AUTOMATED AVAILABILITY STATISTICS Don't do it yourself ! Let the control system do it ...

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Abstract

The availability of a particle accelerator or any large machine with users is not only of paramount importance but is also, at the end of the day, an oft quoted number (0 to 100%) which represents (or is taken to represent) the overall health of the facility in question. When a single number can somehow reflect on the maintenance, operation, and engineering of the machine, it is important to know how this number was obtained. In almost all cases, the officially quoted availability is generated by hand by a machine coordinator, who peruses the operation statistics over the period in question. And when humans are involved in such a calculation there might be a latent tendency to avoid the stigma of low availability. So, not only might there be scepticism at 'impossibly high' availability, but comparing quoted availability from one machine with another might turn out to be virtually meaningless. We present a method for calculating the machine availability automatically, based on the known (and archived) machine states and the known (and archived) alarm states of the machine. Ideally this is sufficient for a completely automatic determination of the availability. This requires, however, a perfect representation of all possible machine states and a perfect representation of all possible fatal alarms (those leading to down time). As achieving perfection is ever an ongoing affair, the ability for a human to 'post-correct' the automated statistics is also described.

Ansatz

"if the machine is not available then there must be at least one fatal alarm in one of its subsystems."

Motivation

• Remove human bias • Reduce workload on machine

Alarms

	A Alarm Viewer: LINAC2												
	<u>File View Options N</u> avigate <u>H</u> elp												
	Alarms for:	LINAC	C2										
	CENTRAL 0/0/4 GUN 0/2/0		iUN /2/0	LINAC PIA 75/34/52 6/0/6			Calend	lar J	interval				
				10101102	Alarm Display —		Mon	Тие	Oc Wed	tober 20	16 Fri	Sat	Sun
	Fatal	Er	rror	Warning		Archive	26	27	28	29	30	1	2
	81		36	62		Archive	3	4	5	6	7	8	9
	Wed Fatal Se	everity >=	13 Selected/T	otal No. of Ala	arms: 81/179 Ter	minated A	10	11	12	13	14	15	16
	Magnete	13 0 0	Kicker-Septa	000	Kontrollen	000	17	18 25	19 26	20	21 28	22 29	23
	H.Korrekt.Mag.	000	Chopper	000	Front-End	0 0 0	31	1	2	3	4	5	6
	V.Korrekt.Mag.	000	Timing	000	L2-Protokoll	41 0 0	Alarm	Count	t				
	Steerer	0 0 0	Temperaturer	000	Diagnose	0 0 0	The nu	mber o	f alarms w	ith Sever	ity >= 0	1	
					Blaghose					179)		
	PIA-HF	3 0 0	PilothWasse	r 000	Interlock	1 0 0							
	L2-HF	<mark>23</mark> 00	Vakuum	000	Schirmmonitore	000							





States

coordinator Monitor Availability on-line

Required Services

State Server

- Well-defined list of possible machine states
- Declared externally (by operator)
- Status of declared state
- with/without beam (running)
- with/without fatal alarms (problems)
- Bean counting: integrated time spent in any one state



Operation History Viewer <u>File Options H</u>elp

elected Context: LINAC2

ate Span Info rom: 18.10.2016 00:00:0

ser BEAM: 0 sec

otal Time: 24 hr

Sum of Slices: 24 h

4:06:44: Alarm messa

Live History Interval: 60

IA BEAM: 0 sec un BEAM: 0 sec

o: 18.10.2016 23:59:59

ected Overview: LINAC-2 Overv

LINAC-2 Overview

Current State: User TEST Selected time range: 10.18.16 00:00 - 10.18.16 23:5

User PETRA: 1.1 hr User DORIS: 0 sec User TEST: 21.3 hr User Control Room: 2.

Machine Studies: 0 sec Preparing: 36 sec

Standby: 1.7 min

Service Mode: 0 se

Problems: 1.5 hr

PIA: 0 sec

Oun: 0 sec

Test: 0 sec

nterlock: 26.6 mi

L2-Protokoll: 1.0 hr L2-HF: 26.2 min PIA-HF: 15.4 min

Alarm Server Subsyster

Components Groups

Total Non-Available Time (CAS)

1.1 hr

Magnete: 1.0 hr

Refresh

bean counting ... \rightarrow (how many seconds spent in Machine Studies?)

