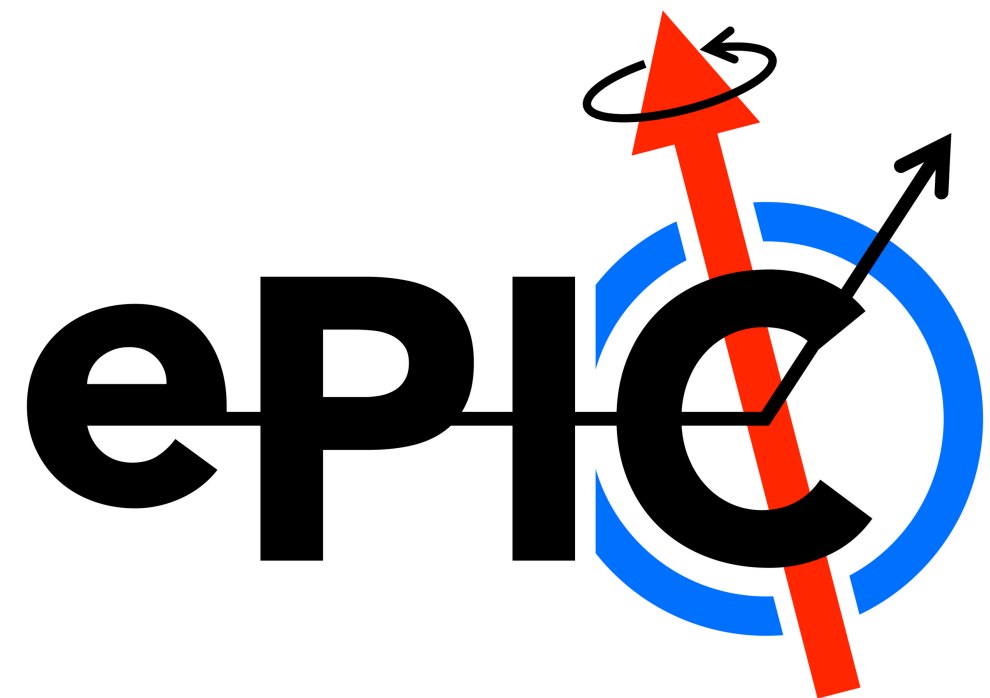


DB for detector information: User Cases

Prakhar Garg

TIC meeting
January 29, 2024



Outline

- ① Slides from Thomas Ullrich: General Discussion and ATLAS+CMS Examples
- ① ALICE/ sPHENIX TPC production Database and Structure

Detector Construction Database* System for the ePIC Experiment

Thomas Ullrich
TIC Meeting
January 29, 2024

* a.k.a.:
Hardware Database
Production Database
Asset Database
Inventory Database
Component Database

Purpose

- ePIC consists of many subdetectors that will be designed and manufactured in many laboratories and commercial firms, located in US, Europe, Asia, and South America. Hundreds of people from many institutions will be involved.
- Many detector components must migrate between manufacturers and laboratories during test and assembly phases. We should be able to trace and register all these movements and synchronize the physical location of components with ownership of related data in database accordingly.
- The purchase/tests/measurements/installation will produce huge amount of data. In modern experiments practically almost all of them are to be stored in database for further analysis and use. The most convenient and reliable solution should assure undisturbed, direct population of database with these data.
- In short the DB should
 - ▶ keep track of detector components, especially electronic components (power supplies, sensors, ASICs, boards)
 - ▶ Each component tracks: purchase (manufacturer, builder, delivery date), SN, installation details, repairs, problems, test measurement, radiation, QA status, locations and more
 - ▶ Allow easy tracking of problems
 - ▶ Frees ePIC of insider know-how of a few (yes people do get hit by buses)

Why do I even have to make a case for this?

- **Past**

- ▶ HW databases were not common at RHIC and JLab experiments
- ▶ Often know how of components relies on individuals
- ▶ Ignorance is bliss

- **Now**

- ▶ CERN <https://eam-opensource.web.cern.ch/content/eam-light>
- ▶ All LHC experiment
 - Example: ATLAS ITK - sophisticated complex DB build by Unicorn University, Prague
 - Example: ALICE - Hardware Database build by Peter Glässel (used by sPHENIX)
- ▶ sPHENIX for some sub detectors (e.g. TPC)

- ATLAS colleagues after I contacted them: *“How can you not already plan this. Every experiment needs a component data base”*

- **Many**

- ▶ Reuse existing HW database software (e.g. ALICE, ATLAS, CMS, LHCb version) and tune for our purpose
- ▶ Build own version - needs workforce, substantial effort

- **My Take**

- ▶ The ALICE DB seems the best suited for our purpose. We have an expert^{??} (Prakhar) to oversee the process
- ▶ May be (?) there's a group in ePIC with less hardware ambitions but interested in further developing these tools (ATLAS was lucky to find a group in Prague, why not we). Needs to be adjusted to needs of subsystems, improved, and maintained.
- ▶ This will need a DB (Oracle, MySQL?) maintained by potentially one of the labs (BNL, Lab, ORNL, ANL, ...)
- ▶ Responsibility should lie with the TC office. Needs general guidelines for DSCs on what is mandatory or voluntary etc.
- ▶ This will be with us a long time (E.g.: 2038 a board dies. What chips are on it, who bought them/built them, who has the plans? X/X_0 is just not right in sims in some corner, what material was that exactly and who has the data sheets?)


Examples - ATLAS

From: Thomas

courtesy Alessandro Tricoli

ATLAS ITk Production Database **Test**

Alessandro Tricoli Tricoli +ZU



Dashboard

My Components

My Institute Components

My Test Results

My Batches

My Institute Shipping to Receive

My Institute Shipping to Send

Components

Test Results

Batches

Shipping






Component Details

Show details of selected Component of the Inner Tracker.


20USBLC2000007

Stave - Long Strip Side A

Basic Info

ATLAS Serial Number	20USBLC2000007	
Alternative Identifier	No alternative identifier	
Component Type	 Stave STAVE	
Type	Long Strip Side A	
Current Stage	RECEIVED AT CERN	Show History 
Current Location	 CERN CERN	
Shipment Destination	No current shipment destination	
Home Institute	 Brookhaven National Laboratory BNL	

Properties

Final Weight (unit)	No value	
---------------------	----------	---

Examples - ATLAS

From: Thomas

Child Component List ?

		Module - BARREL_LS_MODULE	20USBML1234775	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234825	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234826	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234827	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234828	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234829	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234831	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234830	19/10/2023	Alessandro Tricoli Tricoli	6 properties	Disassemble	History
		Module - BARREL_LS_MODULE	20USBML1234814				Disassemble	History

ATLAS ITk Production Database **Test** Alessandro Tricoli Tricoli +5U

About application ITk Production Database

The ATLAS ITk Production Database provides functionality to manage components of the Inner Detector (ATLAS Experiment, CERN) and their tests and shipments.

The component `UuFis.Issue.CreateButton` does not exist.

