



Introduction to Realworld, AI and Diagnostics

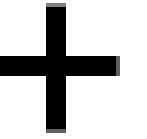
Gillian Kendrick – John Leeuwenburg

Zagreb - 2024





Zagreb 2024



Presentation Agenda:

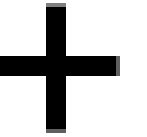
- Realworld Systems Introduction
- Bringing Artificial Intelligence to PNI
- News/Update from the Diagnostics Team



Introductions...

Realworld Systems Stats:

- 200+ People working for Realworld in 5 continents
- 30+ Years of Smallworld experience and product development
 - Including building some of GE's products.
- 200+ Satisfied customers
- Many successful Realworld products developed, including:
 - Smallworld Enterprise Gateway, or SWEG (providing integration with Oracle)
 - Realworld Diagnostics
 - Smallworld Design Gateway (provides automated fiber network design, using Comsof)
 - Construction Gateway – automated integration to Sitetracker, Vitruvi and IQGeo
 - Water Office



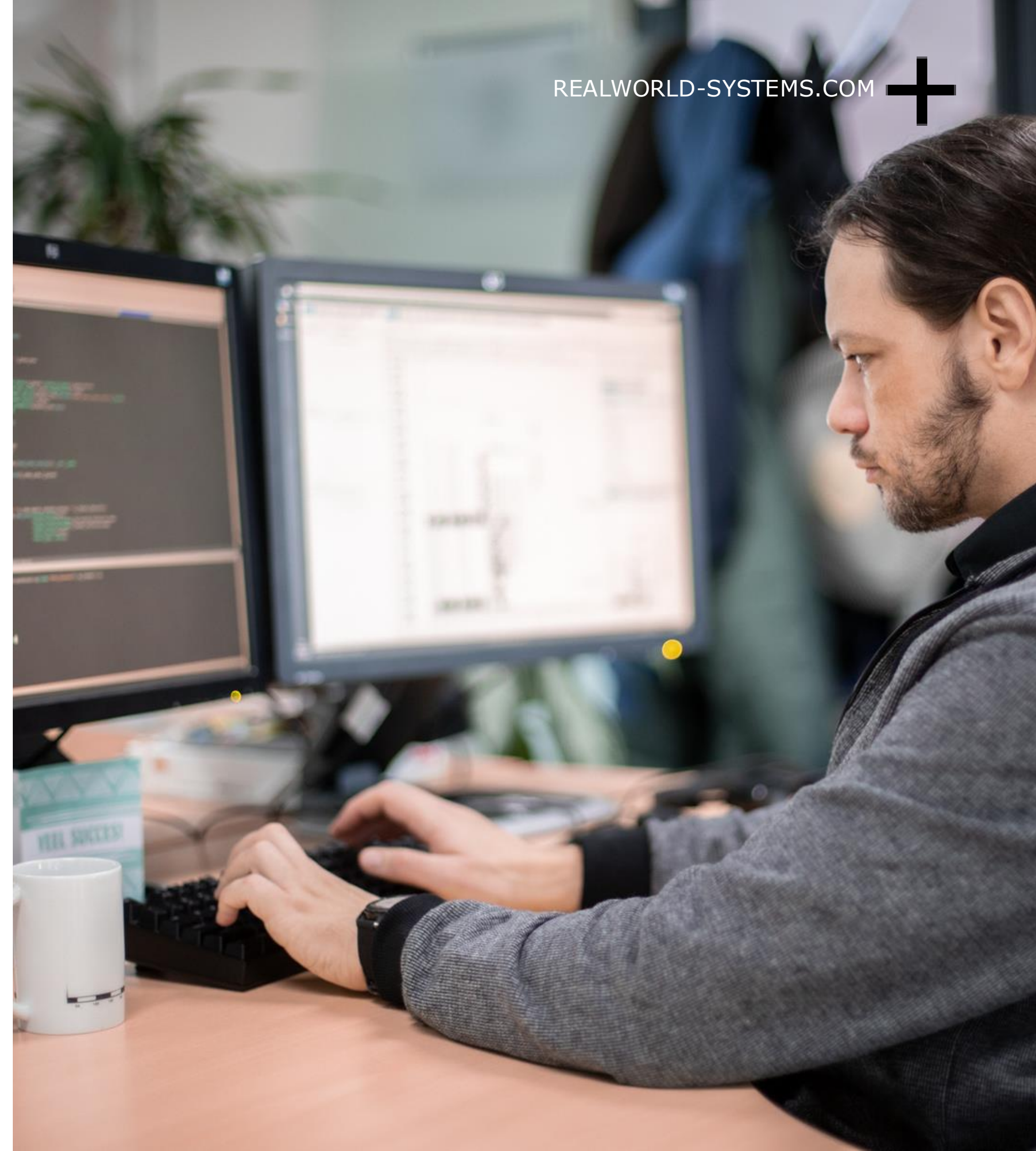


Strategic Vision

Realworld Systems is a group of companies, based in many locations: Netherlands, United Kingdom, South Africa, Romania, Germany, Switzerland, Australia, Indonesia, now **adding North America and South America**.

We still have a clear vision to **innovate and expand** our services for **GE Smallworld** customers, particularly in the Telecom, Electricity, Gas and Water sectors.

Committed to **continuous innovation** and **exceptional service delivery**



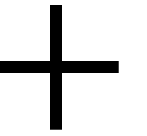


realworldsystems

Using AI to access data – Integrating ChatGPT into PNI, to enable natural language, to answer complex questions

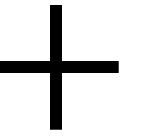
“Find the chambers in the Build Area”





What can we do?

- AI is becoming ever present in day-to-day personal use
- Realworld wanted to see what we could do with AI.
- We came up with the idea of integrating AI into GE Vernova's Physical Network Inventory System.
- Unlocking information, using natural language queries...

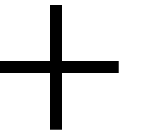


What can we ask?

AI can answer everyday questions, which it is easy to ask, but without needing specialist knowledge.

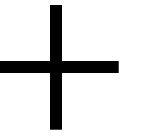
For example:

- “Find chambers in the build area?”
- “Get shelves in the Building”
- “Di ye ken where the manhole is?”



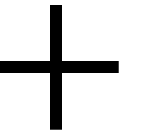
Building a 'Chatbot' for PNI

- An Inventory AI 'chatbot'
 - Make it easy for planners, managers and general users, to ask questions about their data
 - To allow users enter natural language queries
 - We should be able to use standard industry terms, such as – joint, chamber, cabinet, cable, etc.
 - Integrate the answers back into PNI
 - Enables much easier access into queries, reporting, visualisation and much more...



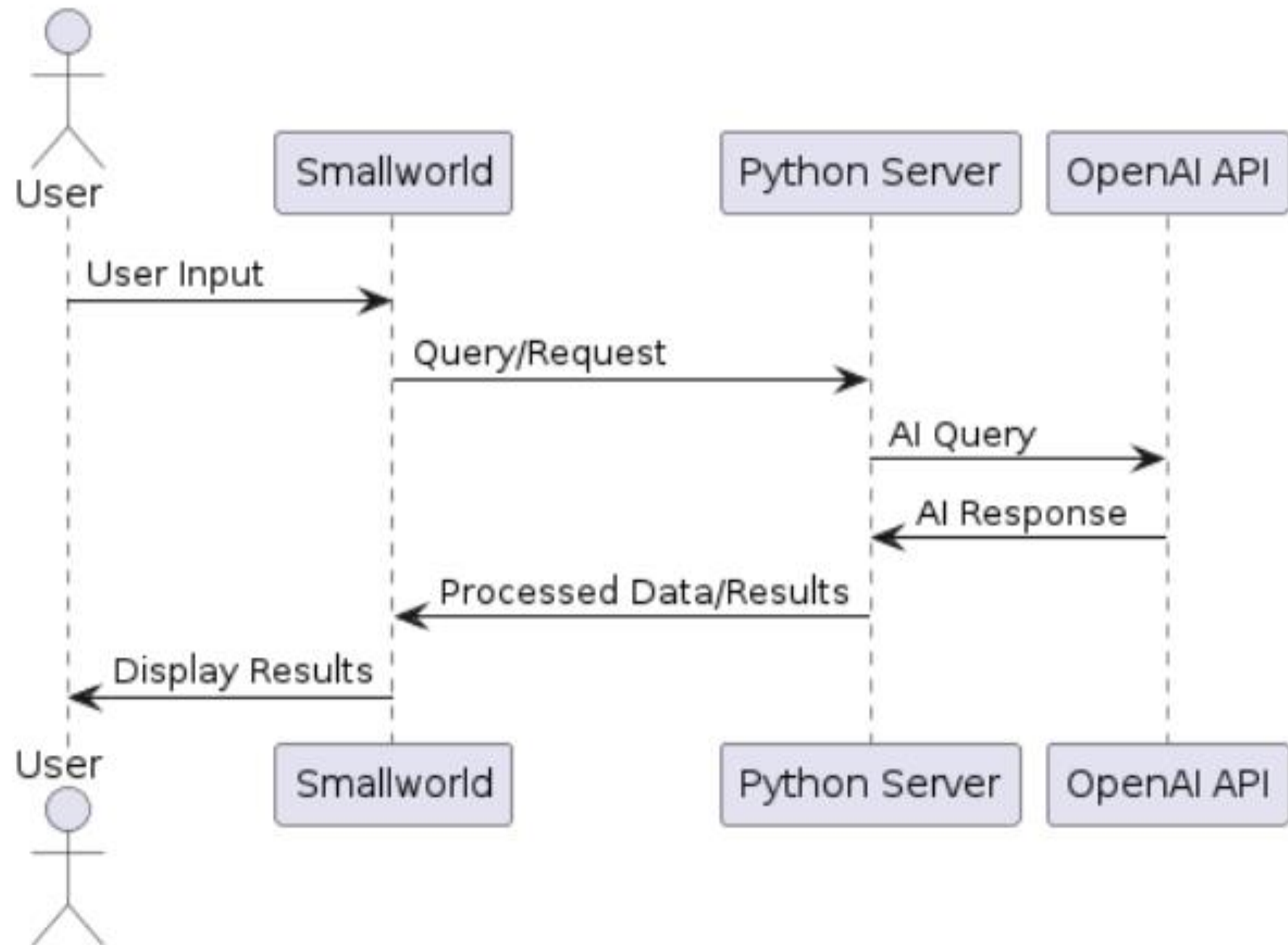
How to Build a Chatbot for PNI

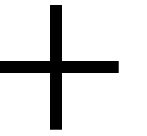
- Choose your AI
 - OpenAI API
- Devise a training program
 - 'teach' the AI about the PNI schema
 - Provide examples of Magik query code
- Integrate it



