# Gui-Building Goals and how to reach them

A Case Study of Goal-Oriented Gui-Building:

The Technical Subsystem XFEL HPRF

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# Gui Building: Agenda

#### 01 The XFEL HPRF Modulators

Some Background Info

#### 02 Goals

- Use Case: Technical Subsystem
- Priorities (HPRF, mine: ex-BKR; an opinionated consultant)

## 03 Control System Gui Functionality

- Control
- Monitoring a Technical System
  - Data are Interesting when:
    - A Failure / Trip
    - Running but out of tolerance
  - Foreground (users)
    - A.k.a "Live Data"
  - Background (servers)
    - A.k.a. "Archiving"

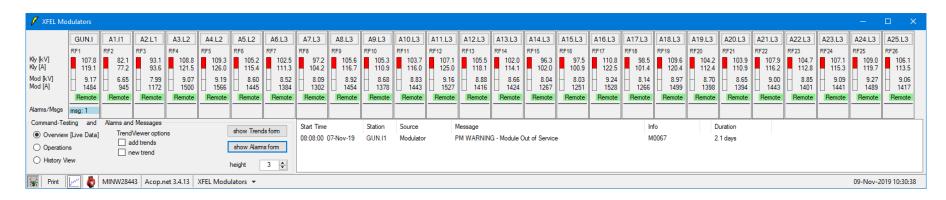
## 04 Building the Gui

- Tools: VS and ACOP.NET
  - Program a Rich Client
  - Gui's in the ACOP.NET Status Bar
    - The Spider
    - The Trend Viewer
    - The Alarms Viewer
- Foreground Monitor-Data
  - Organizing the data flow
  - Overview (single values)
  - Selected Devices (traces)
- Background Monitor-Data
  - Trip Events are of greatest interest
  - Integrating System Services in Display
    - Alarm System and the AlarmsViewer
    - Event Archiver

## **05 Summary and Conclusions**

**06 Demonstration** (Clicking around a bit)

## The XFEL Modulator Gui: revisited



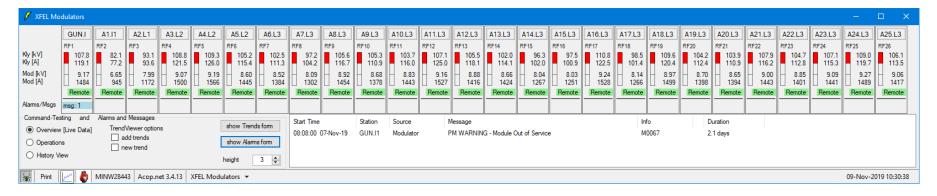
#### The XFEL HPRF Modulators

- High Power RF pulsed at 10 Hz
- 26 "devices" Ampegon front-ends
- Details: *nearly* identical devices
- Standard Operating Gui: written in jddd by Torsten Grevsmuehl
- Set higher goals: try to reach using Visual Studio, TINE and ACOP.NET

#### The Target Group / Customers

- The members of the HPRF group
- Focus on day-to-day monitoring issues, not on Control

 This Gui is a good, uebersichtliche example of Setting your Goals and Reaching Them.

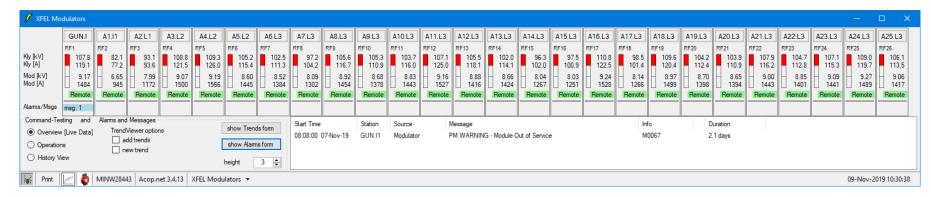


# The XFEL Modulator Gui: Perspective, Goals

- General Goals: My Perspective, World View, Design Principles
  - One-Stop-Shopping: User can find all required information without needing to start other applications
  - Cut-to-the-Chase : (i.e. get to the point)
    - Show clearly what is needed, everything else "out of the way"

Basic Idea: Invest *my* time with the goal to save the time of the *Users* (the HPRF Group).

Requirements, Needs, Wishes for Functionality" – Experience, from Customer Interviews



# The Gui: Functionality Requirements

- Control
  - A Light Bulb (with dimmer switch)
  - The Front-End controls the pulsed MW
- Monitoring: Foreground "Live Data"
  - Data-Transport @10Hz, Browsing Issues
  - Overview: 4 floats + 4 Integers per Station
    - 8 values \* 26 stations = 208 per update
  - Selected Device: Traces (2000 floats)
    - Modulator: 4 RF: 8
  - Status Bits:
    - Modulator ~150 bits
    - RF-Interlock: ~150 bits
  - Control System Status Information

- Monitoring: Background
- A Technical System
  - does not require e.g. Data Collection for Number-Crunching for On- or Off-line Analysis

If the System is

Running and within Tolerances

then

Data Storage not necessary/of much interest Flse

Store **Status** and **Traces**: for **Detective Work** 

- Need to Store
  - Out of Tolerance Pulses
  - Status i.e. Interlock Information
- Present this information clearly

# Reaching Goals: Configure or Program?

New Tricks, but I'm an Old Dog with Principles!

My Tool-Kit of Choice: Visual Studio VB.NET, ACOP.NET and TINE.