- uclltkpd - Business Requests
- uclltkpd - Business Model
- uclltkpd - Application Model

License

Organisation: [Unicorn Vysoká škola s.r.o.](#)

Authorities: [Marek Beránek](#)

ARID: `dcb3f6d1f130482581ba1e7bbe34413c`

Application creators

- Václav Vacek** - Project Supervisor
- Vladimír Kovář** - Chief Business Architect & Stakeholder
- Marek Beránek** - Project Manager & Development Leader
- Andrew Blue** - ITk Production Database Stakeholder
- Luise Poley** - ITk Strips Supervisor
- Monika Wieler** - ITk Pixels Supervisor
- Tatiana Sarokina** - FE Designer & Developer
- Nataliya Dyak** - FE Designer & Developer
- Jan Bárta** - Developer
- Ondřej Vít** - Developer
- Ondřej Novák** - Developer
- Tereza Jabomická** - Developer
- Eliška Kučerová** - Project Coordinator
- Jiří Šolc** - Developer
- Jaromír Tomáš** - Tester
- Petr Janoušek** - Tester
- Michael Kúdela** - Technical Writer
- Jakub Krejčířík** - Developer
- František Raszyk** - Technical Writer
- Lukáš Šykora** - Developer

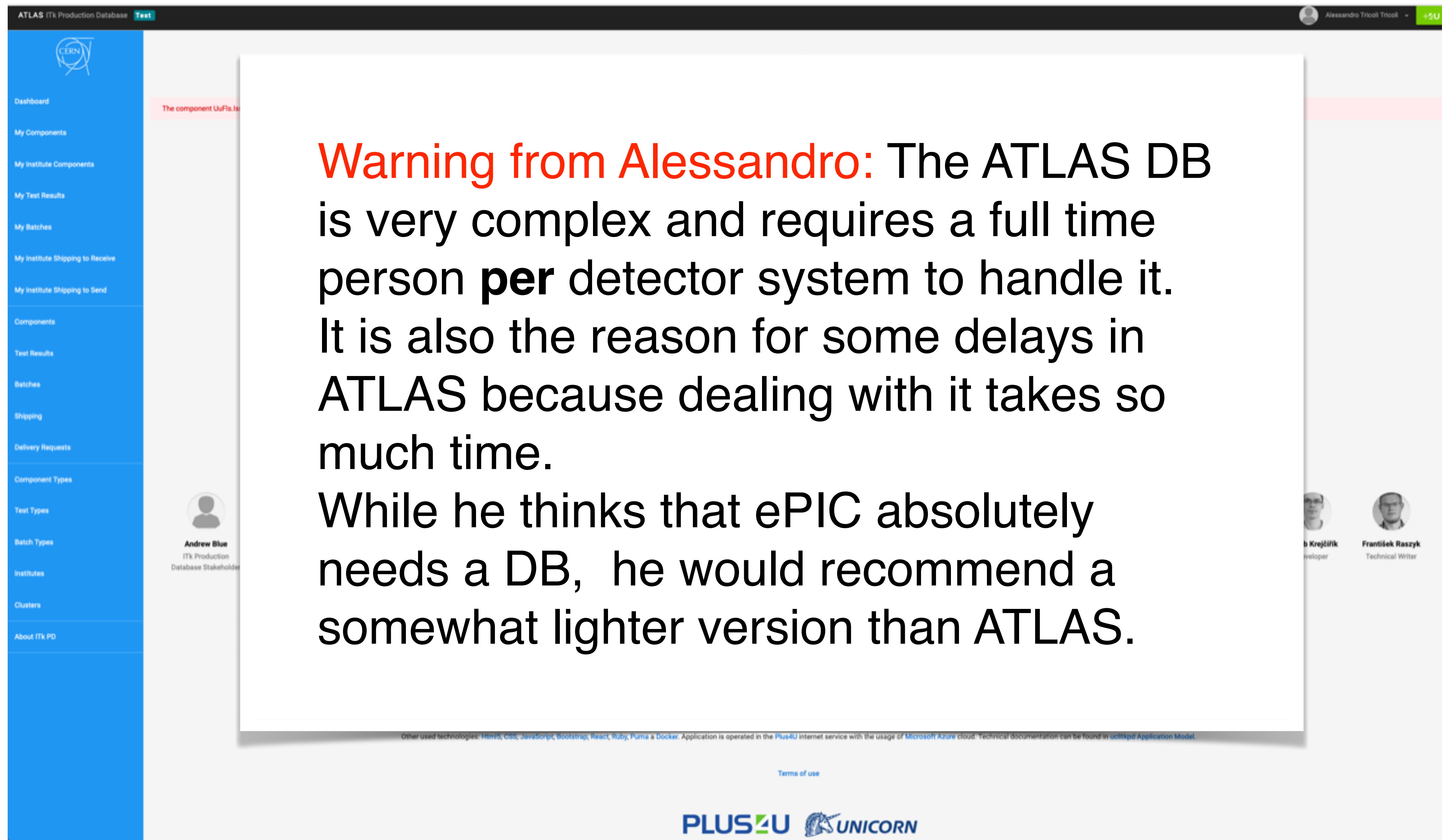
Used Technologies

Following Unicorn technologies were used to create the application/library:
`UAF, uuApp, uuS, uuPlus4U5, uuProductCatalogue, uuAppServer, uuOIDC` and `uuCloud`.

Other used technologies: `Html5, CSS, JavaScript, Bootstrap, React, Ruby, Puma` a `Docker`. Application is operated in the `Plus4U` internet service with the usage of `Microsoft Azure` cloud. Technical documentation can be found in `uclltkpd Application Model`.

[Terms of use](#)

PLUS4U UNICORN



The screenshot shows the ATLAS ITk Production Database interface. On the left is a blue sidebar with a CERN logo and a navigation menu including: Dashboard, My Components, My Institute Components, My Test Results, My Batches, My Institute Shipping to Receive, My Institute Shipping to Send, Components, Test Results, Batches, Shipping, Delivery Requests, Component Types, Test Types, Batch Types, Institutes, Clusters, and About ITk PD. The main content area is white and contains a large text overlay. At the top right of the interface, the user 'Alessandro Tricoli Tricoli' is logged in. Below the text overlay, there are profile cards for 'Andrew Blue' (ITk Production Database Stakeholder), 'Krejčík' (Developer), and 'František Raszyk' (Technical Writer). At the bottom of the interface, there is a footer with logos for PLUS4U and UNICORN, and a 'Terms of use' link.

Warning from Alessandro: The ATLAS DB is very complex and requires a full time person **per** detector system to handle it. It is also the reason for some delays in ATLAS because dealing with it takes so much time. While he thinks that ePIC absolutely needs a DB, he would recommend a somewhat lighter version than ATLAS.