How to Build a Chatbot for PNI

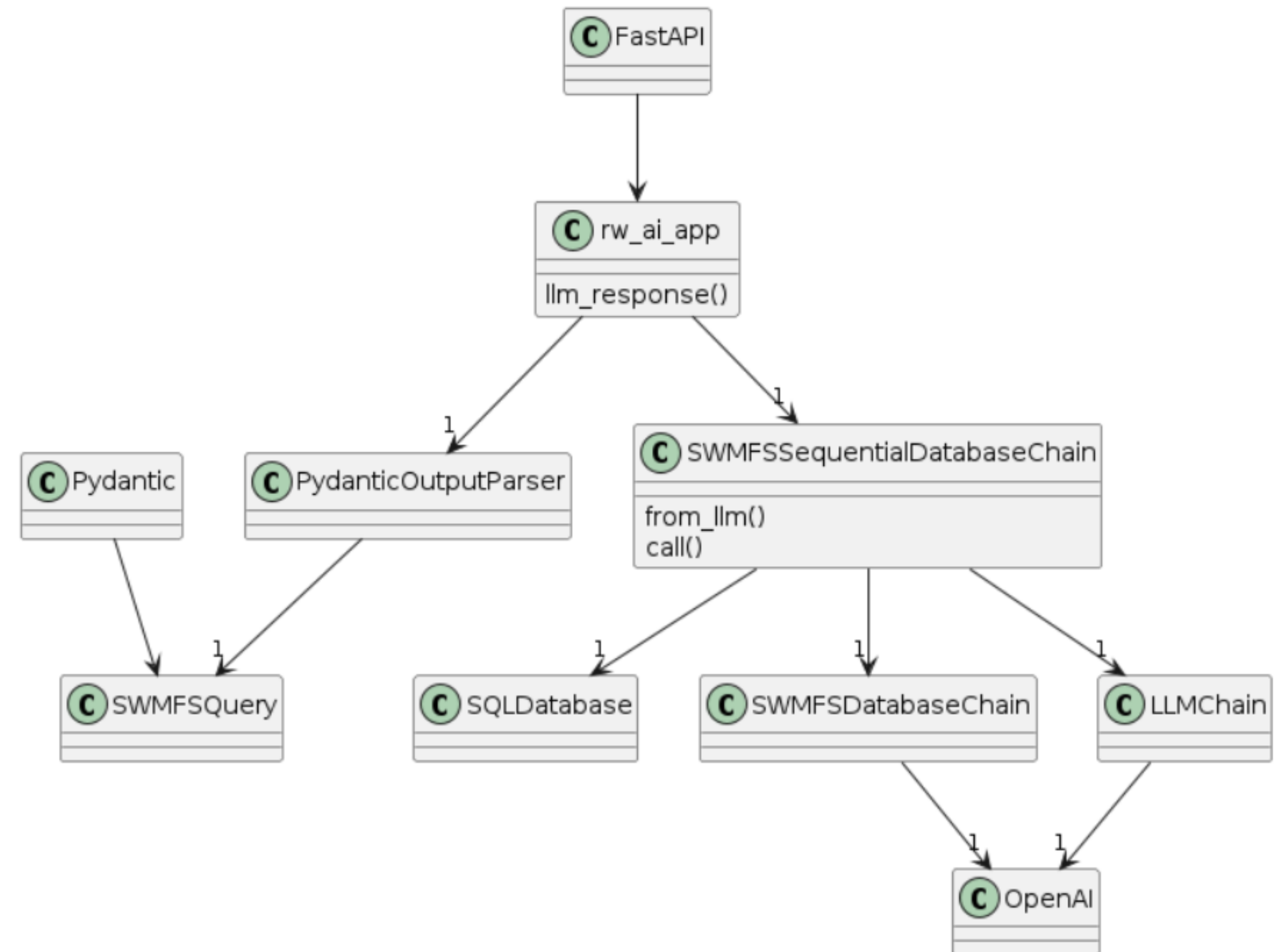
- Smallworld is used for the input/output from the explorer
- Behind the scenes, a Python server talks to the OpenAI API

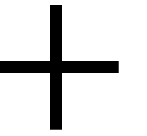




How to Build a Chatbot for PNI

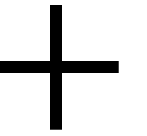
- The Python server is based on FastAPI
 - This has an endpoint 'Chat'
 - It includes Large Language Model (LLM) libraries
 - A 'learning' library populated with the Smallworld schema
 - Add examples of how to create DB queries
 - A parser to structure the response





How to Build a Chatbot for PNI

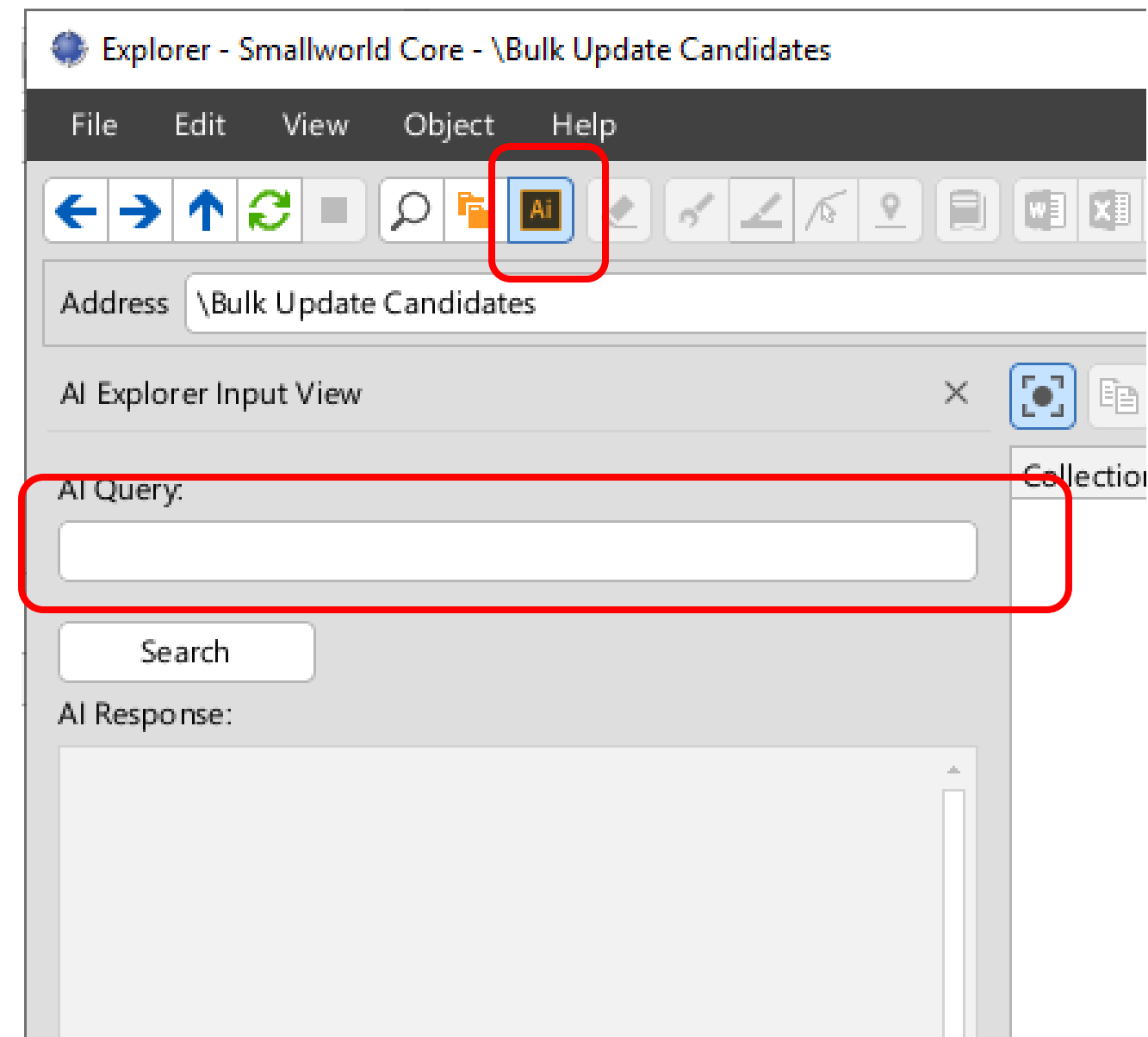
- There are two phases to the 'chat'
 - The decider phase/chain finds the tables required in the query
 - Chamber = uub
 - Shelf = mit_shelf
 - The db phase, figures out what question has been asked
- You can 'train' the chatbot by adding more example queries

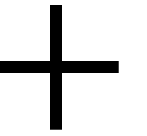


Ask the chatbot

Here, you see the new AI chatbot function, added to the standard PNI explorer

And a box to submit the questions



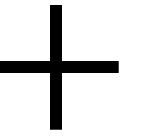


Ask the chatbot

Having selected or drawn an area in the GIS, we can ask the question:

1. 'find chambers in area'
2. The AI chatbot, figures out what to ask the database
3. View the results

Type	Label	Specification	Construction Status	Asset Owner	Cubic C...	Dro...	Dro...	Inst
Manhole	Y359906	Generic PIA	In Service	PIA				None
Manhole	Y380123	Generic PIA	In Service	PIA				None



Ask another way

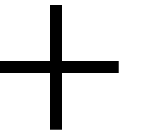
Now we can select a new area in the GIS and ask about 'Boxes in Area'

The AI chatbot, figures out that is actually the same question...

View the results – lots of manholes found within the selected area

The screenshot shows an AI chatbot interface. At the top, there is a search bar containing the text "get boxes in area" and a "Search" button. Below the search bar, the "AI Response:" section displays several natural language queries and their corresponding MongoDB-style SQL queries. The queries include "find chambers in area", "get shelves in building", and "get boxes in area". The "get boxes in area" query is highlighted with a red box. To the right of the chatbot interface, a table of results is displayed, also highlighted with a red box. The table contains six rows of data, including manhole and conduit information.

Conduit...	Y34913...	Generic PIA	In Service
Manhole	Y34924...	Generic PIA	In Service
Manhole	Y34910...	Generic PIA	In Service
Manhole	Y34910...	Generic PIA	In Service
Manhole	JPF4	JMF 104 6ri...	Proposed
Manhole	JPF4	JMF 104 6ri...	Proposed



Ask the chatbot

- And now let us try a more complex query
- “Find shelves in...”