Alarm Server

- Well-defined alarm subsystems
- Fatal alarm statistics
- Archive of all alarms
- 'is ready' = absence of any fatal alarm (availability)
- Bean counting: integrated time where a subsystem has at least one fatal alarm

Archive Server

- Archive the bean counts for each
- state
- Archive the bean counts for the 'is ready' information

System	Device Name	Message	Sev	Alarm Descriptor	Alarm Time 💌	Duration	
L2-HF	Modulator 11	Shunt Diode (Fehlanpass	15	Terminated	23:13:15.592 - Oct 18 CEST	4 sec	~
L2-HF	Modulator05	Shunt Diode (Fehlanpass	15	Terminated	22:55:59.548 - Oct 18 CEST	4 sec	
L2-HF	Modulator05	Shunt Diode (Fehlanpass	15	Terminated	18:05:17.722 - Oct 18 CEST	4 sec	
L2-HF	Modulator 12	Shunt Diode (Fehlanpass	15	Terminated	15:07:38.888 - Oct 18 CEST	4 sec	
L2-Protokoll	Corr-Inj	> N PS ALARMS	13	Terminated	14:45:29.176 - Oct 18 CEST	36 sec	
L2-Protokoll	YAQ2.7	PS AUS	13	Terminated	14:43:07.687 - Oct 18 CEST	30 sec	
Magnete	QD	PS AUS FEHLER	13	Data Changed Terminated	14:41:03.071 - Oct 18 CEST	2.7 min	
L2-Protokoll	QD	PS AUS FEHLER	13	Data Changed Terminated	14:41:03.071 - Oct 18 CEST	2.7 min	
Magnete	OF	PS ALIS FEHLER	13	Terminated	14-41-03-071 - Oct 18 CEST	1 4 min	Y
13:23:52: Alarms loade	h						

Use the Alarm system and the Operation State history to deduce and assign blame for nonavailability ...



A Day in the Life of the PETRA Linac

Chart Options

20:00

15:00

10:00

Corrections



Chart Alarms

sor: Tue 18.10.2016 16:29:08.079 CEST

24-hour history of selected machine parameters and "AlarmsISREADY" (a boolean value): 1 => machine is available 0 => machine is not available

We can select any time range we like either with the calendar or by zooming on the trend chart ...

Why was the machine not available? Which subsystems were responsible?

Only those subsystem with at least one fatal alarm are displayed in the 'Info' and 'Availability' tabs ...

Cperation History Viewer		Where :
Selected Context: LINAC2	Chart Alarms	
Selected Overview: LINAC-2 Overview	10. Oct 14:11:3.321 L2-Protokoli: 810 RAlarm/Modulator03: Modulator nicht bereit 18. Oct 14:11:3.321 L2-Protokoli: 810 RAlarm/Modulator03: Modulator nicht bereit	alarms?
User PETRA: 1.1 hr	18. Oct 14:11:33.321 L2-Protokoli: 810 RFAlarm/Modulator05: Modulator nicht bereit 18. Oct 14:11:33.321 L2-Protokoli: 810 RFAlarm/Modulator06: Modulator nicht bereit 18. Oct 14:11:33.321 L2-Protokoli: 810 RFAlarm/Modulator06: Modulator nicht bereit	alarrio.

05:00

Cursor Availability Gantt

and what were the fatal





Philosophical Question: is *problems* a declared state? or is *problems* an attribute ?

time spent in *problems* and total non-available time are not equal !

- Notes: this is an on-going project (maybe forever ...)
- Alarms (Why were they there? Why weren't they there?) are where most of the action is ...
- Corrections are currently necessary in the trail-and-error phase !
- Can also correct the availability with another dialog popup !

To do:

- Consistency checks
- Automatic notification to responsible parties if there's a correction



it doesn't always have to have a *slick* web site to be good ...