Example - CMS

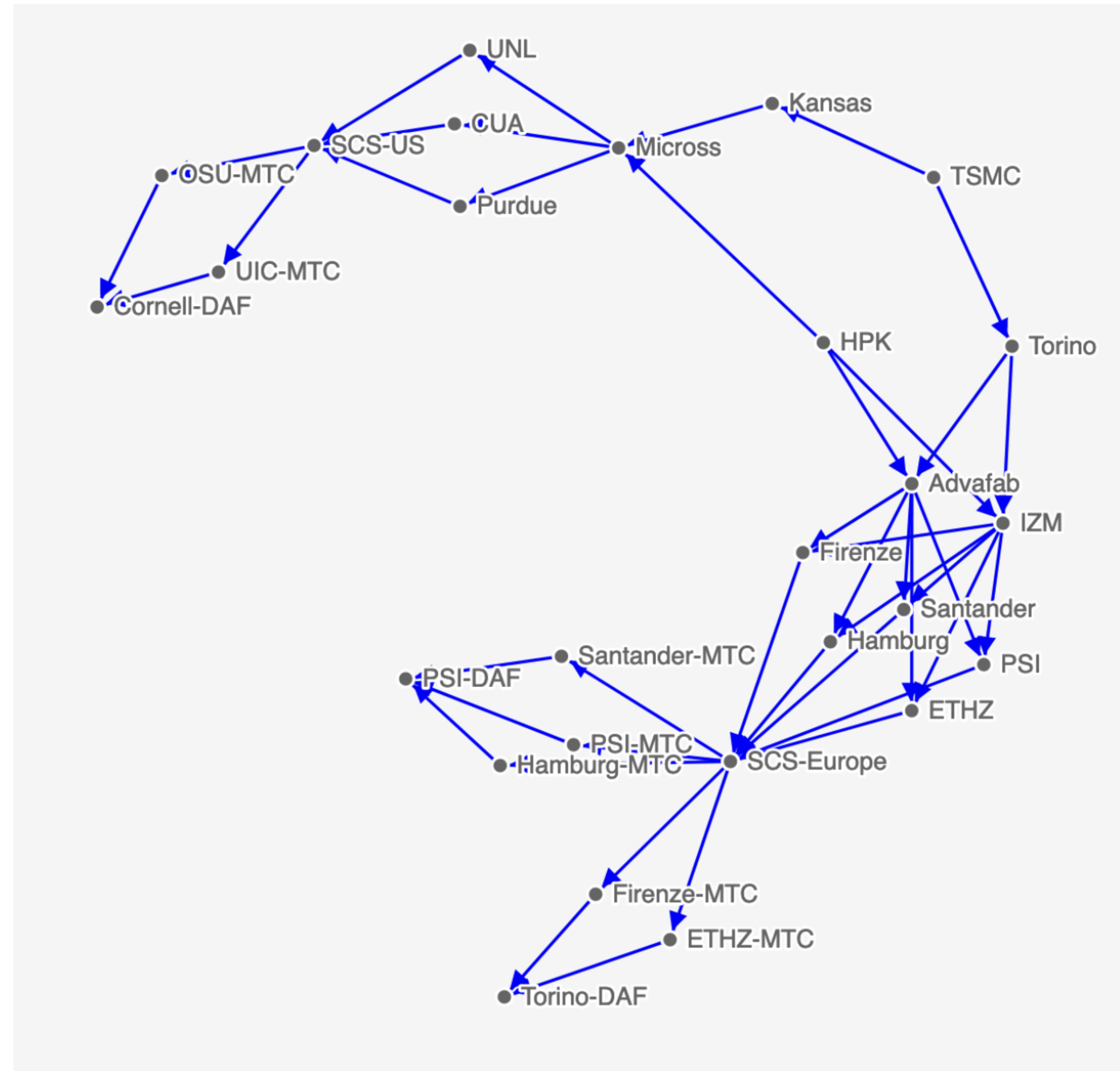
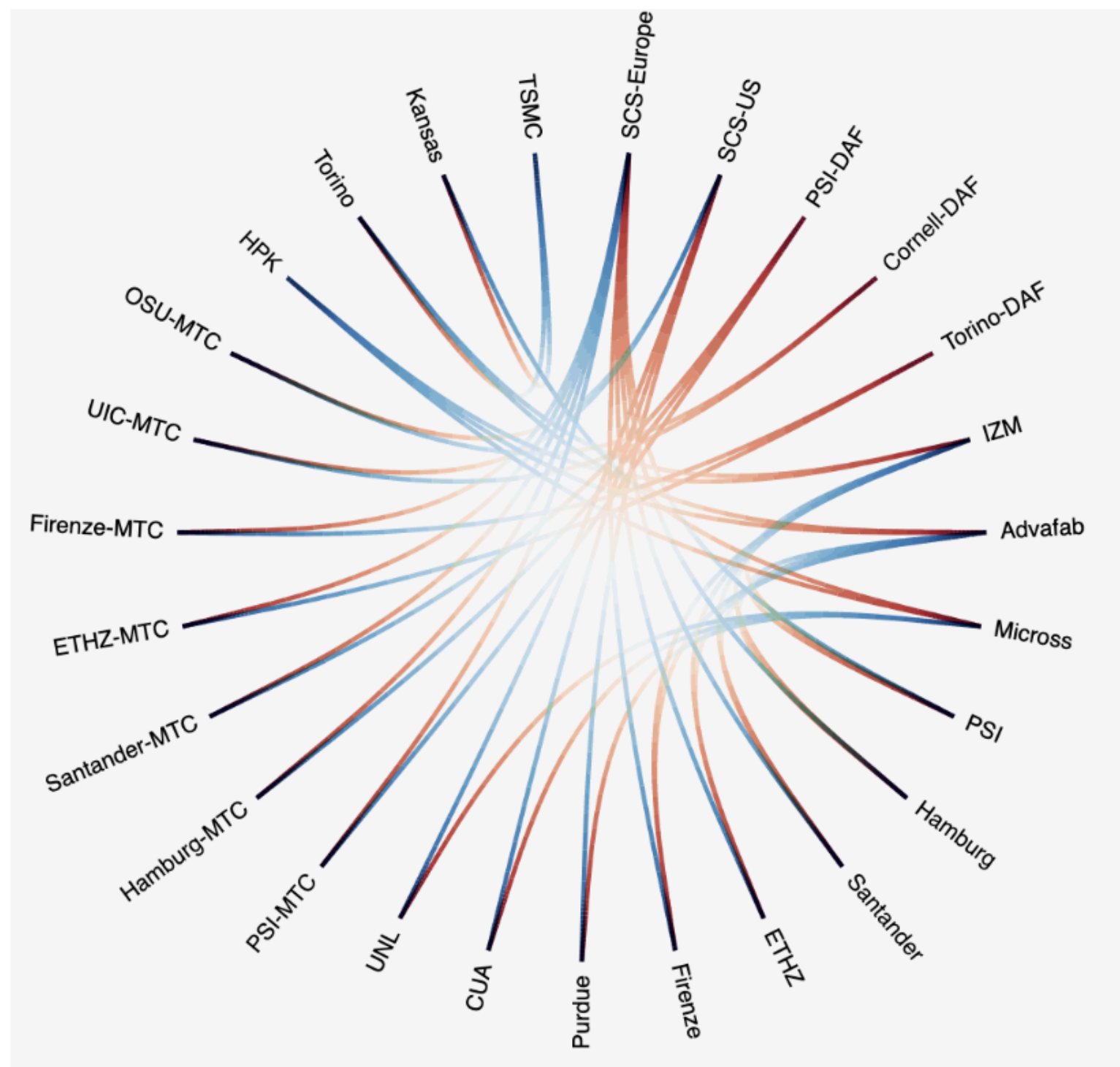
➤ Define a detector (InnerTracker) that consists of subcomponents that consist of subcomponents that ...