Explorer - Smallworld Core - \Chat Query\Chat (25)\Chat Result

File Edit View Object Help

Address \Chat Query\Chat (25)\Chat Result

AI Explorer Input View

AI Query:

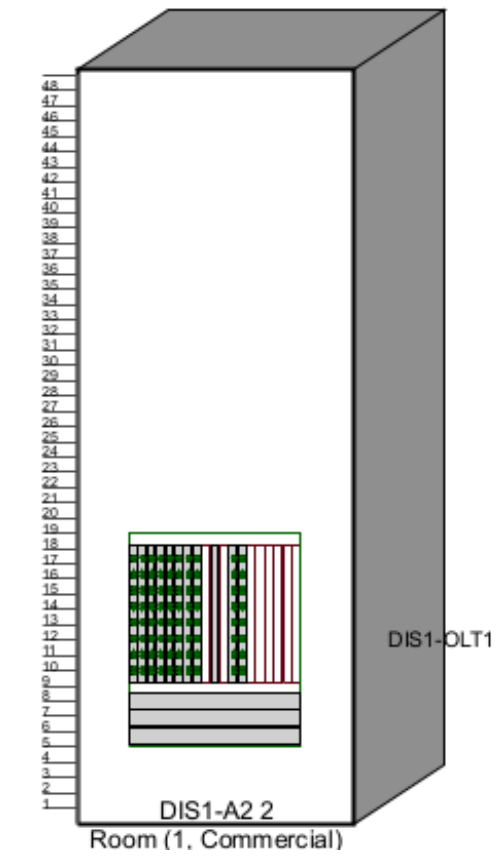
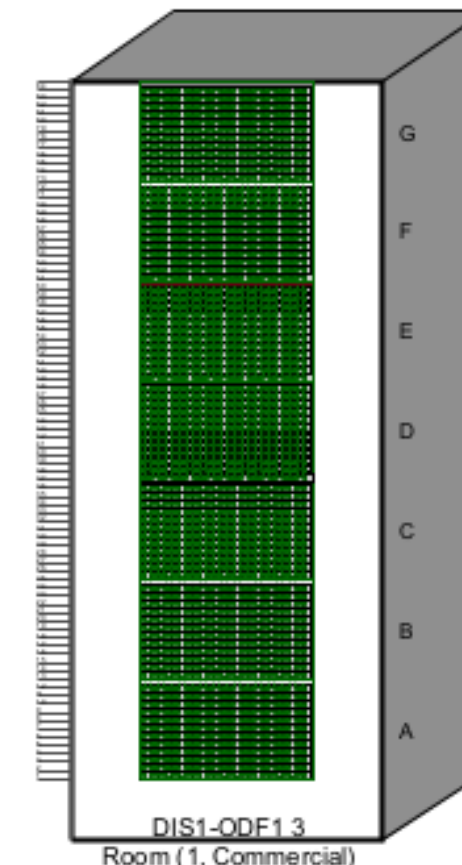
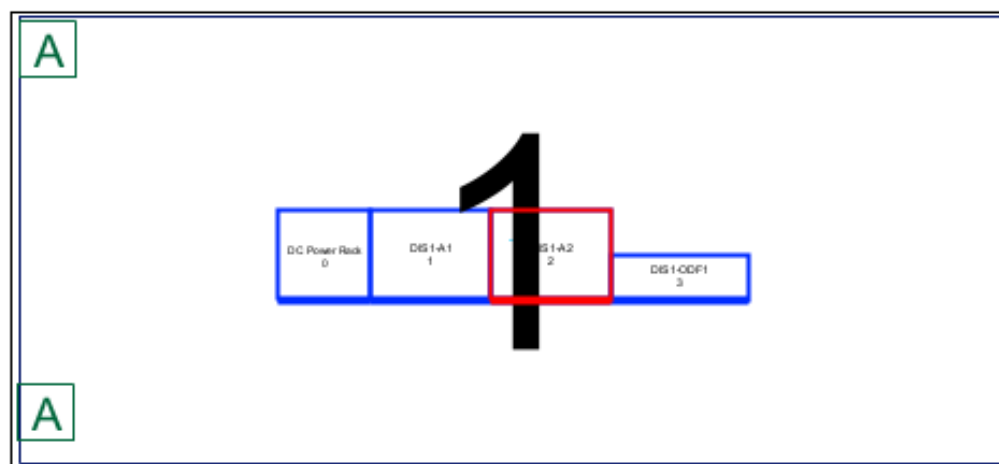
find shelves in building called DIS1

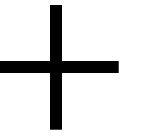
Search

AI Response:

```
gis_program_manager.databases[:gis].collections[:buil
find shelves in building called DIS1
gis_program_manager.databases[:gis].collections[:buil
find shelves in building called DIS1
```

Description	Con...	Asset Owner	NE Name	ENID Name
DIS1-OLT1	In S...	Owned	DIS1-A2./DIS1-olt1	
C	In S...	Owned		
B	In S...	Owned		
A	In S...	Owned		
E	In S...	Owned		
F	In S...	Owned		
G	In S...	Owned		
D	In S...	Owned	DIS1-ODF1./D	





How smart is the LLM?

- LLM = Large Language Model
- It could 'Find the shelves..'
- But did it 'ken' where the chambers were?
 - (Scottish version!)

Success!

Explorer - Smallworld Core - \Chat Query\Chat (27)\Chat Result

File Edit View Object Help

Address \Chat Query\Chat (27)\Chat Result

AI Explorer Input View

AI Query:
di ye ken the chambers in the area

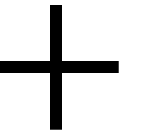
Search

AI Response:
gis_program_manager.databases[:gis].collections[:buil
di ye ken the chambers
gis_program_manager.databases[:gis].collections[:uub
di ye ken the chambers in the area
gis_program_manager.databases[:gis].collections[:uub

Type	Label	Specification	Construction Status	Asset Owner	Cubic C...	Dro...	Dro...	Inst...
Conduit...	Y34913...	Generic PIA	In Service	PIA				None
Manhole	Y34924...	Generic PIA	In Service	PIA				None
Manhole	Y34910...	Generic PIA	In Service	PIA				None
Manhole	Y34910...	Generic PIA	In Service	PIA				None
Manhole	JPF4	JMF 104 Gri...	Proposed	Owned				None 900...
Manhole	JPF4	JMF 104 Gri...	Proposed	Owned				None 900...

Chat Result

Number of Records: 6 (0 selected)



How smart is the LLM?

- Could it 'onde estao' where the cabinets were?
- Portuguese version

Success!

The screenshot shows a web browser window titled "Explorer - Smallworld Core - \Chat Query\Chat (28)\Chat Result". The interface includes a menu bar (File, Edit, View, Object, Help), a toolbar with navigation and search icons, and an address bar containing the path "\Chat Query\Chat (28)\Chat Result".

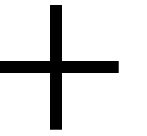
The main content area is divided into two sections:

- AI Explorer Input View:** Contains an "AI Query" input field with the text "onde estão os armários na área" (highlighted with a red box) and a "Search" button below it.
- AI Response:** Displays the following text:
gis_program_manager.databases[:gis].collections[:uub
di ye ken the chambers in the area
gis_program_manager.databases[:gis].collections[:uub
onde estão os armários na área
gis_program_manager.databases[:gis].collections[:mit

On the right side, a table displays search results:

Name	Spe...	Con...	Asset Owner	CLLI	A...	Inst...	Con...
W9138732	Gen...	In S...	PIA				Upp

At the bottom of the window, a status bar indicates "Chat Result" and "Number of Records: 1 (0 selected)".



How smart is the LLM?

- Could it 'Pronadite odaje u okolici' where the uubs were?

- (Hopefully) Croatian version

Success!

Explorer - Smallworld Core - \Chat Query\Chat (2)\Chat Result

File Edit View Object Help

Address \Chat Query\Chat (2)\Chat Result

AI Explorer Input View

AI Query:
Pronadite odaje u okolici

Search

AI Response:

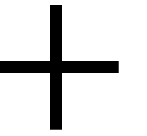
Find chambers in the area
gis_program_manager.databases[:gis].collections[:uub].select(location interacts 1 area)

Pronadite odaje u okolici
gis_program_manager.databases[:gis].collections[:uub].select(location interacts 1 area)

Type	La...	Spe...	Con...	Asset Owner	Cubic C...	Dro...	Dro...	Inst...	Width	A...
Con...	Y3...	Gen...	In S...	PIA						None
Ma...	Y3...	Gen...	In S...	PIA						None
Ma...	Y3...	Gen...	In S...	PIA						None
Ma...	Y3...	Gen...	In S...	PIA						None
Ma...	JPF4	JMF...	Pro...	Owned				None	900...	
Ma...	JPF4	JMF...	Pro...	Owned				None	900...	

Chat Result

Number of Records: 6 (0 selected)



How smart is the LLM?

- But what about other planets?

(Klingon version)

Success!

Explorer - Smallworld Core - \Chat Query\Chat (30)\Chat Result

File Edit View Object Help

Address \Chat Query\Chat (30)\Chat Result

AI Explorer Input View

pa' SoHvaD pagh Daq tu'lu'

Search

AI Response:

qo' ChaH nuvpu'bogH tu'lu'

gis_program_manager.databases[:gis].collections[:uub

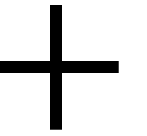
pa' SoHvaD pagh Daq tu'lu'

gis_program_manager.databases[:gis].collections[:uub

Type	Label	Specification	Construction Status	Asset Owner	Cubic C...	Dro...	Dro...	Ins
Manhole		Generic PIA	In Service	PIA				None
Manhole		Generic PIA	In Service	PIA				None
Manhole		Generic PIA	In Service	PIA				None
Manhole		Generic PIA	In Service	PIA				None
Manhole		Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	Unknown	Generic PIA	In Service	PIA				None
Manhole	JRF6	JMF 104 6ri...	In Service	Owned				None 90C
Manhole	JPF4	JMF 104 6ri...	In Service	Owned				None 90C
Manhole	JPF4	JMF 104 6ri...	Proposed	Owned				None 90C
Manhole	JPF4	JMF 104 6ri...	Proposed	Owned				None 90C
Manhole		JMF 104 Upp	Proposed	Owned				None
Manhole		Generic PIA	In Service	PIA				None
Manhole		Generic PIA	Planned	Owned				None
Manhole		Generic PIA	Planned	Owned				None
Manhole	W9030...	Generic PIA	In Service	PIA				None
Manhole		JMF 104 BT	Planned	Owned				None
Manhole		JMF 102	Planned	Owned				None
Manhole	W9110	Generic PIA	In Service	PIA				None

Chat Result

Number of Records: 152701 (0 selected)

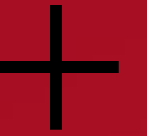


Conclusion...

AI is an incredible technology, which can be used to unlock information.

No matter how you want to ask, regardless of dialect, country or even the planet you come from 😊

For next steps – we need to ask the chatbot!



realworldsystems

The logo for Realworldsystems, featuring a stylized white 'O' with a black dot inside, followed by the text 'realworldsystems' in a bold, black, sans-serif font.

Diagnostics – Update and News...



Performance Monitoring Ecosystem

very little overlap

System monitoring tools

(AppDynamics, Nagios, SignalFX, Elastic Search, etc.)

ERP

CRM

EAM

Smallworld

Microsoft

SCADA

DMS

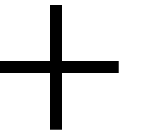
QHSE

Diagnostics



DIAGNOSTICS





Diagnostics Updates and News

News

Diagnostics version 2.7.0 was released in June 2024

Improvements include:

- SWMFs latency assessment dashboard
- Expanded Datastore Growth Monitor capabilities
- As well as bug fixes and enhancements

Diagnostics version 2.7.1 was released on 6th September.

