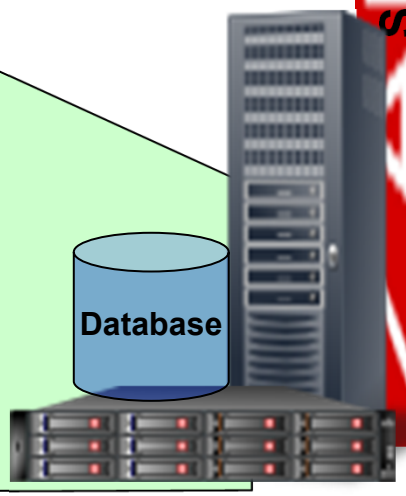
Monitoring

Alerting

Web Presentation

Archiving

Performance Analysis



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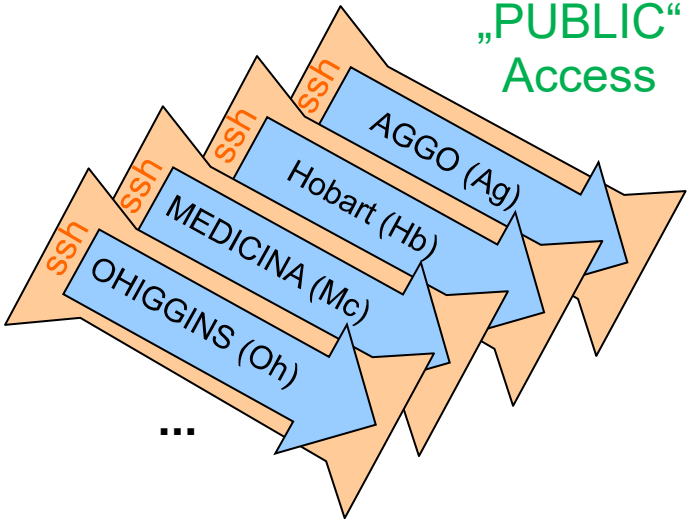
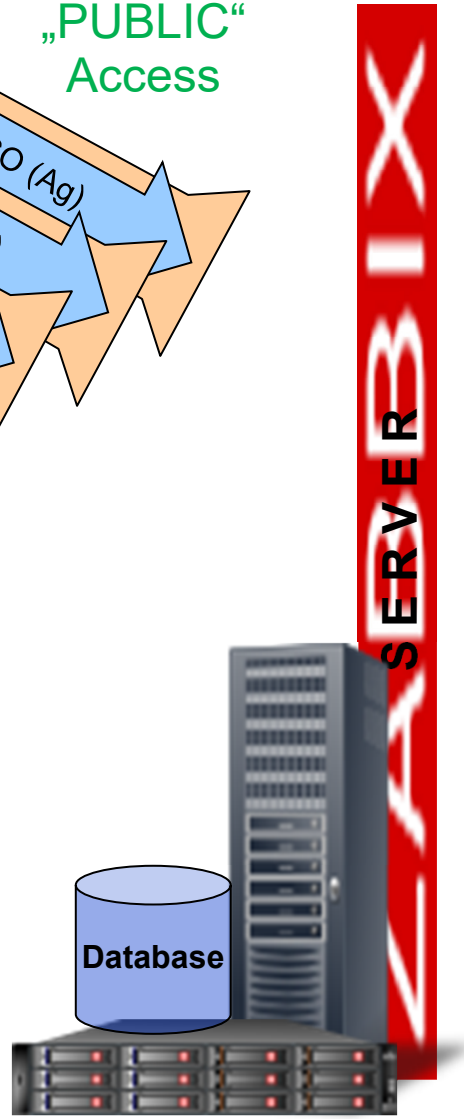
Potential for IVS stations and network





https://vlbisysmon.lrg.tum.de/zabbix/

Potential for IVS stations and network

Data Injenction by Sites

ERC.TEMPERATURE => Temperature => unit deg C
ERC.HUMIDITY => Humidity => unit %
ERC.PRESSURE => Pressure => unit hPa
ERC.WINDSPEED => Windspeed => unit km/h
ERC.WINDDIRECTION => Winddirection => unit degree
ERC.DOTMON => Dotmon Clock Offsets (GPSminusFMOUT) => unit usec