Direct Subcomponents		
TYPECODE	COMPONENT NAME	QUANTITY
TBPX	Barrel pixel tracker	1
TEPX	Endcap pixel tracker section one-end	2
TFPX	Forward pixel tracker section one-end	2

Atomic Subcomponents		
TYPECODE	COMPONENT NAME	QUANTITY
CROC-wafer-untested-double	Double CROC wafer chips (untested)	2952
CROC-wafer-untested-quad	Quad CROC wafer chips (untested)	10944
Sensor-planar	Planar Sensor	4212

Example - CMS

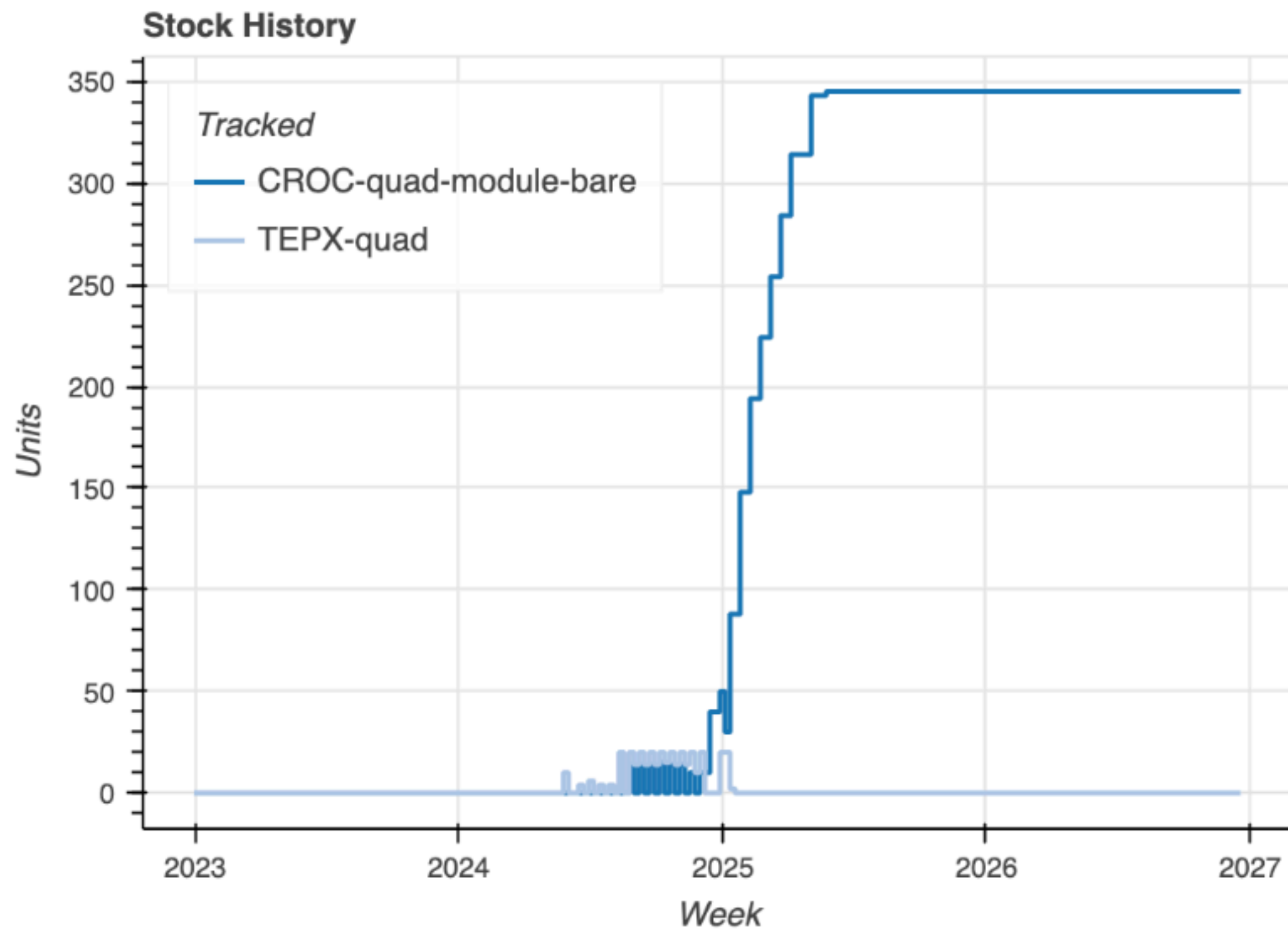
- Overall idea: a site produces one or more components that are then transported to another site



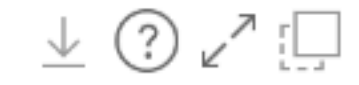
Example - CMS

> Example: Santander module assembly site

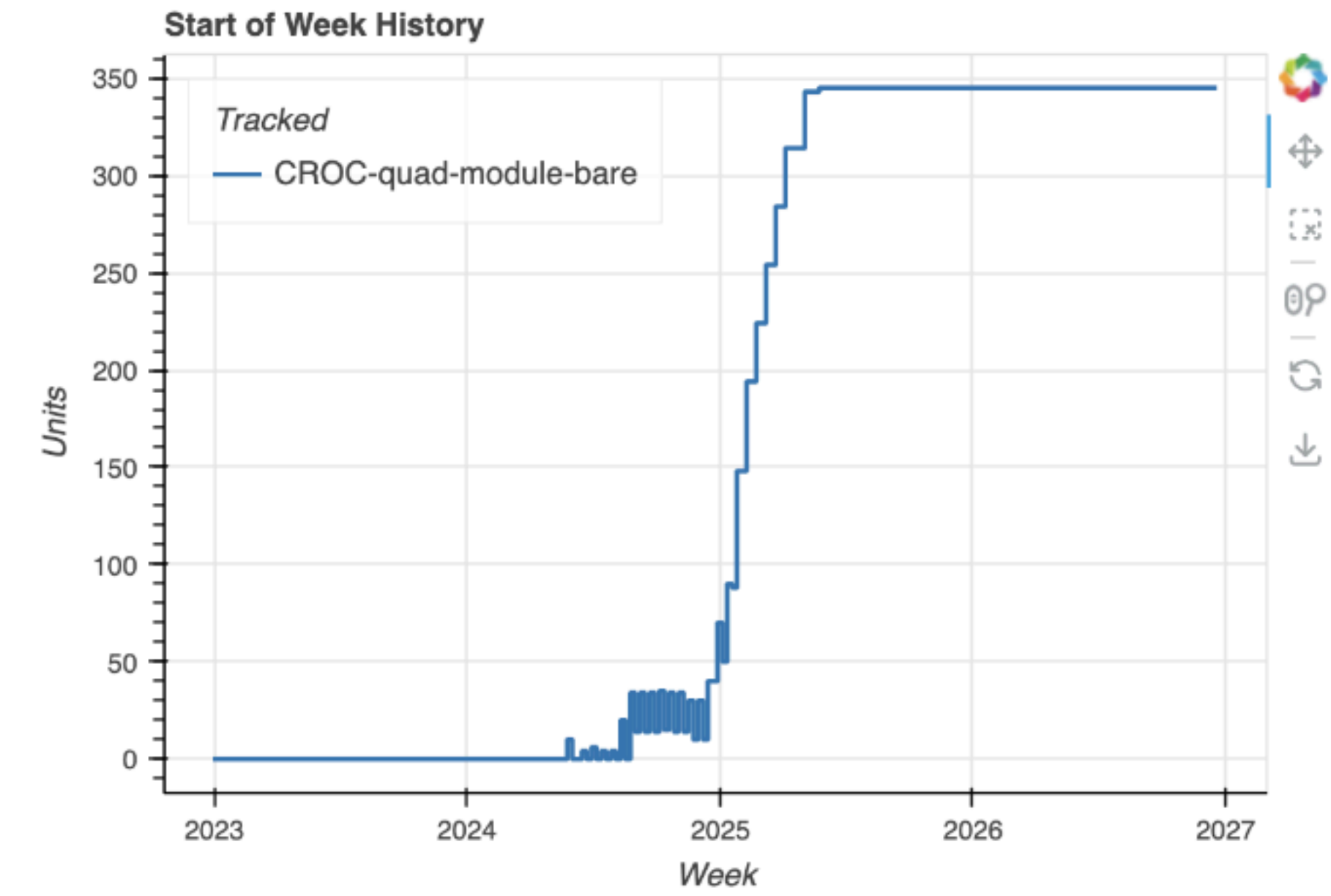
- “Optimised” site flavour, 20 modules per week
- 24.5% of total TEPX quads