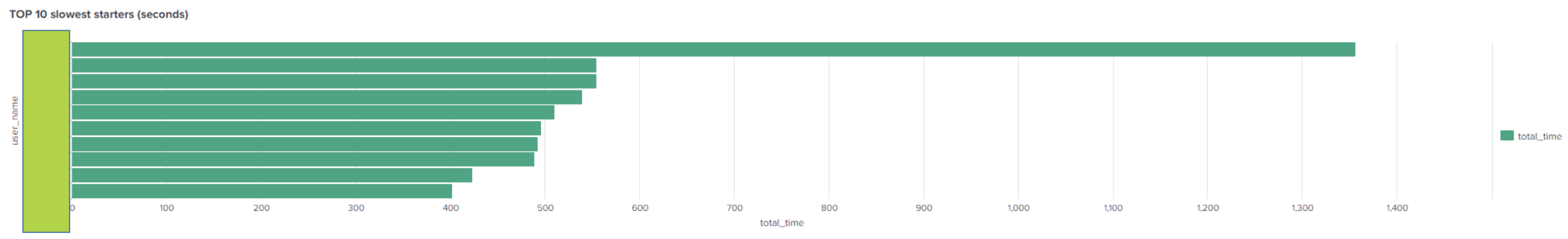
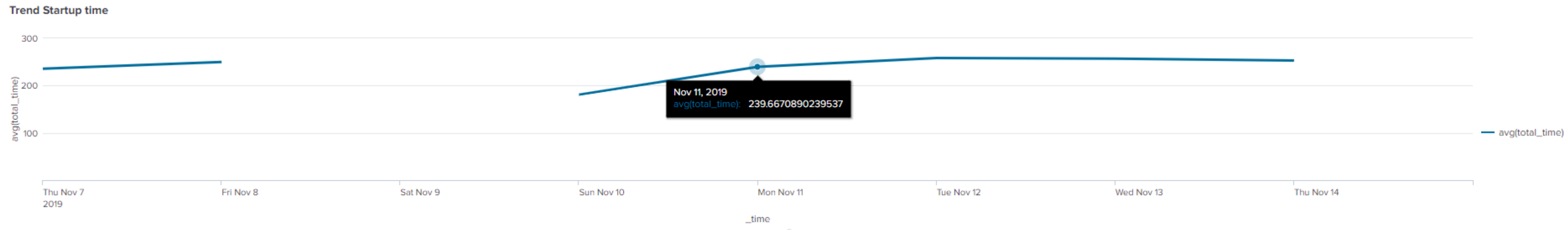
- This version ensures compatibility with the SW 5.3.4 suite

DIAGNOSTICS®



In control

Use case: startup profiling

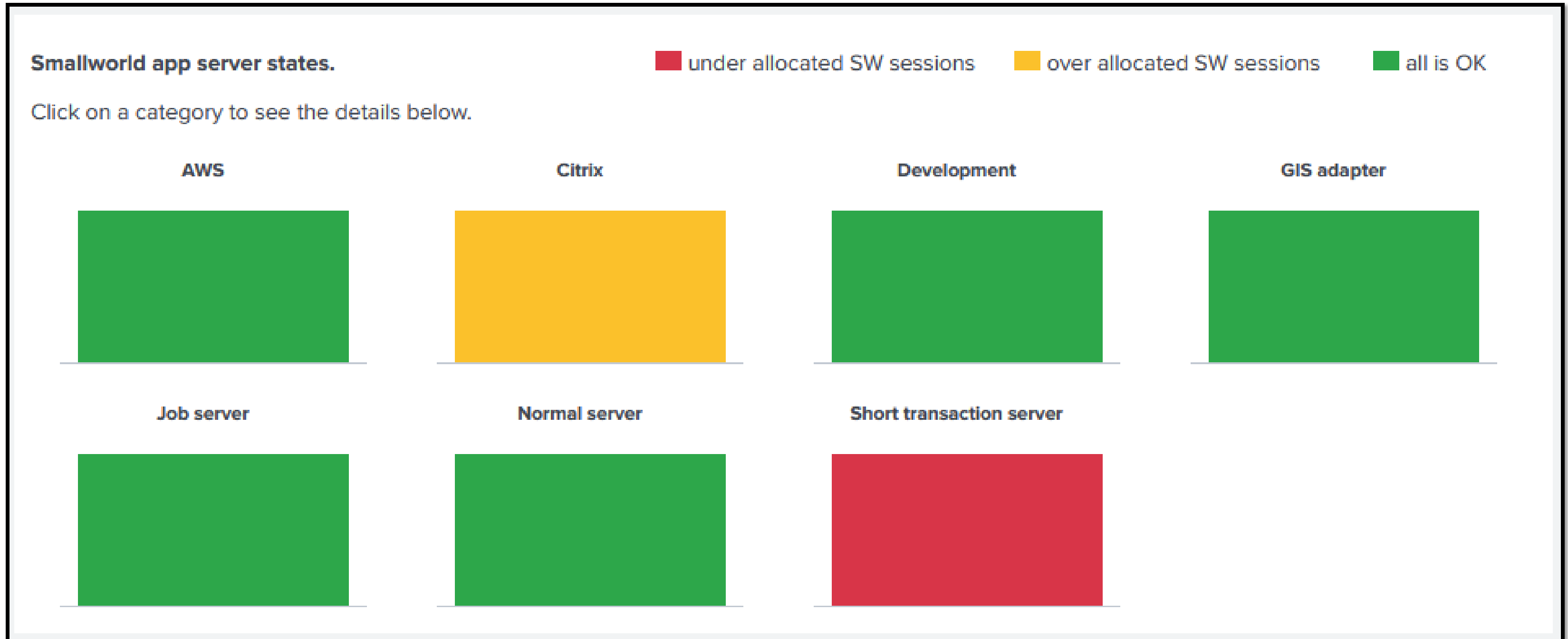




No worries - Diagnostics is here



Use case: monitoring & alerting

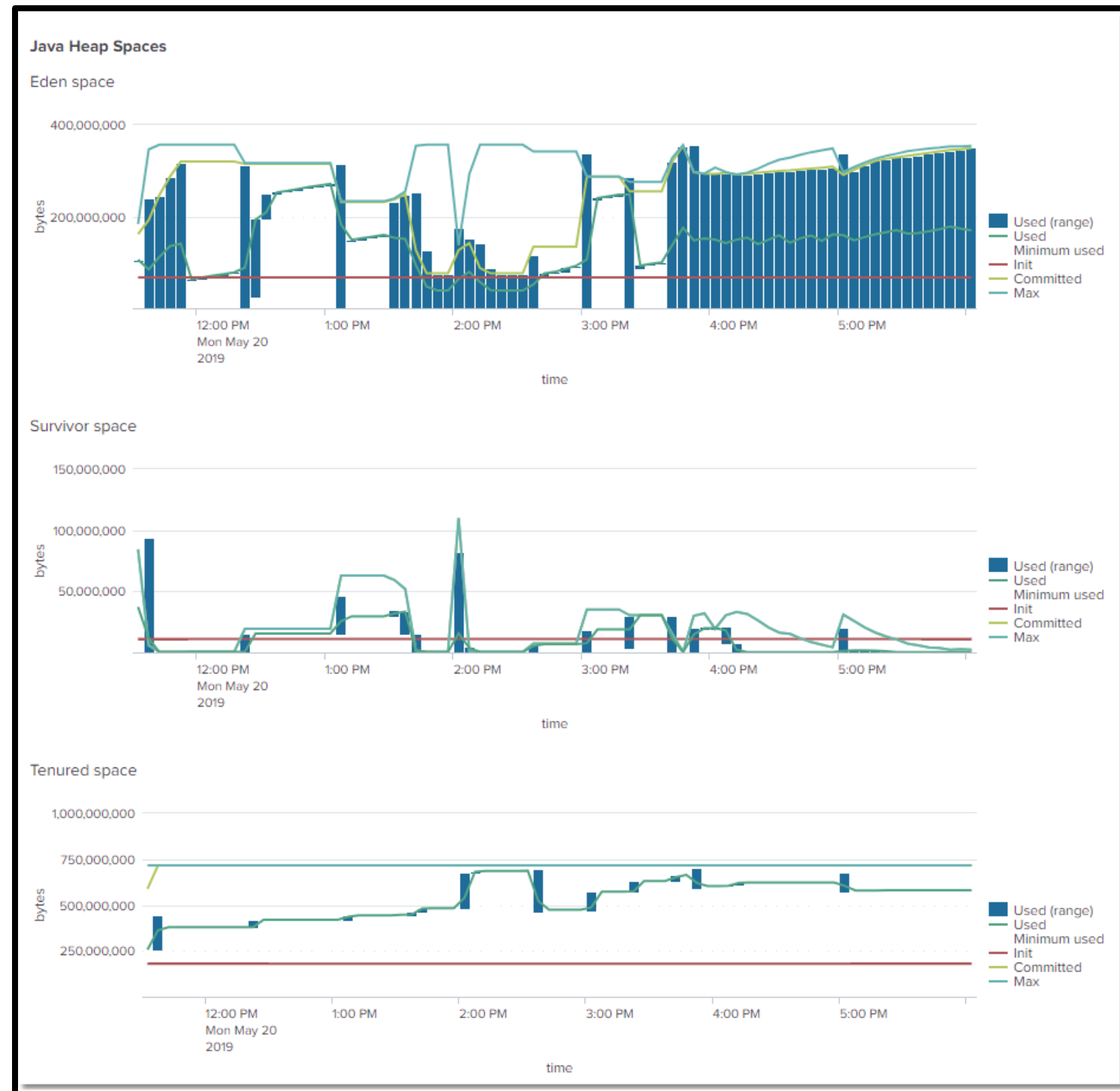




No worries - Diagnostics is here

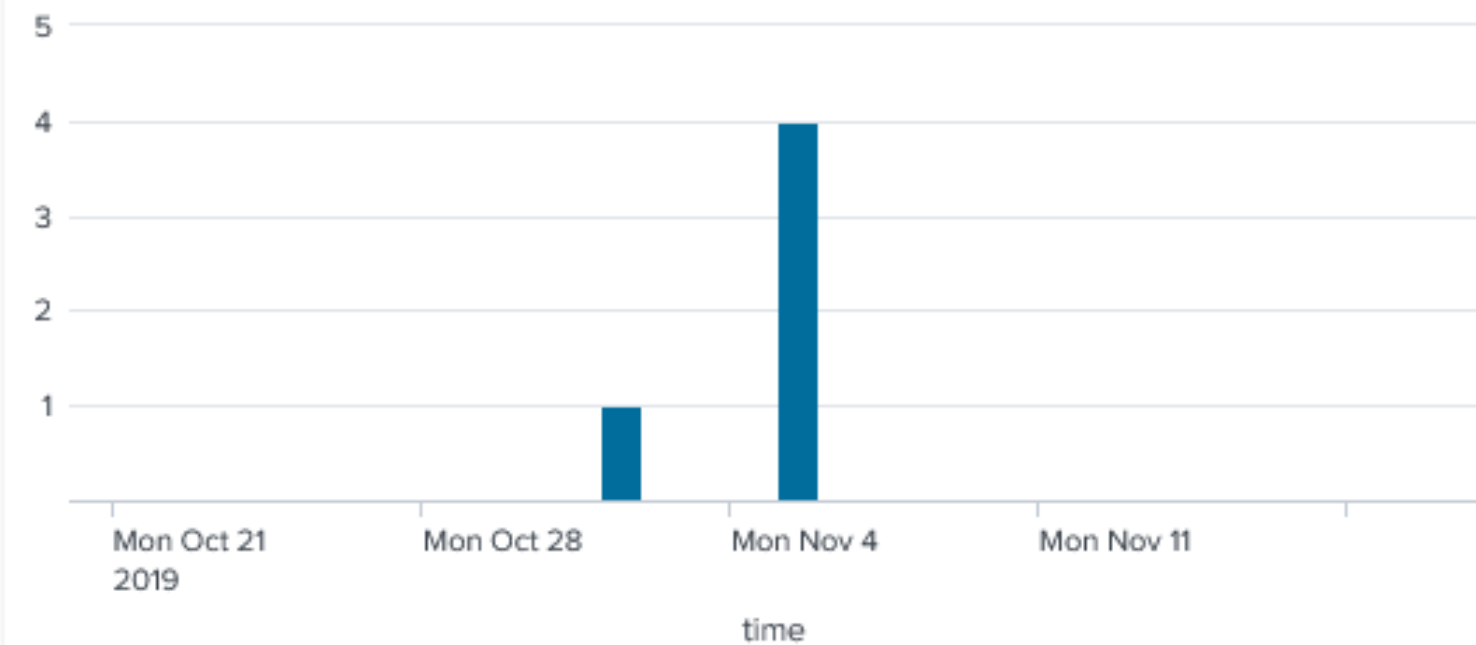


Use case: memory leak



JVM monitor alerts triggered

The JVM monitor alert triggers if the Java Virtual Machine of a SW session is using more than 50% of the tenured space after a full garbage collection. This indicates that there could be a Memory leak and that the session is about to crash.