(without additional installation of software)

IVS SADA

SSH

ssh MEDICINA (Mc)

zabbix_ sender

„PUBLIC“ Access

SERVER ZABBIX

IVS SADA

Database

Web Presentation

Web Content

vlbisysmon.lrg.tum.de

ZABBIX BKG ZABBIX TUM

https://vlbisysmon.lrg.tum.de/zabbix/

python **Script “ZabbixAPI.py”**

Sample call: seamless request for specific time interval

```
python.exe ZabbixAPI.py -C config_evn.ini -L
-H YEBES_000_NASAFieldSystem  -K ERC.PRESSURE
-TS "2022-03-15 18:15:00" -TE "2022-03-15 18:30:00"
```

#Date	Unixtime	Value
2022-03-15 18:29:01	1647368941	911.0114
2022-03-15 18:28:01	1647368881	911.0114
2022-03-15 18:27:01	1647368821	911.0114
2022-03-15 18:26:01	1647368761	911.0114
2022-03-15 18:25:02	1647368702	911.0114
2022-03-15 18:24:02	1647368642	910.9211
2022-03-15 18:23:01	1647368581	910.9211
2022-03-15 18:22:01	1647368521	910.9211
2022-03-15 18:21:01	1647368461	910.9211
2022-03-15 18:20:02	1647368402	910.9211
2022-03-15 18:19:01	1647368341	910.8493
2022-03-15 18:18:02	1647368282	910.8493
2022-03-15 18:17:02	1647368222	910.8493
2022-03-15 18:16:01	1647368161	910.8493
2022-03-15 18:15:02	1647368102	910.8493

(Seamless) Data API

Potential for IVS stations and network

Data Injenction by Sites

ERC.TEMPERATURE => Temperature => unit deg C
ERC.HUMIDITY => Humidity => unit %
ERC.PRESSURE => Pressure => unit hPa
ERC.WINDSPEED => Windspeed => unit km/h
ERC.WINDDIRECTION => Winddirection => unit degree
ERC.DOTMON => Dotmon Clock Offsets (GPSminusFMOUT) => unit usec

(without additional installation of software)

„PUBLIC“ Access

HTTPS-Webhook

```
curl -X POST
https://vlbisysmon.lrg.tum.de/ivssada/webhook/<secret>
-H "Content-Type: application/json"
-d '{ "IVS_WZ-WETTZELL_VLBIFieldSystemTest" :
    {"METEO" : {"ERC.TEMPERATURE" : 15.3 ,
                "ERC.PRESSURE" : 952.3 ,
                "ERC.HUMIDITY" : 30.1 ,
                "ERC.WINDSPEED" : 27.00 ,
                "ERC.WINDDIRECTION" : 214}}}'
```