Constituent Component Stock

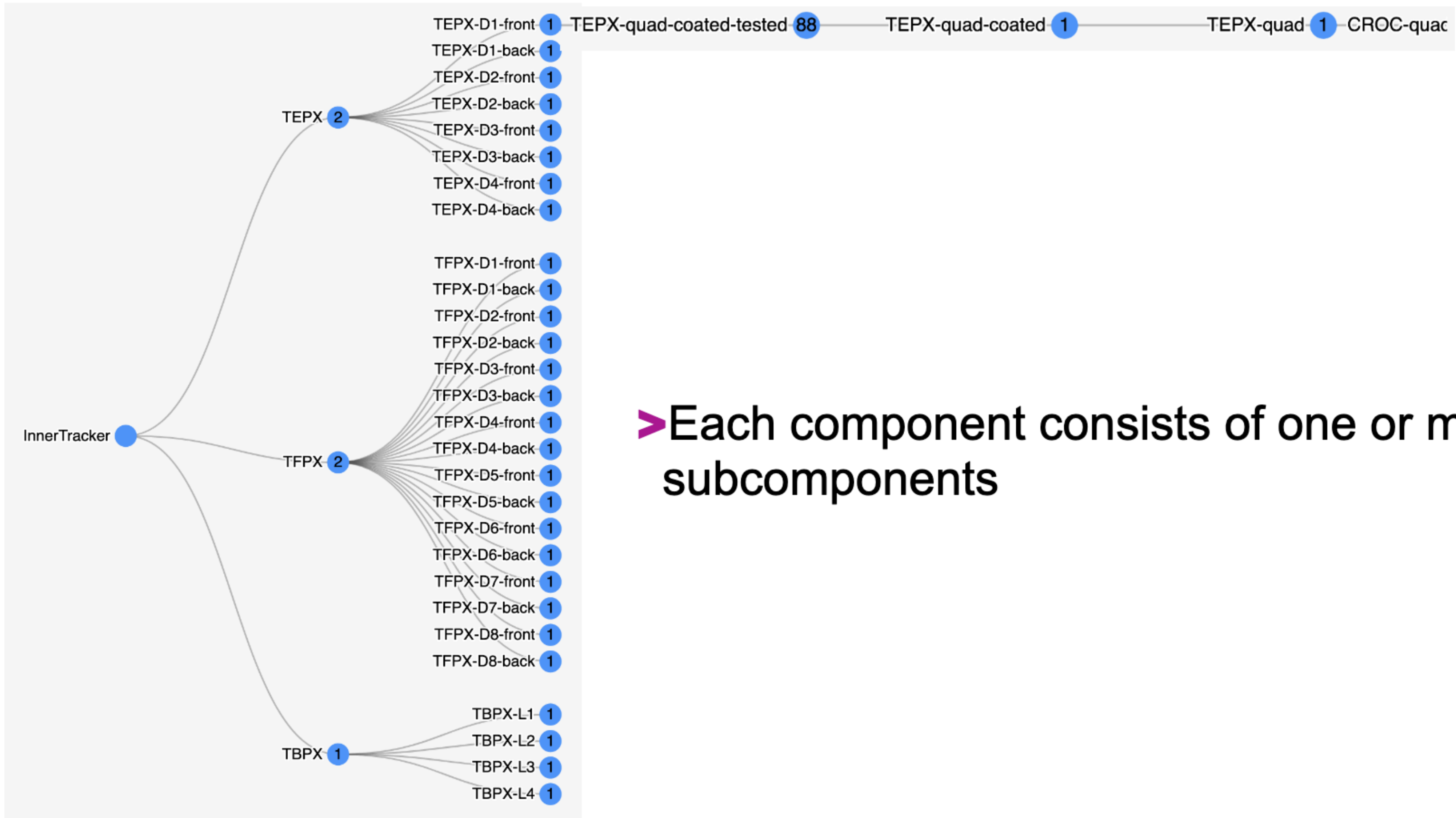


Show/Hide Datasets



TYPECODE	LIFETIME PRODUCTION	LIFETIME TARGET
TEPX-quad	345	345

Example - CMS



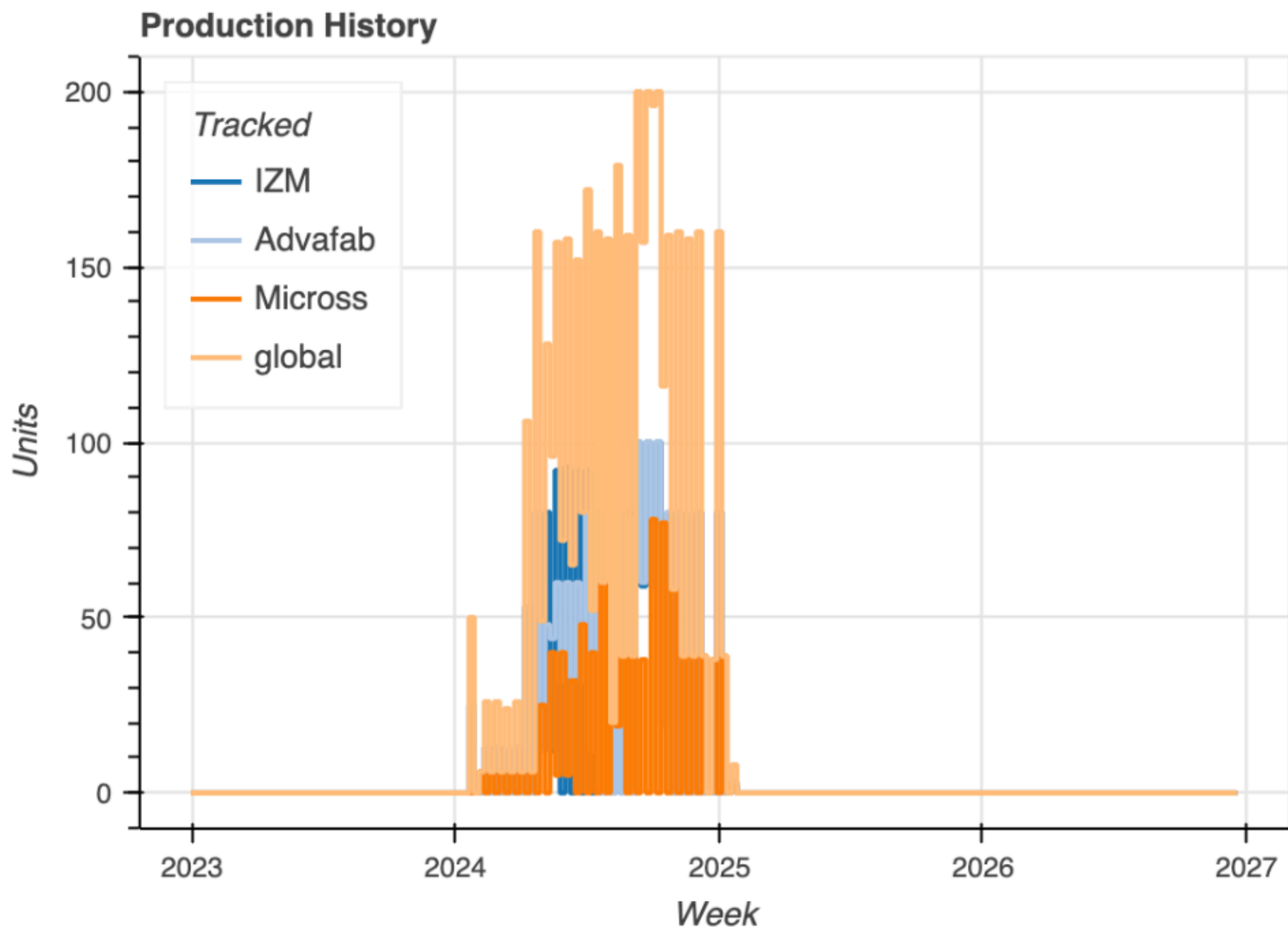
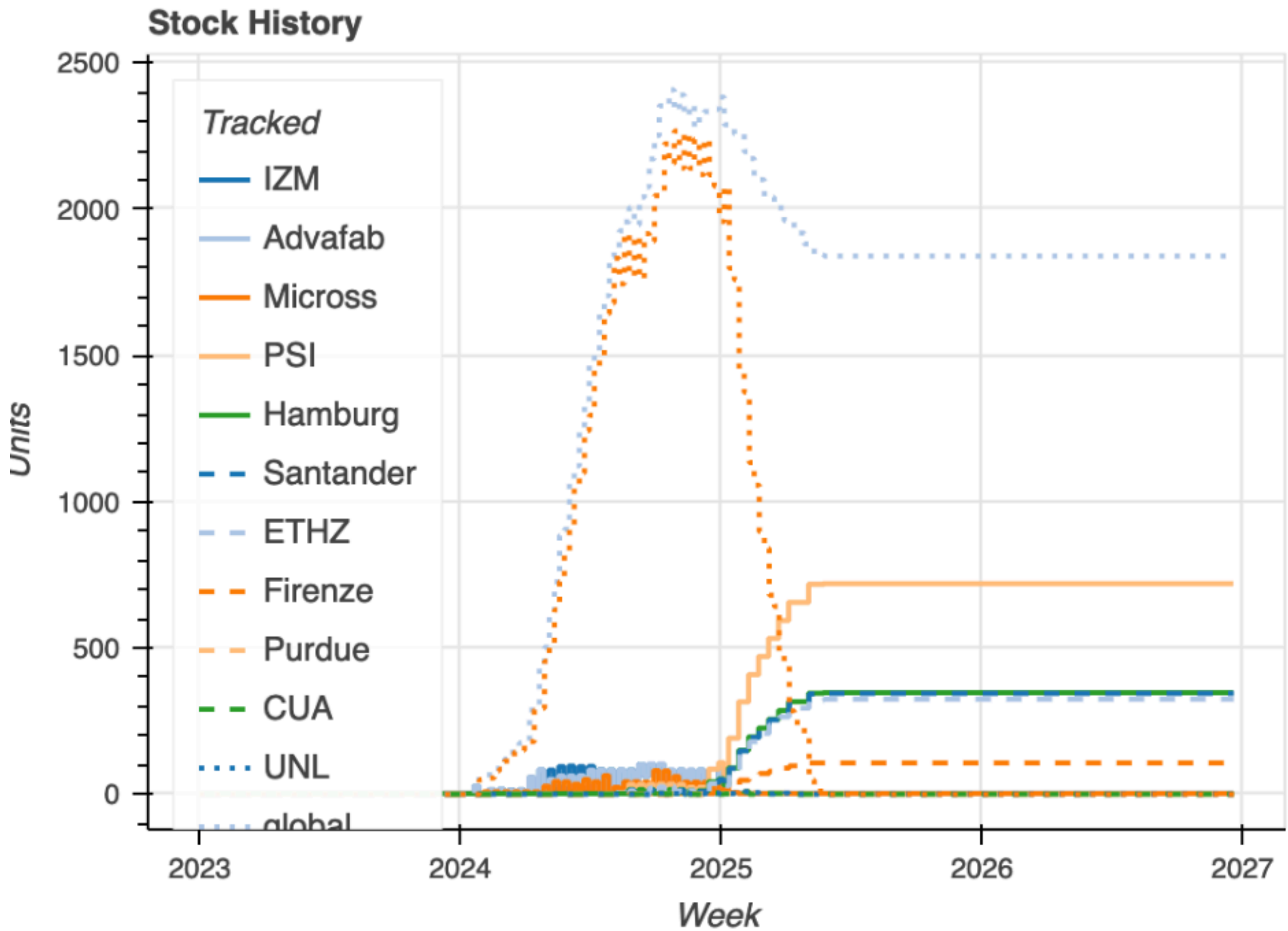