Clicking on one of the alerts will open the JVM statistics dashboard.

time	session_id
11/05/2019 16:10:02	27
11/05/2019 11:30:03	25
11/05/2019 11:10:02	24
11/05/2019 10:55:02	21





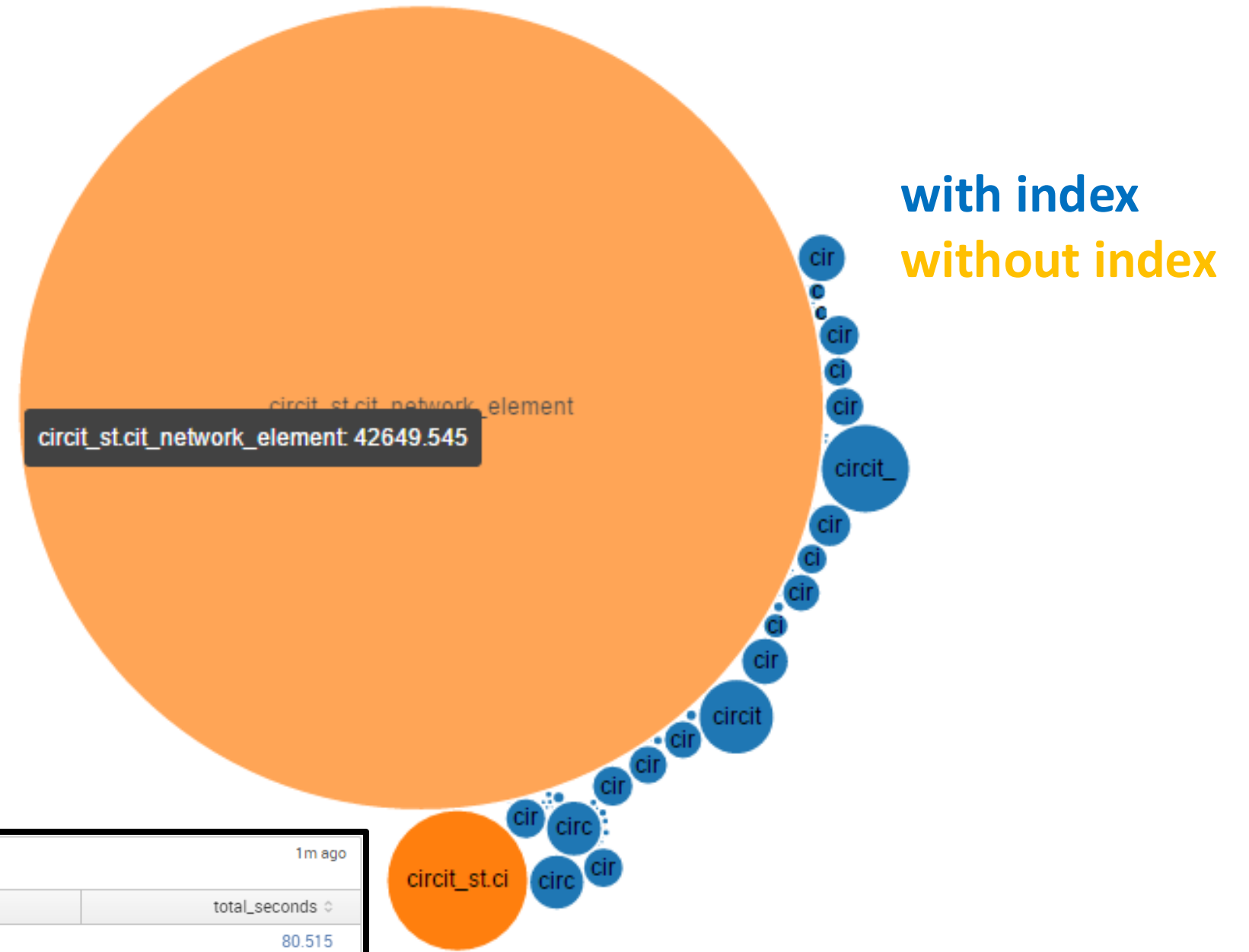
No worries - Diagnostics is here



Use case: db tuning

- 12 hours on querying this collection only, every day
- Use index and cache result: **save 10 hours**

Indexed versus non-indexed access



Slowest 10 queries

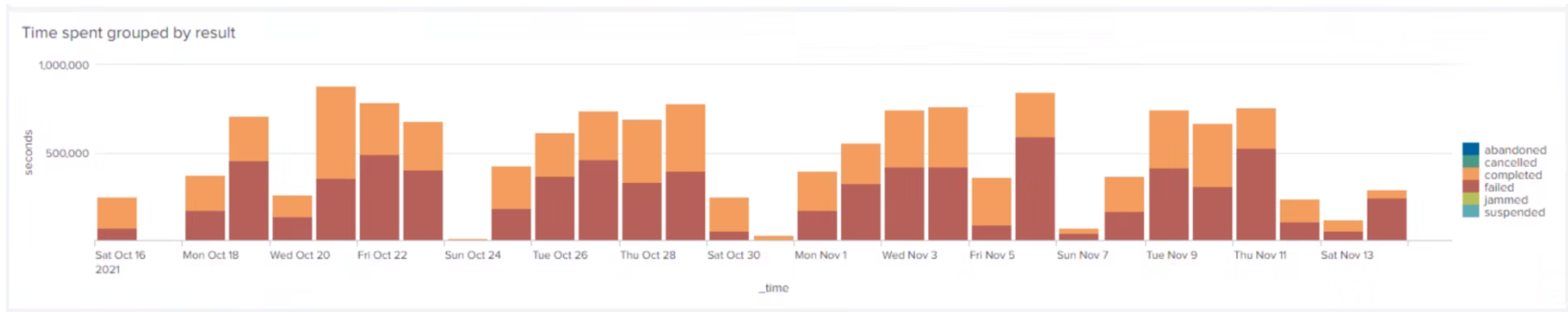
dataset	collection	query	contributions	total_seconds
circuit_st	cit_network_element	cpo_manager_name = "sw6-cl0400"		80.515
circuit_st	cit_network_element	cpo_manager_name = "md1-cl0445"		79.377
circuit_st	cit_network_element	cpo_manager_name = "cs-bi0514"		79.202
circuit_st	cit_network_element	cpo_manager_name = "md2-br0072"		79.001
circuit_st	cit_network_element	cpo_manager_name = "md1-ba0056"		78.937
circuit_st	cit_network_element	cpo_manager_name = "md1-ga0418"		78.546
circuit_st	cit_network_element	cpo_manager_name = "obs-gr-eq-bi0514"		78.376
circuit_st	cit_network_element	cpo_manager_name = "md1-ti0195"		78.221
circuit_st	cit_network_element	cpo_manager_name = "md1-bi0651"		78.063
circuit_st	cit_network_element	cpo_manager_name = "mr1-bi0670"		78.047

total_seconds	label
42649.545	circuit_st.cit_network_element
1289.251	circuit_st.cit_service_port
504.456	circuit_st.int!rwee_ip_range_lor_ip_address
358.166	circuit_st.int!cit_service_p_cit_parameter
190.598	circuit_st.cit_customer

« prev 1 2 3 4 5 6 7 8 9 10 next »



Time spent on failed > time spent on completed



More job server time spent on failed merges than on completed merges





STRESSED
OUT!

No worries - Diagnostics is here

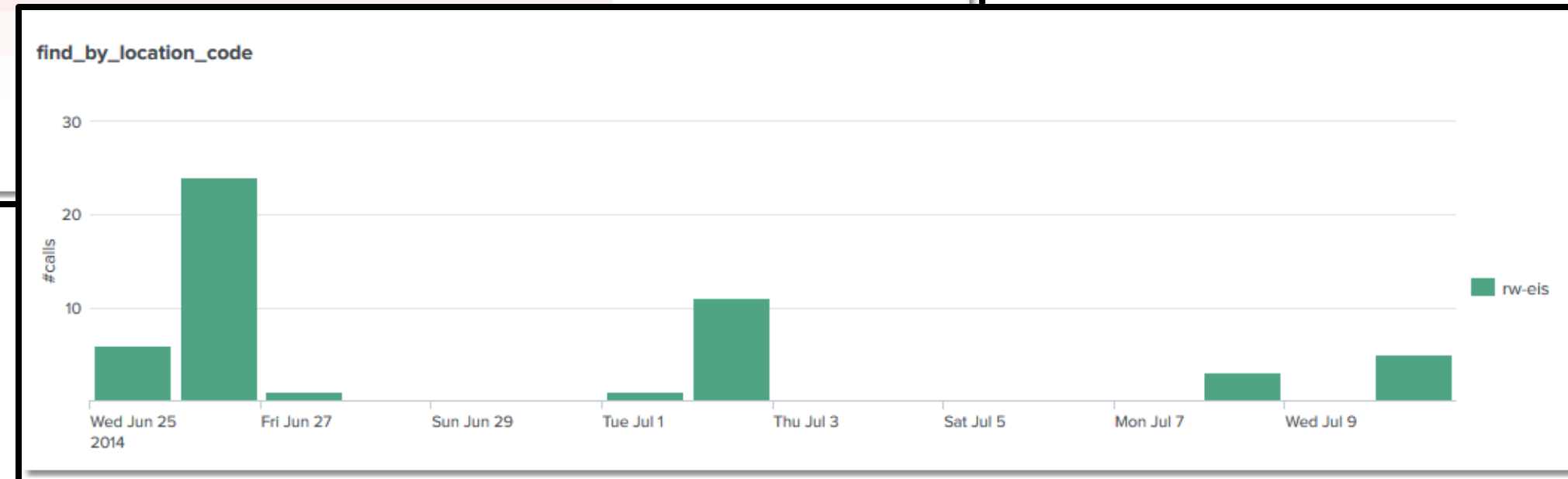


Use case: interface monitoring (GSS)