python **Script “ZabbixAPI.py”**

Sample call: seamless request for specific time interval

```
python.exe ZabbixAPI.py -C config_evn.ini -L
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#Date	Unixtime	Value
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2022-03-15 18:23:01	1647368581	910.9211
2022-03-15 18:22:01	1647368521	910.9211
2022-03-15 18:21:01	1647368461	910.9211
2022-03-15 18:20:02	1647368402	910.9211
2022-03-15 18:19:01	1647368341	910.8493
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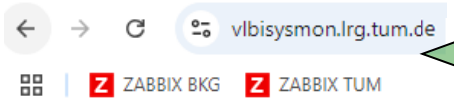
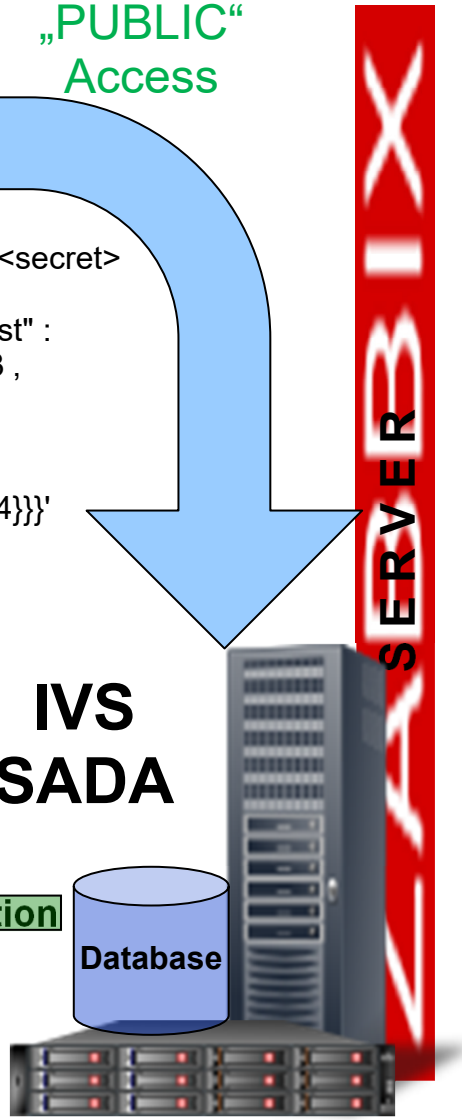
(Seamless) Data API

Web Content



Web Presentation

IVS SADA



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IVS Session Monitoring

Data Injenction by Sites with potential for:

- Start Message
- Stop Message
- Error Messages

„PUBLIC“ Access

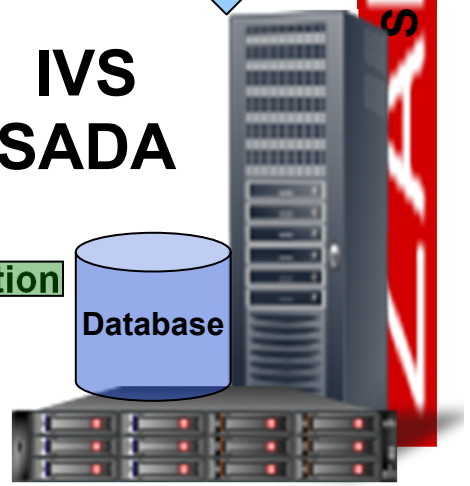
HTTPS-Webhook

curl -X POST