➤ Each component consists of one or more subcomponents



Example - CMS

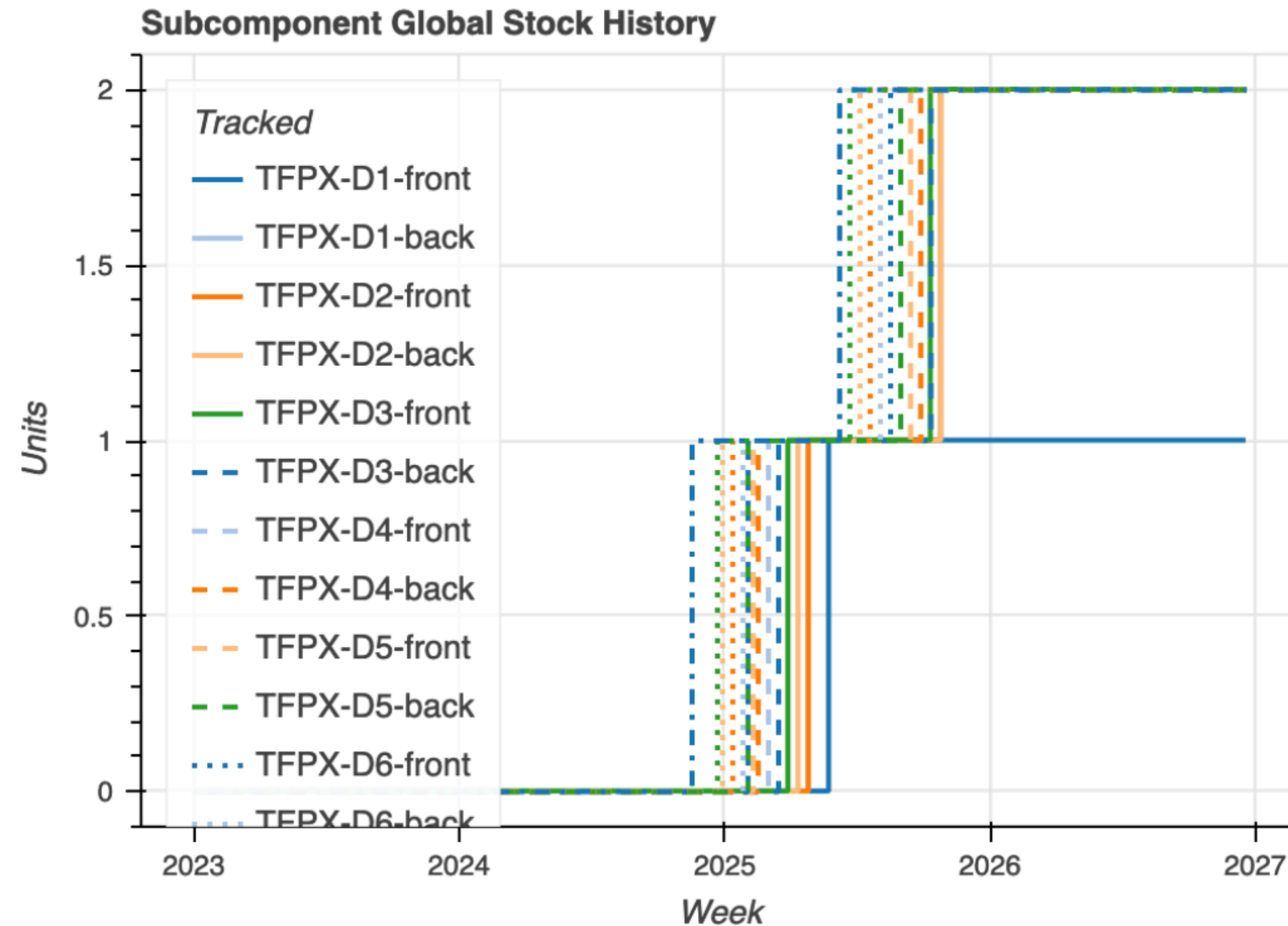
TYPECODE	COMPONENT NAME	QUANTITY
CROC-wafer-tested-quad	Quad CROC wafer chips (tested)	4
Sensor-planar	Planar Sensor	1