- Build a fence, open interfaces (i.e. GSS), monitor access

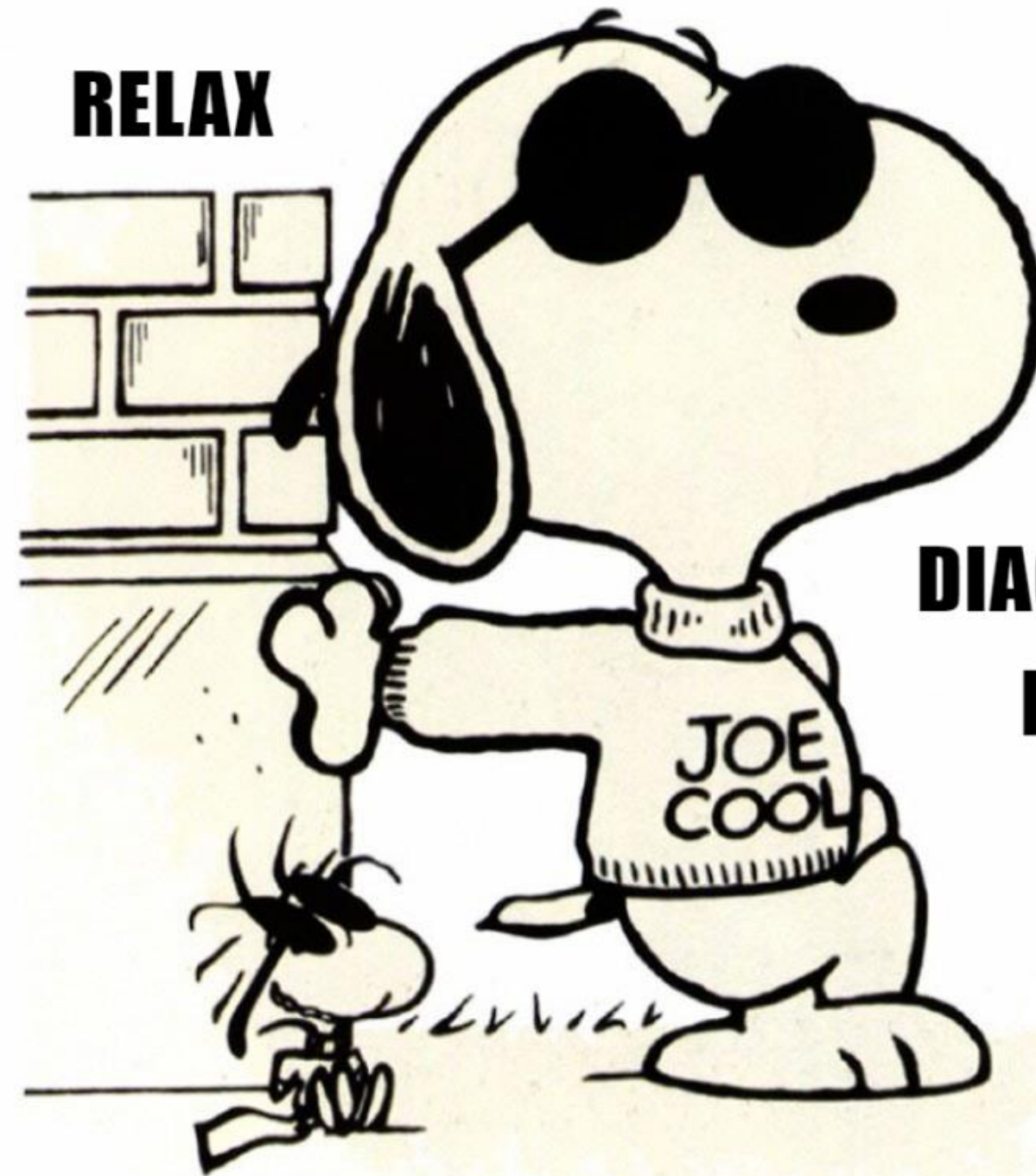
Top 10 total duration of service calls
Select a service call to show the details below.

Service calls ↕	Total duration (seconds) ▾	Count ↕
get_tile	211.787	3699
find_by_location_code	91.869	51
get_bay_children	75.100	8
web_plot_layout_types	46.828	21
wmts_selection	45.214	321
get_multitap_components	44.538	8
update_remarks	37.534	8
get_fibres_in_fibre_sheath		
do_location		
update_catv_cables		



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RELAX



**DIAGNOSTICS
IS HERE**



Use case: errors

Session details
Clicking on a session will open the session details dashboard.

user_name	location	department	machine	ip	session_startup	log_file
root	Realworld Office	Development	diag-208	172.17.2.199	C:\SubversionTest-4.2\Images\diagnostics_swaf_environment_open.asf	

Number errors
Click the errors to show the conditions.

3

Number of warnings
Click the warnings to show the conditions.

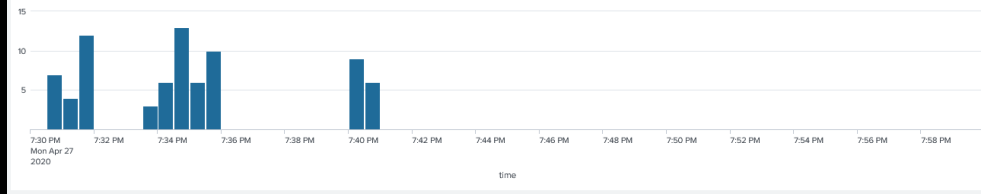
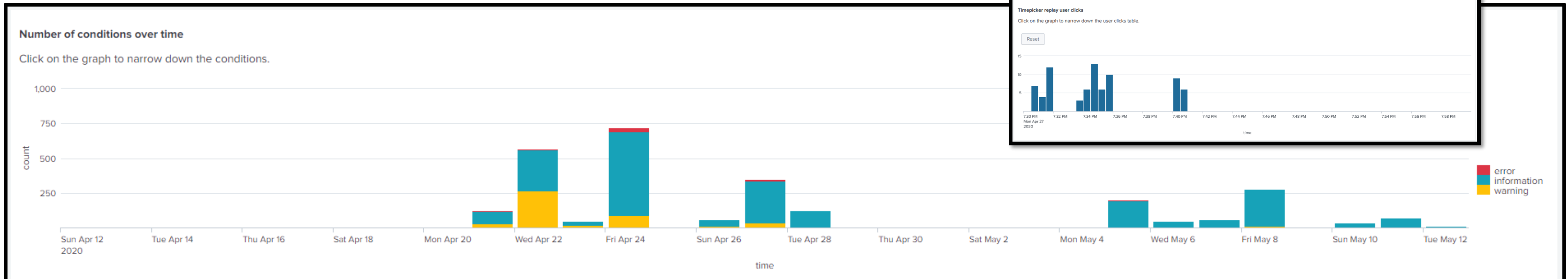
6

Number of informations
Click the informations to show the conditions.

84

Timepicker replay user clicks
Click on the graph to narrow down the user clicks table.

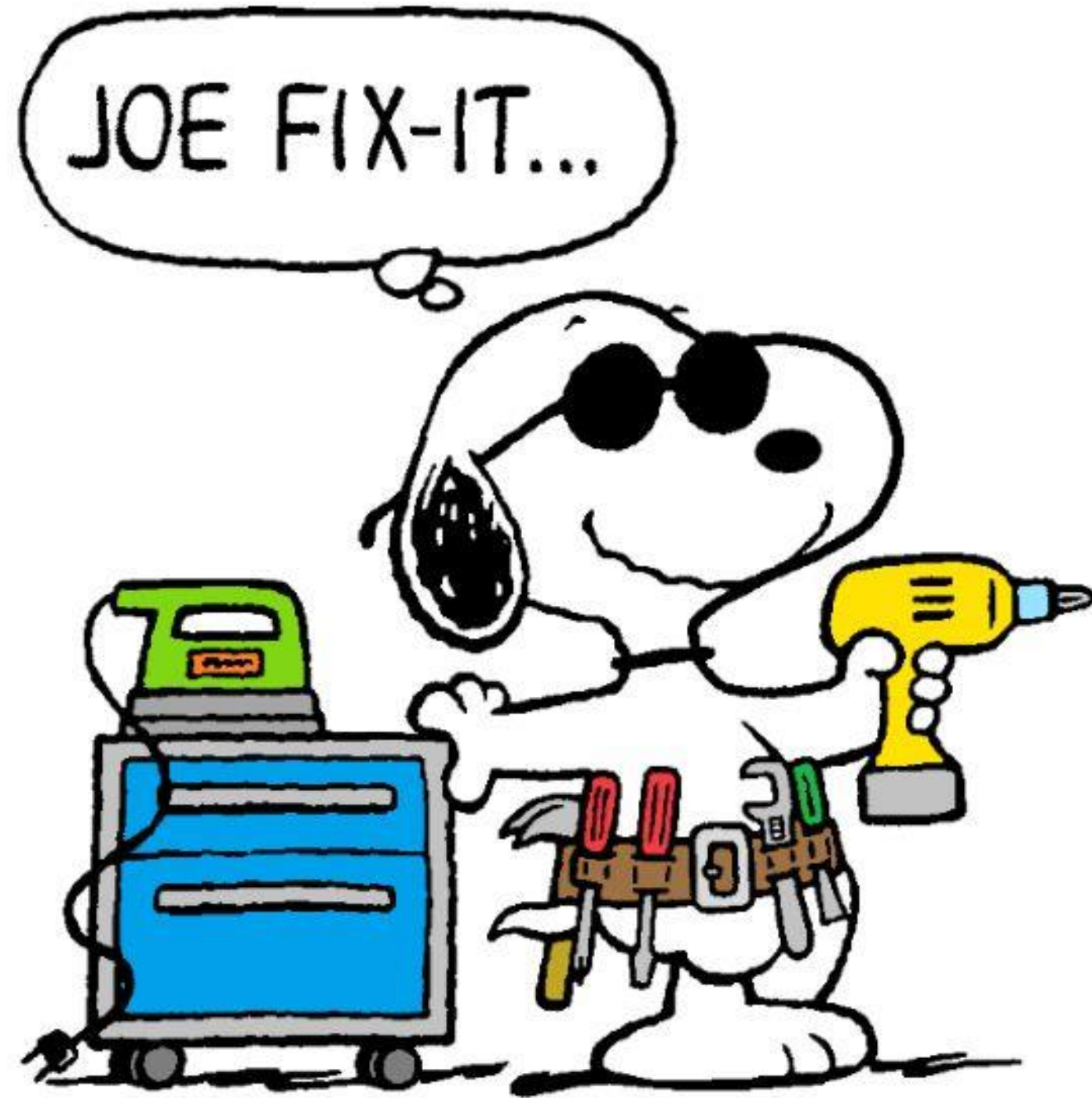
Reset

Errors reported				Warnings reported				Information reported			
Clicking on an error will show the related reports below.				Clicking on a warning will show the related reports below.				Clicking on an information condition will show the related reports below.			
	condition	count	percent		condition	count	percent		condition	count	percent
1	does_not_understand	44	58.666667	1	component_no_such_action	250	52.192067	1	sw_module_already_loaded_same_version	542	25.256291
2	parser_error	10	13.333333	2	global_changing_nature	110	22.964509	2	patch_seeking	402	18.732526
3	too_few_arguments	4	5.333333	3	exemplar_already_exists	51	10.647182	3	patch_dir_loading	258	12.022367
4	sw_module_required_module_not_defined	4	5.333333	4	framework_plugin_not_found	20	4.175365	4	sw_module_loading_module	210	9.785648
5	no_coercion_defined	3	4.000000	5	condition_exists	12	2.505219	5	pragma_monitor_info	198	9.226468
6	self_error	2	2.666667	6	conflict_methods	8	1.670146	6	sw_module_loaded	192	8.946878
7	resource_not_found_in_module_error	2	2.666667	7	cannot_register_custom_function_monitor	8	1.670146	7	patch_loading_done	86	4.007456
8	global_not_a_class	2	2.666667	8	resource_not_found_in_module_warning	7	1.461378	8	sw_module_redefining_module	85	3.960857
9	error	2	2.666667	9	warning	3	0.626305	9	defining_global	78	3.634669
10	update_key_field_user_error	1	1.333333	10	resource_not_found_warning	3	0.626305	10	sw_module_loaded_with_dependencies	45	2.096925







No worries - Diagnostics is here



Datastore growth monitor

- See current state
- ...