https://vlbisysmon.lrg.tum.de/ivssada/webhook/<secret>
-H "Content-Type: application/json"
-d '{ "IVS_WZ-WETTZELL_VLBIFieldSystemTest" :
{"METEO" : {"ERC.TRACKINGSTATE" : "TRACKING",
"ERC.SCHEDULE" : „v25090" }}}'

Email-Message

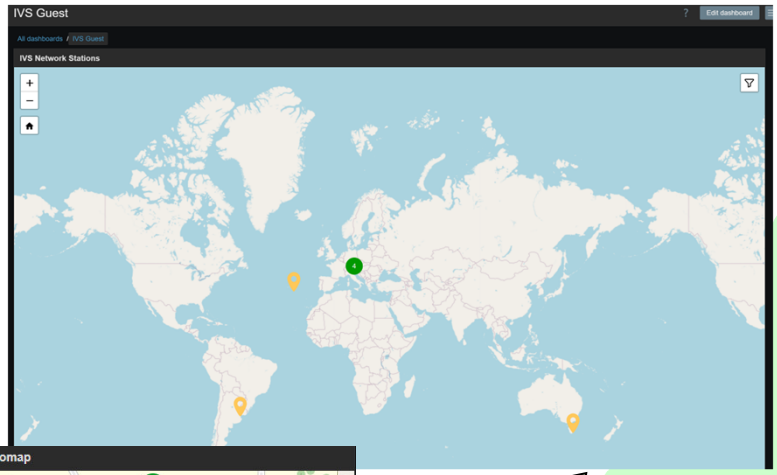
Web Content

Web Presentation



https://vlbisysmon.lrg.tum.de/zabbix/

IVS Session Monitoring



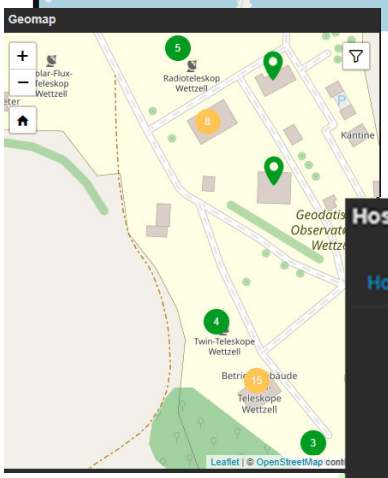
IVS
SADA

„PUBLIC“
Access

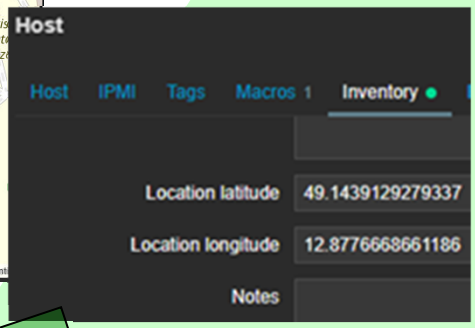
ssh AGGO (Ag)
ssh Hobart (Hb)
ssh MEDICINA (Mc)
ssh OHIGGINS (Oh)
...

Host Monitoring

WTZ_WN-WETTZ13N_ACU
WTZ_WN-WETTZ13N_AntennaBuildingTemperatur
WTZ_WN-WETTZ13N_AntennaUPS
WTZ_WN-WETTZ13N_Feed
WTZ_WN-WETTZ13N_Meteo
WTZ_WN-WETTZ13N_VLBIFieldSystem
WTZ_WN-WETTZ13N_VLBIFieldSystemAgent
WTZ_WN-WETTZ13N_VLBIFieldSystemHardware



Network
Monitoring



Monitoring

Alerting

Web Presentation

Archiving

Performance Analysis

Grafana

Database

ZABBIX SERVER

https://vlbisysmon.lrg.tum.de/zabbix/