Bare quad modules require 4 CROCs



Example - CMS

- Can define assembly order
- Here: start with one disk, begin construction from the outer disks
- This will then e.g. also show if sufficient double vs. quad (vs. 3D) modules are available

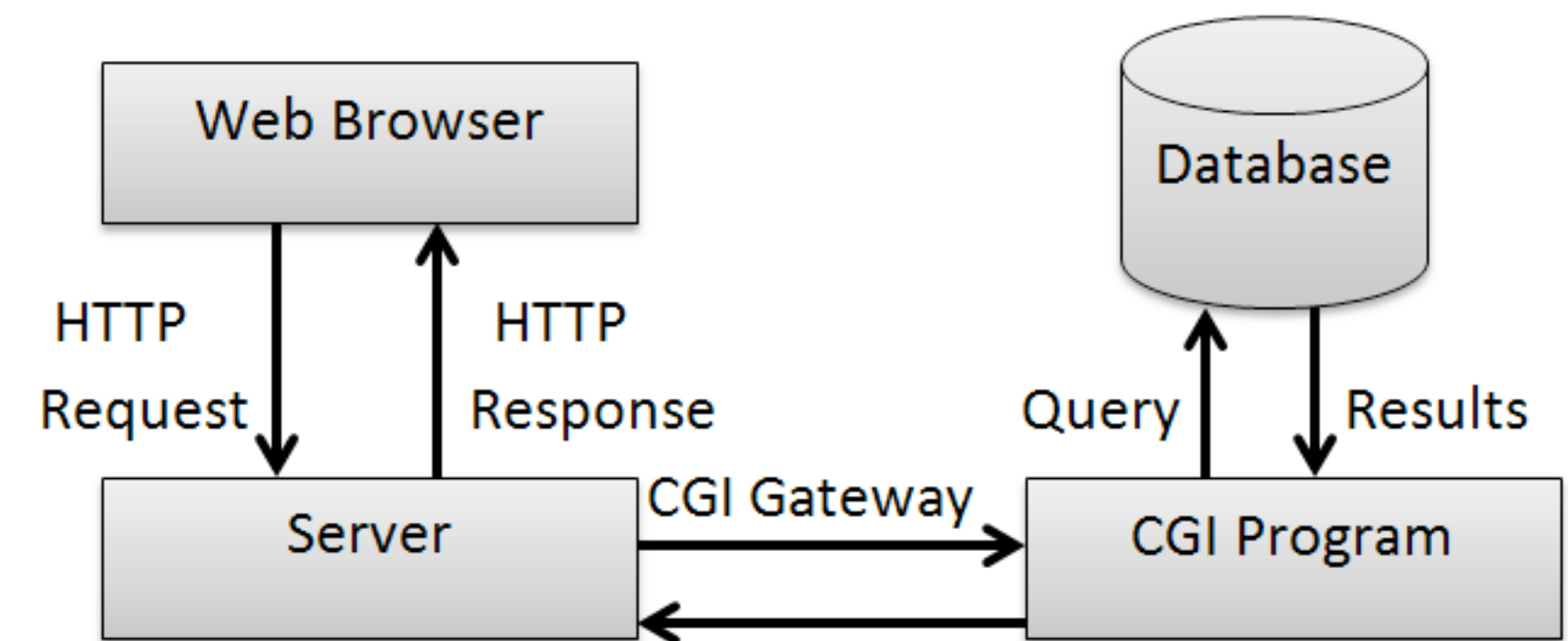


ALICE Upgrade: TPC Production DB

Developed by Peter Glassel @ Heidelberg

(Adopted by sPHENIX TPC)

- Software-wise it is mysql (very standard) (Relational database)
- perl CGI programming
(less standard and a bit dinosaur age, but fairly easy for any programmer)
- Linux-based web-server
- Modular
- Backups
- Mirror to a test DB for new users to get familiarize



Stock at the level of category

choose category

shortcut to individual item with barcode or use barcode scanner

Home Category: R1 Stock Shipping Select by barcode: Information logged in: Prakhar Administration debug

sPHENIX TPC production database, category R1

link color code	serial no	barcode	unnumbered
prefix color code:	parent part	daughter part	both
part color code:	QA defined		

link	category	part	batch	type	prefix	ordered	sent	unnumbered stock at institutes		numbered stock		QAstatus	actions	drawings
								used	inventory	finished	used			
X	R1	R1 GEM foil		G1	R1-G1-nn				12		25		156	
X	R1	R1 GEM foil		G2	R1-G2-nn				5		25		131	
X	R1	R1 GEM foil		G3	R1-G3-nn				8		25		139	
X	R1	R1 GEM foil		G4	R1-G4-nn				14		25		174	
X	R1	R1 module		N	R1-N-nn				13				13	
X	R1	R1 module		S	R1-S-nn				12				12	
X	R1	R1 padplane			R1-P-nn				5		25		30	

Link to next level of stock

Individual item page, QA table

units given in data field, not in entered value

Uploaded file has to be .txt

QA file upload:
browse for file on your computer
then upload

QA table for R1-G1-01 [Show generic QA table](#) Status is 0

step (link)	status	data field (hover cursor for explanations)	value	n	date	QA step/file comment	author	condition	true?
Basic QA									
1	1	resistors are checked between 19Mohm - 1Mohm	<input type="text"/>			<input type="text"/>		eq ok	
2	2	absolute humidity [ppmV] at start of leakage current measurements	<input type="text"/>			<input type="text"/>		<= 6000	
3	3	HV cleaning instantaneous 500V. Comment sparks	<input type="text"/>			<input type="text"/>		eq ok	
4	QA-B	I_leak histo data	Upload datafile: <input type="button" value="Browse..."/> No file selected. <input type="button" value="upload file"/> after choosing file!			file comment: <input type="text"/>		file txt	
5	5	leakage current [pA] at 500 V leakage current of worst segment.	<input type="text"/>			<input type="text"/>		<= 167	
Framing and assembly									
11	11	frame glueing comment if not perfect (wrinkles?)	<input type="text"/>			<input type="text"/>		eq ok	
12	12	quality A; perfect, B: minor deficiencies ...	<input type="text"/>			<input type="text"/>		le C	
13	13	assembly in Module if failed, comment on reason	<input type="text"/>			<input type="text"/>		eq ok	
		<input type="button" value="submit"/> darker field: mouse hover for more explanations							

string/number entry field

comments scrollable/no limit

Individual item page, QA table

link to uploaded file

Green if step passed

QA table for R1-G1-01 [Show generic QA table](#) Status is **5** (allows to repeat QA steps, edit QA file comments)