Total size

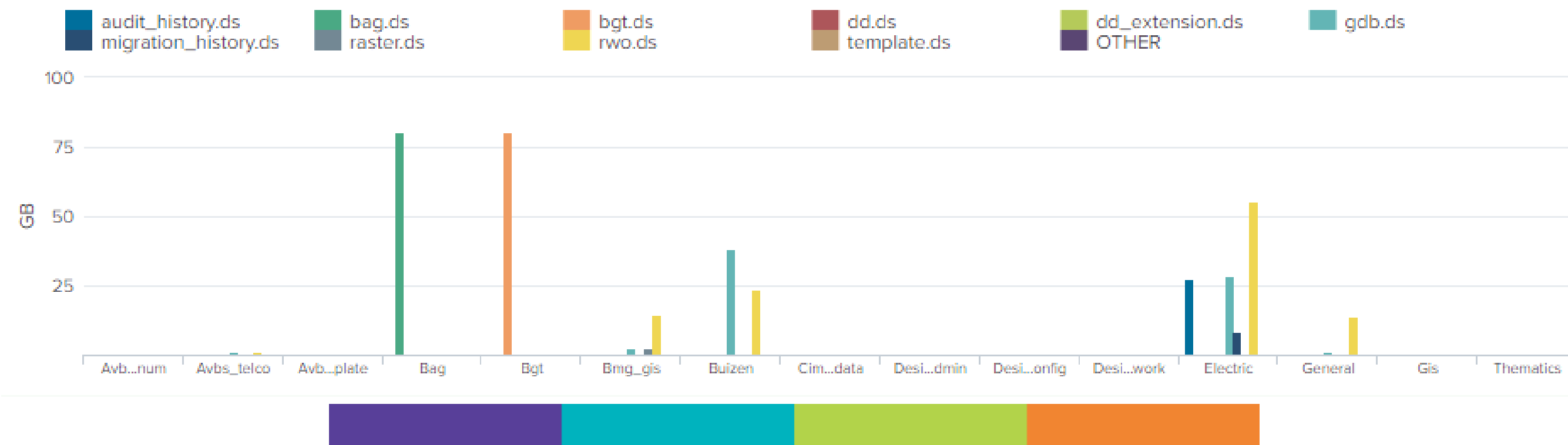
381.4 GB

Total used

378.8 GB

Size of all datastore files on 30 May 2024

Clicking on a file will show its details and growth prediction below.



Datastore growth prediction

- ...
- See future state
- See required actions
 - Choose A or B or C

State of all datastore files on 30 May 2024

Clicking on a file will show its details and growth prediction below.

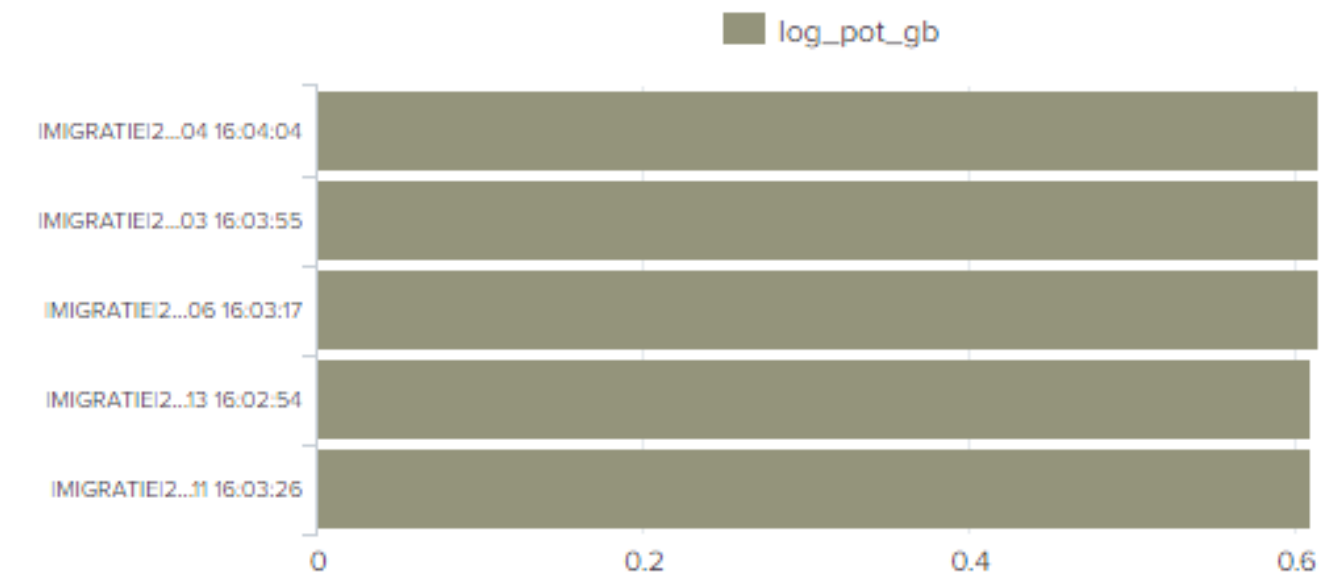
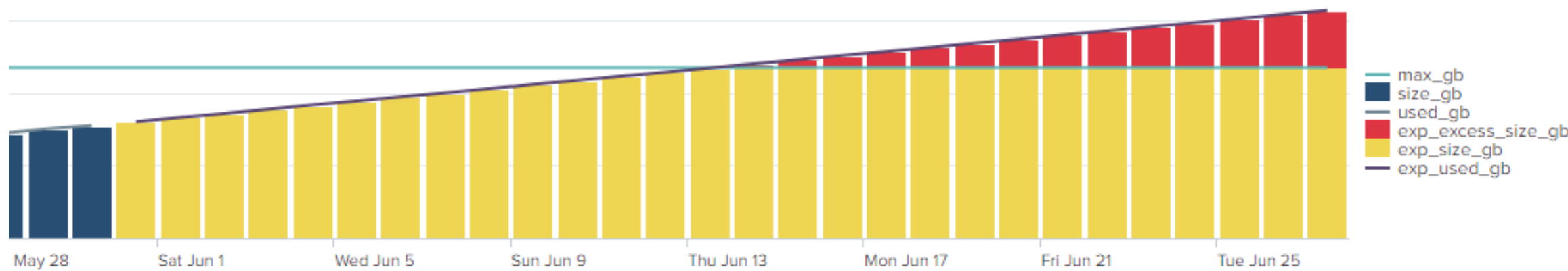
dataset	name	percent_maxed	days_until_99_percent_maxed	act_before
Buizen	gdb.ds	65.92 %	13	13 Jun 2024
Buizen	rwo.ds	53.53 %	62	01 Aug 2024
General	rwo.ds	85.75 %	>90	
Bmg_gis	rwo.ds	33.96 %	>90	
Electric	gdb.ds	25.72 %	>90	

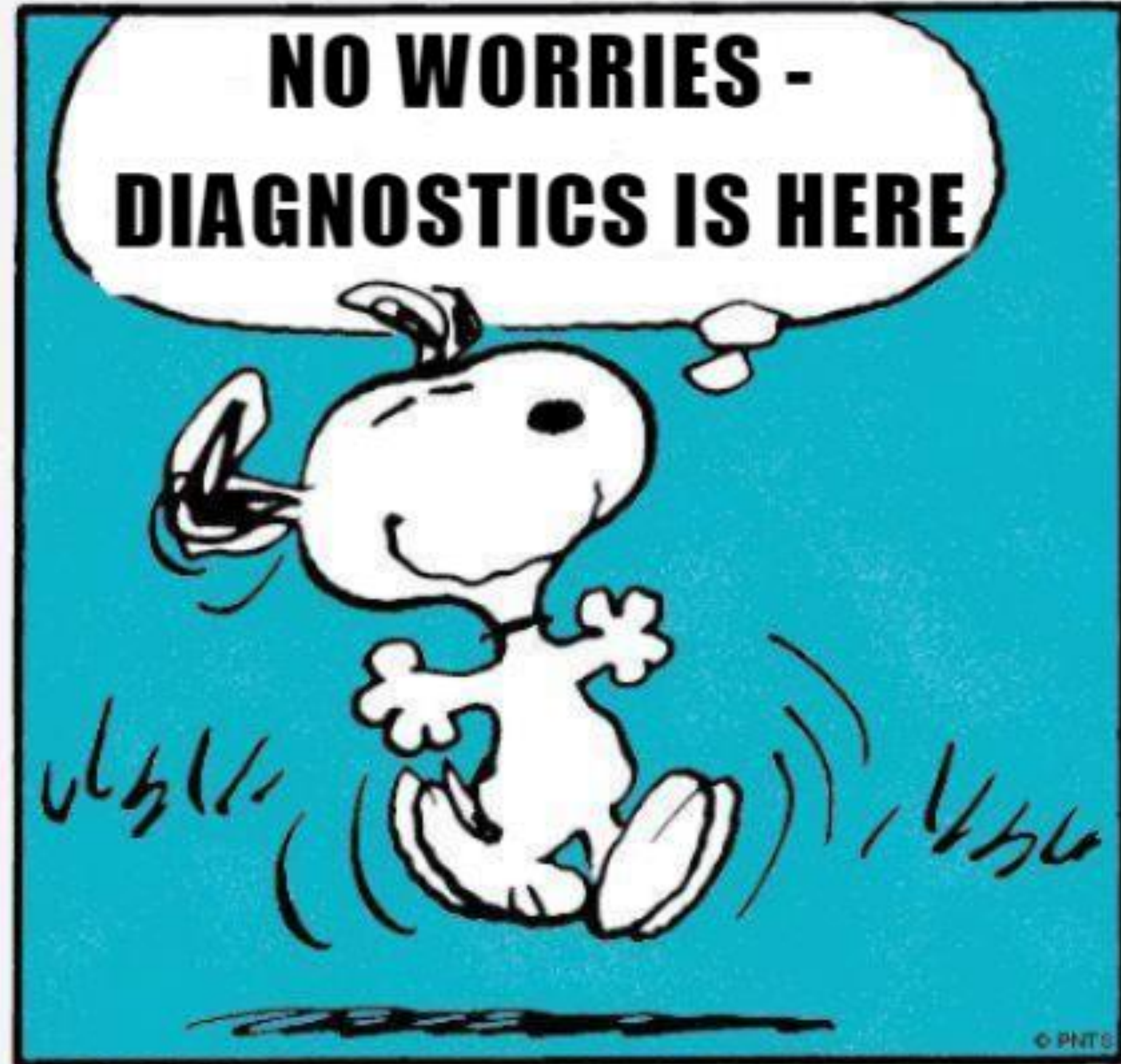
« Prev 1 2 3 4 5 6 7 8 9 10 Next »