IVS Session Monitoring

„PUBLIC“ Access

Name ▲	Triggers	Key	Interval	History	Trends	Type	Status	Tags
Antenna name		ERC.ANTENNA		90d		Zabbix trapper	Enabled	Application: FS Syste…
Azimuth		ERC.AZIMUTH		90d	90d	Zabbix trapper	Enabled	Application: FS Syste…
Cable		ERC.CABLE		90d	90d	Zabbix trapper	Enabled	Application: FS Syste…
Catalog year		ERC.CATALOGYEAR		90d		Zabbix trapper	Enabled	Application: FS Syste…
Declination (text)		ERC.DEC		90d		Zabbix trapper	Enabled	Application: FS Syste…
Dotmon2 Clock Offset	Triggers 3	ERC.DOTMON2		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Dotmon Clock Offset	Triggers 3	ERC.DOTMON		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Elevation		ERC.ELEVATION		90d	90d	Zabbix trapper	Enabled	Application: FS Syste…
Halt		ERC.HALT		90d		Zabbix trapper	Enabled	Application: FS Syste…
Log file		ERC.LOG		90d		Zabbix trapper	Enabled	Application: FS Syste…
Meteo Humidity	Triggers 1	ERC.HUMIDITY		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Meteo Pressure	Triggers 1	ERC.PRESSURE		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Meteo Pressure Height		ERC.PRESSUREHEIGHT		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Meteo Temperature	Triggers 1	ERC.TEMPERATURE		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Meteo Wind direction		ERC.WINDDIRECTION		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Meteo Wind speed	Triggers 2	ERC.WINDSPEED		90d	90d	Zabbix trapper	Enabled	Application: FS Syste… Application: IVS Seam…
Next time		ERC.NEXTTIME		90d		Zabbix trapper	Enabled	Application: FS Syste…
Rate		ERC.RATE		90d		Zabbix trapper	Enabled	Application: FS Syste…
Right ascension (text)		ERC.RA		90d		Zabbix trapper	Enabled	Application: FS Syste…
Schedule		ERC.SCHEDULE		90d		Zabbix trapper	Enabled	Application: FS Syste…
Source		ERC.SOURCE		90d		Zabbix trapper	Enabled	Application: FS Syste…