step (link)	status	data field (hover cursor for explanations)	value	n	date	QA step/file comment	author	condition	true?
Basic QA									
1	1	resistors are checked	ok		2020-09-27 21:50:46	ok	Tutorial	eq ok	<input checked="" type="checkbox"/>
2	2	absolute humidity [ppmV]	6000		2020-09-27 21:51:55	ok	Tutorial	<= 6000	<input checked="" type="checkbox"/>
3	3	HV cleaning	ok		2020-09-27 21:51:55	ok	Tutorial	eq ok	<input checked="" type="checkbox"/>
4	QA-B	I_leak histo data	R1-G1-01.txt evaluate		2020-09-27 21:50:46	no comment avg all segments 14.8, sparks: 0, duration 568 s	Tutorial	file txt	<input checked="" type="checkbox"/>
5	5	leakage current [pA] at 500 V	18.3		2020-09-27 21:50:46	avg all segments 14.8, sparks: 0, duration 568 s	Tutorial	<= 167	<input checked="" type="checkbox"/>
Framing and assembly									
11	11	frame glueing comment if not perfect (wrinkels?)	<input type="text"/>			<input type="text"/>		eq ok	<input type="checkbox"/>
12	12	quality A; perfect, B: minor deficiencies ...	<input type="text"/>			<input type="text"/>		le C	<input type="checkbox"/>
13	13	assembly in Module if failed, comment on reason	<input type="text"/>			<input type="text"/>		eq ok	<input type="checkbox"/>
<input type="button" value="submit"/>		darker field: mouse hover for more explanations							

evaluation of leakage current data: means of segments and overall, plots spark detection (experimental)

QA tables can be modified as required:

QA table of R1 GEM foil: label GF / G1

valid for type(s): **G1 G2 G3 G4**

existing step # with will insert new step
 step buttons: edit or delete this step

step edit?	status	datafield	op	value / file type	explanations (optional)	step delete?
<input type="button" value="1"/>	1	resistors are checked	eq	ok	between 19Mohm -21Mohm	<input type="button" value="1"/>
<input type="button" value="2"/>	2	absolute humidity [ppmV]	<=	6000	at start of leakage current measurements	<input type="button" value="2"/>
<input type="button" value="3"/>	3	HV cleaning	eq	ok	instantaneous 500V. Comment sparks	<input type="button" value="3"/>
<input type="button" value="4"/>	QA-B	I_leak histo data	file txt	ok		<input type="button" value="4"/>
<input type="button" value="5"/>	5	leakage current [pA] at 500 V	<=	167	leakage current of worst segment.	<input type="button" value="5"/>
<input type="button" value="11"/>	11	frame glueing	eq	ok	comment if not perfect (wrinkels?)	<input type="button" value="11"/>
<input type="button" value="12"/>	12	quality	le	C	A; perfect, B: minor deficiencies ...	<input type="button" value="12"/>
<input type="button" value="13"/>	13	assembly in Module	eq	ok	if failed, comment on reason	<input type="button" value="13"/>
<input type="button" value="14"/>	<input type="text" value="14"/>	<input type="text"/>	eq	<input type="text"/>	<input type="text"/>	<input type="button" value="14"/>

[back to actions on this part](#) [back to stock](#)

Explanations	
step	sequence number of QA test
status	name of QA test of this step (alphanumeric, blanks allowed)
datafield	datafield name of tested value (alphanumeric, blanks allowed)
op	operator used in test
value	value for test condition for numerical operators this must be a number in C-style, examples: 10, -1.6, 2.5e3
explanations	more info for this step
Special condition 'file'	
operator	file
value	file extension, e.g. pdf empty = don't care
comment	ok required to pass
Special condition 'link'	
operator	link
value	URL of link
comment	ok required to pass
Special last step 'quality' (optional)	
operator	le
value	single capital letter e.g. value B → A, B : finished C,D,... unusable

Contact Info, Send Email

- name, email, phone no. of all people registered for the DB (sorted according to institutes)
- Email to individuals, institutes or all with cc to yourself

sPHENIX TPC production database

Contact info of all people registered with the database.
Email to selected people and/or institutes. Update your info [here](#).

mail to selected		mail to all				edit			
select people and/or institutes									
Institute	I#	P#	Persons	email	telephone	last login	last action		
BNL	6								
CERN	10								
<input type="checkbox"/>	SBU	1	2 <input type="checkbox"/> Tom	thomas.hemmick@stonybrook.edu					
			3 <input type="checkbox"/> Klaus	klaus.dehmelt@stonybrook.edu					
		98	<input type="checkbox"/> Tutorial			2020-09-27			
		1	<input type="checkbox"/> Prakhar Garg	prakhar.garg@stonybrook.edu		2020-09-27	2020-09-09	create	
		99	<input type="checkbox"/> peter Glassel						
<input type="checkbox"/>	TU	5	6 Matt	posik@temple.edu					
<input type="checkbox"/>	VU	4	7 Sourav	sourav.tarafdar@vanderbilt.edu		2020-09-27			
<input type="checkbox"/>	WIS	3	5 Evgeny	evgeny.shulga@weizmann.ac.il					
<input type="checkbox"/>	WSU	2	4 Oleg	oleg.grachov@cern.ch					

mail to selected

[back](#)

Stock selection: location, shipping and QA status

Selections

QA graphic representation:
 1 stripe per QA step
 green: passed,
 red: failed,
 white: not done yet

Last consecutive QA step passes

sPHENIX TPC production database

Show selected stock items [link to bookmark this selection](#)

Selection specific QA step selection: off not done passed failed no list, only item count:
QA graphics ON:

category	part	batch	type	QA status	serialno/bc wildcards % , _	sent?	select location or 'used'	search string within comment regular expressions accepted
any	any	any	select part first	any	%			

category	part	item	batch	sent from	to	date	location or link to parent	QA status	link	comment
R1	R1 GEM foil	R1-G1-01	1	SBU	WIS	27.09.20		 5	27.09.20 SBU	X
R1	R1 GEM foil	R1-G1-02	1	SBU	WIS	27.09.20		0		X Dummy Comment
R1	R1 GEM foil	R1-G1-03	1	SBU	WIS	27.09.20		0		X Another dummy comment
R1	R1 GEM foil	R1-G1-04	1	SBU	WIS	27.09.20		0		X
category	part	item	batch	sent from	to	date	location or link to parent	QA status	link	comment
R2	R2 GEM foil	R2-G1-01	1				SBU	0		X
R2	R2 GEM foil	R2-G1-02	1				SBU	0		X
R2	R2 GEM foil	R2-G1-03	1				SBU	0		X
R2	R2 GEM foil	R2-G1-04	1				SBU	0		X
category	part	item	batch	sent from	to	date	location or link to parent	QA status	link	comment
R3	R3 GEM foil	R3-TG1-01	1				SBU	0		X
R3	R3 GEM foil	R3-TG1-02	1				SBU	0		X
category	part	item	batch	sent from	to	date	location or link to parent	QA status	link	comment
R3	R3 GEM foil	R3-VG1-01	1				SBU	0		X
R3	R3 GEM foil	R3-VG1-02	1				SBU	0		X
R3	R3 GEM foil	R3-VG1-03	1				SBU	0		X

13 items, 13 not red

[back](#)

Summary

- It is extremely useful to have a Production Database in the early phase of ePIC construction.
- Various examples in large collaborations and software options exist.
- Even after DB set-up, regular attention is required for maintenance and issues.

Suggestions and open for discussion!!