2 alerts

Potential action B: drop old references to data to free internal space

Alternatives with highest amount of data in older versions

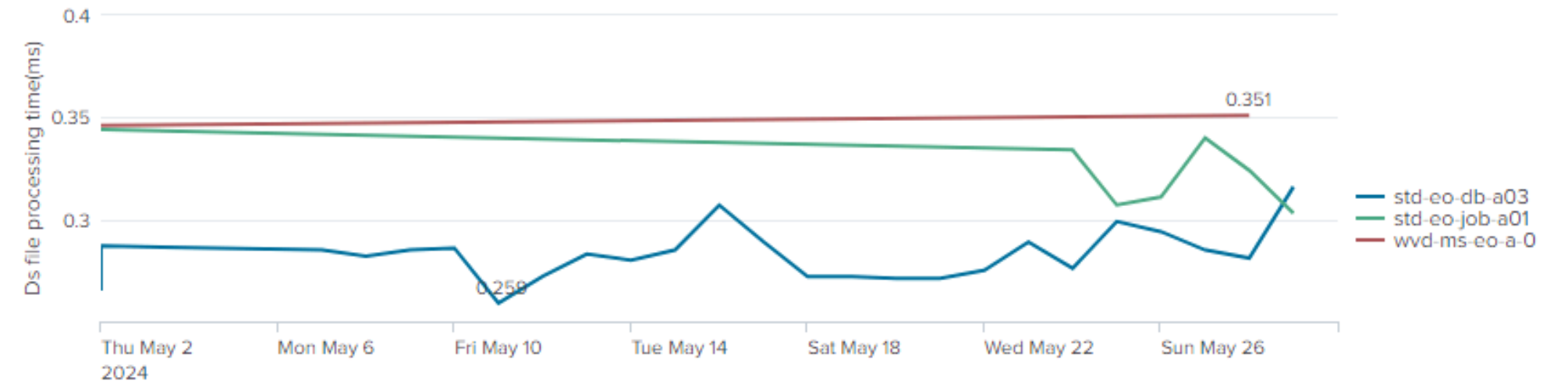




Swmfs latency assessment

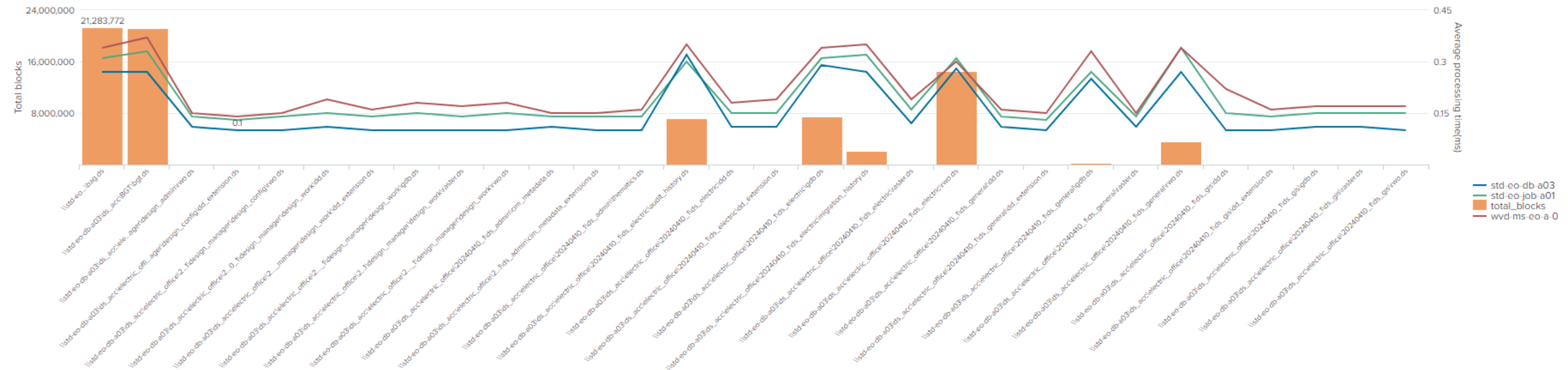
- Compare vmds latency
 - network latency
 - storage latency
- Show past measurements

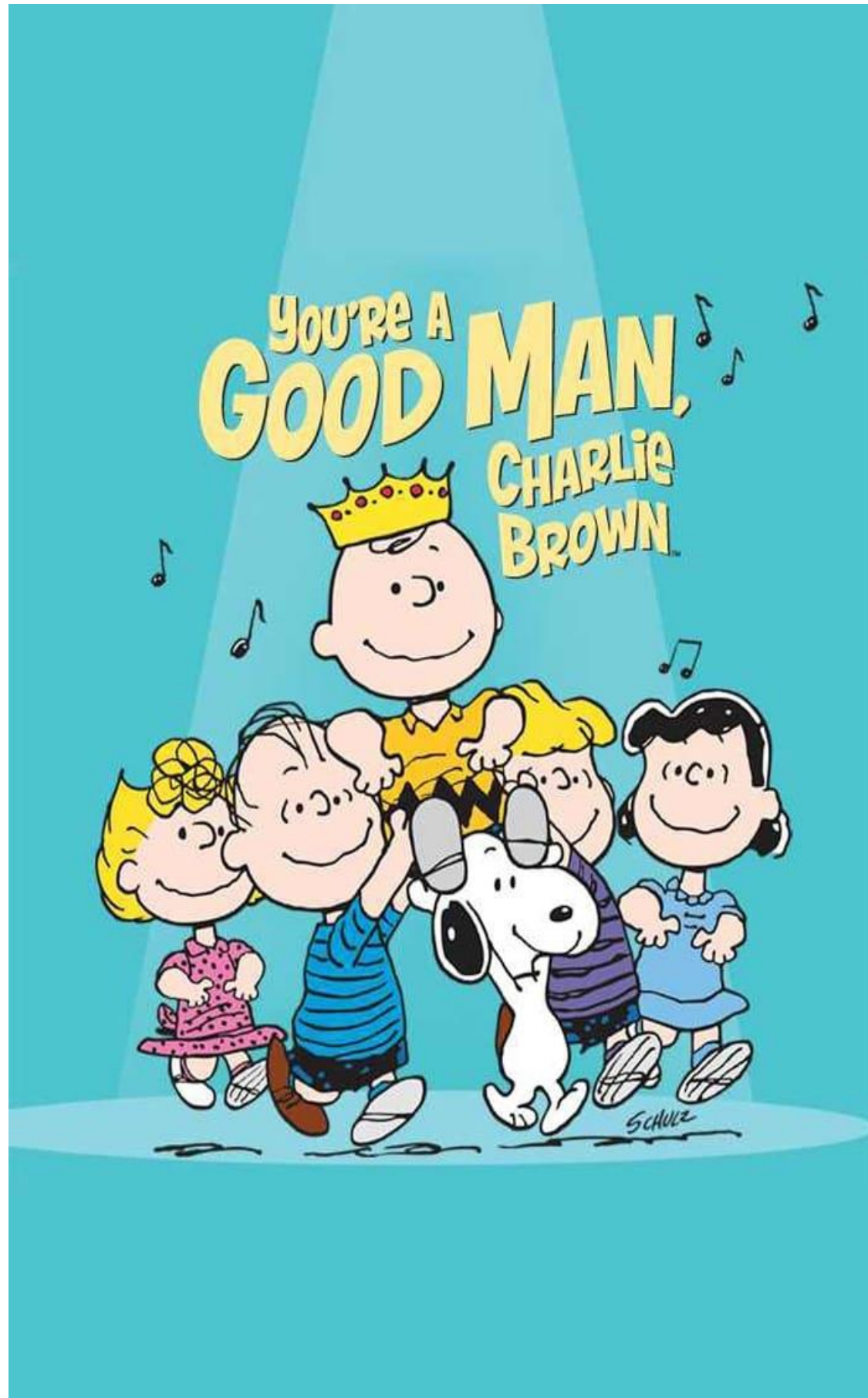
Processing trends over time - \\std-eo-db-a03\ds_acc\electric_office\20240410_1\ds_electric\audit_history.ds



Database latency across machines

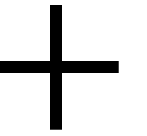
Click on the bar to view individual processing times for each dataset file across all machines.





Bringing transparency into
Smallworld - Diagnostics is here





Diagnostics Updates and News

Updates

Success Stories

Over the last year or so, Diagnostics was used to help many clients to improve system performance in their various environments

Case 1:

Data corruption had been introduced to a customer's network asset database

They looked for over a year, but couldn't find the cause

Diagnostics came to the rescue and helped to identify the cause of the problem

It was caused by the status of the network assets being changing **before** a design plan was completed

Upon design refresh, conflicts arose

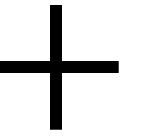
The corruption impacted a lot work and schedules

Based on the findings in the analysis of the Diagnostics data, a solution was formulated for the new designs

DIAGNOSTICS®



In control



Diagnostics Updates and News

Updates (cont.)

Case 2:

Map rendering at a customer, was taking a very long time, for a relatively small map (1:10k)

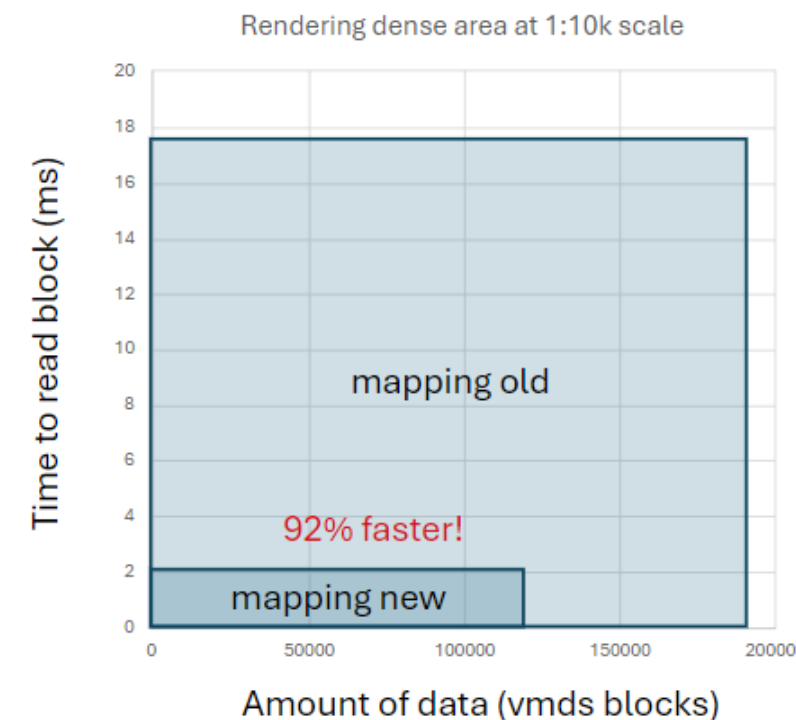
Analysis of the Diagnostics data, helped to pinpoint the problem – the block read time was part of the bottleneck

The main part of the solution:

- Reduction in number of blocks being read
- Reduction in read time of each block-read

The render time for the map was reduced significantly

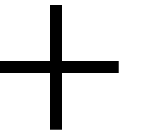
As part of the analysis, Diagnostics also helped to find a problem in a query rewrite, which resolved a massive reduction in query time.



DIAGNOSTICS®



In control



Diagnostics Support

Here to help...

Diagnostics helps users to do many things:

- Generates valuable system operation data
- Identifies errors and bugs
- Improve system performance
- Locates memory leaks
- And much, much more...

For help and support contact me or any of my colleagues in the Diagnostics team

We will be happy to help you solve the problem!

DIAGNOSTICS®



In control



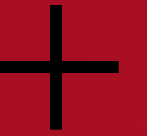
Taking the Ghosts and Gremlins out of
Smallworld - Diagnostics is here





On behalf of the Diagnostics and Peanuts team Happy Thanksgiving(with Diagnostics)





realworldsystems

Questions