Time		ERC.TIME		90d		Zabbix trapper	Enabled	Application: FS Syste…
Tracking state		ERC.TRACKINGSTATE		90d		Zabbix trapper	Enabled	Application: FS Syste…

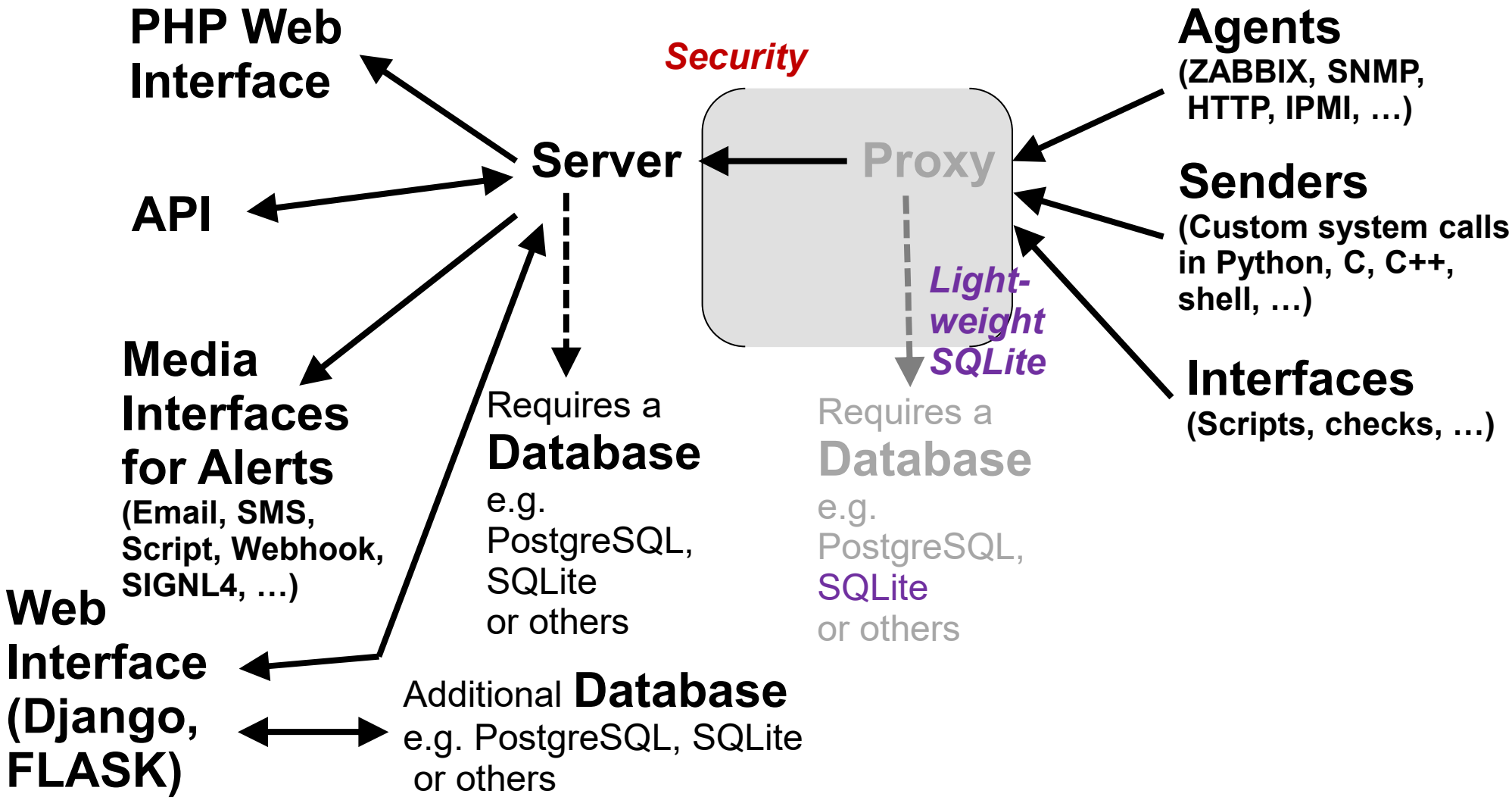
TOW2025 - Lecture

Parallel System Monitoring to Improve Automation

- System Monitoring
- Monitoring Implementation
  - Antenna
  - Security
  - Central Monitoring Service
- Potential for IVS stations and network
- IVS Session Monitoring
- **IVS Station Administration**

IVS Station Administration

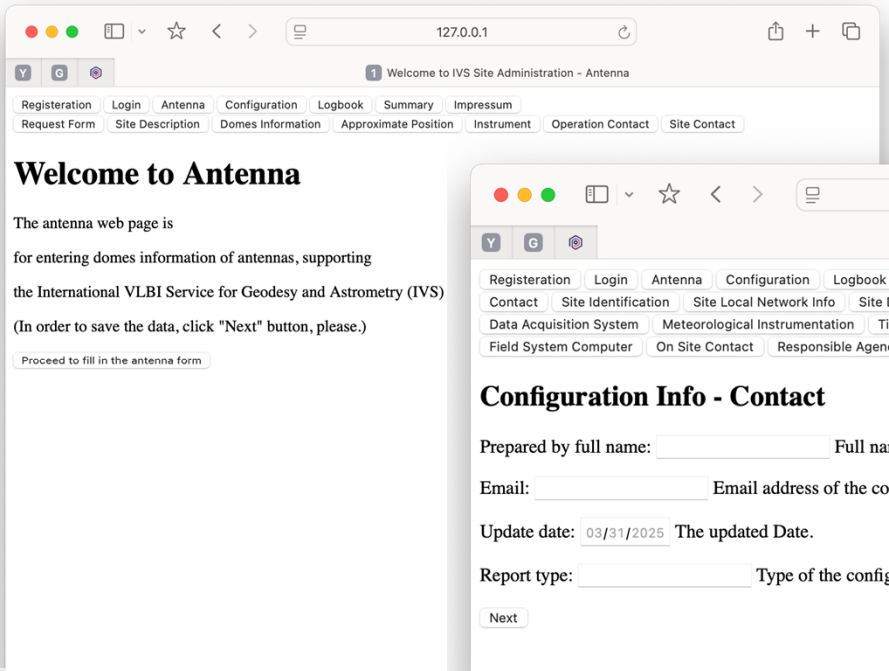
Using ZABBIX as another example



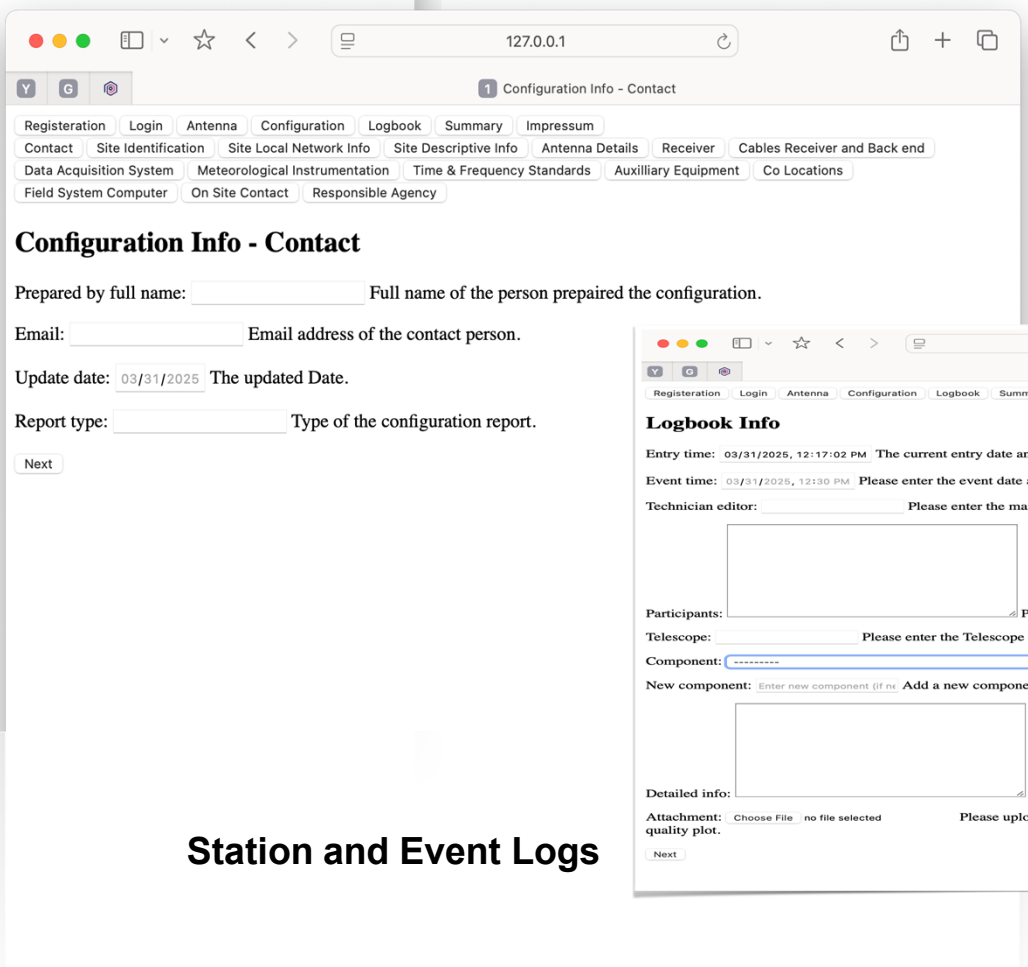
https://www.zabbix.com/documentation/current/en/manual/introduction/about

IVS Station Administration

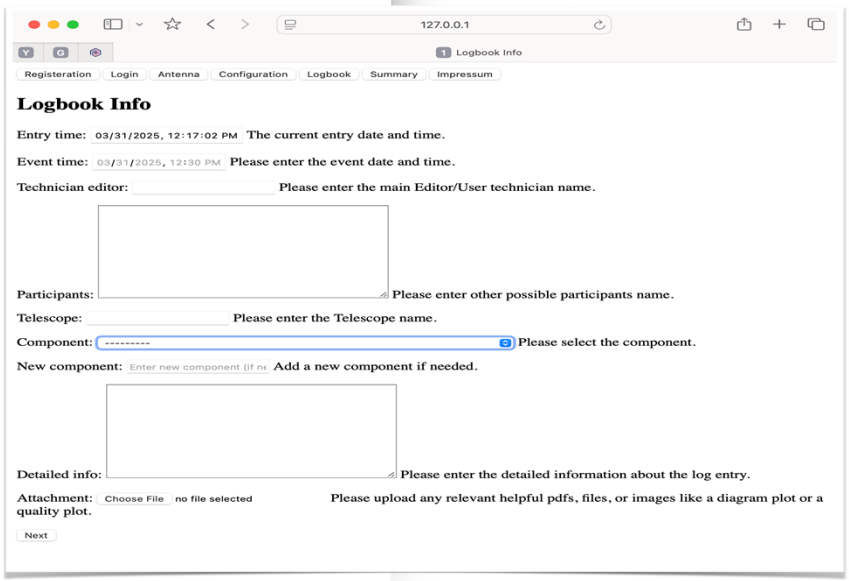
Extension with coordination functionality



Antenna registration => CDP number, domes number



Network Configuration File Management



Station and Event Logs

IVS IVTW 2024

Thank you …