Try Something New: "Configure" the Gui

- Use ACOP Smart Graphical Components [Labels connected to a TINE Address]
- Simplify (?) Gui-Building by configuring not programming? Give it a try, see how far I can go
- But: my Starting Point putting together a Gui:

The Data-Flow from Control System Servers

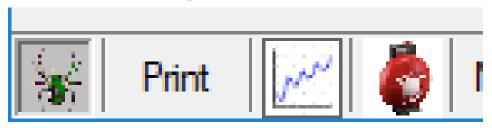
• I have been doing this too long: not yet ready to give up *all* responsibility to the "engine" running "under the hood"

My Strategy: Stay with Programming in Visual Studio VB.NET

My Message: Using these tools, it is easier than ever to reach the goals.

# Reaching Goals: The ACOP.NET StatusBar

Rich Client Functionality which you need, but don't need to do yourself!



### The Spider

- Status of Control System Activity
  - A clear and simple view (easier said than done)
  - Debug, remote access to Server
- Life without the Spider? Does anyone remember Life before the Spider?
- ACOP Smart components "know" how to show their link-status
- The Spider's got new Functionality!

#### The Trend Viewer

- Gui integrates Central Archiver and Local History Data Viewing into the Gui
- Just the Basics of the General Purpose Archive Viewer (Cut-to-the-Chase)

#### The Alarms Viewer: <u>A Game Changer</u>

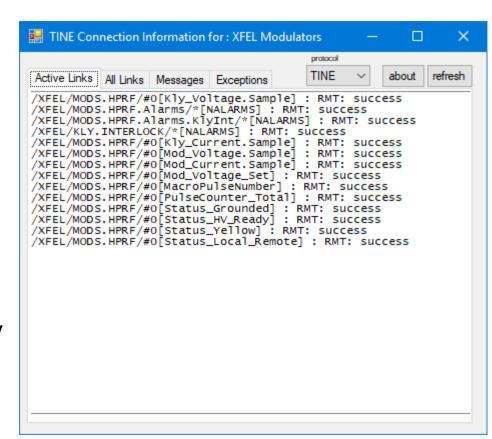
- Access from the Gui to the Local- and Central Alarm Servers!
- **Start Times** and **Durations** of Status-Bit (a.k.a. Alarms) Changes!
  - Current Status shown in the Gui
  - Provides a Quick view of the timeline of Status Changes
  - An Archive-Viewer of Status-Changes/Alarms!
- Just the Basics of the General Purpose Alarm Viewer (*Cut-to-the-Chase*)

# Monitoring in the Foreground: Efficiency

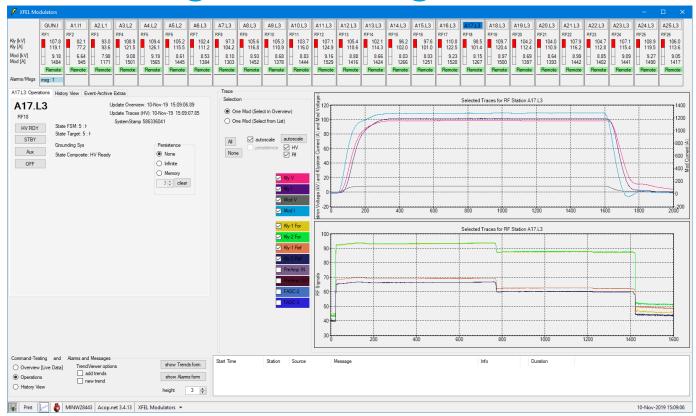
With the help of *The Combobulator*: a System-Standard Middle-Layer

## **Constructing Multi-Channel Arrays**

- 26 F.End Servers with identical Props
- Configure a Combobulator to collect and "re-export" data as MCA Arrays
- Clients [Archiver, all Gui's] connect to Combobulator for data
- The Gui has 8 Data Links (grouped!) instead of 208
- "support" services: Status and Quality Statistics of Links, Local Histories, ...
- "Plug [configure] and Play"!
- Helps you reach Goals for Efficiency
  - Leaves a Small "Foot Print" on the Front Ends



## Monitoring in the Foreground: Browsing



## Displaying Traces / Pulse Data from the Modulator and the RF-Interlock System

- Select a device to view the corresponding traces
- The General-Purpose Scope Trace Viewer could be used to compare selected trace properties from selected stations
- But providing a simplified, limited browsing saves time for the User!
- Cut-to-the-Chase [flexible trace selection] and One-Stop-Shopping [without the STV]!

# **Monitoring Status Info: The Alarms Viewer**

#### Click on the Icon:

Open a Gui for the Alarm-System

Active Alarm from 26 Front-End Servers: started 4 days ago!

"Status Changes" earlier in the day – from various RF Stations

Without coding anything!

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			=> MSL TIL2 Main Coupler	<= 10.11.19 13:29:08 (4	
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Source	ce	N	r. Alams	Nr. Active	^
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<		0			

Most Operating Programs do not have a "History" Mode. This is a Rich Client which provides a general view of **live** *and history* of alarms!

Operations in BKR: Status is red? Now Green? When did that happen? How long was it red? The other Dingie is also Red? Which went South first?

Full Information available in CAS Viewer – but Cut-to-the-Chase!

Maintenance of the Alarm System: Helps CS Bozos integrate Status-Information into CAS

## Monitoring: Trends with the TrendViewer

🔯 Acop Trend Viewer

Click on the Icon
Open a gui for the Central
and Local Histories

Drag and Drop onto form to select Properties

Assist Browsing with Coding in Gui

I planned on a consistency check:
View a Station-Trip with Status Info
Pulse Data
Trends

But Trends not (yet?) interesting in the HPRF Use-Case

19-Oct -19 20-Oct -19 Refresh Live ✓ Nomalized Print 1920.0 1280.0 /XFEL/ARCHIVER/A17.L3[Mod.Current]: 1188.8A 640.0 /XFEL/ARCHIVER/A17.L3[Mod.Voltage]: 8.148kV time : Oct 20 20:25:23.235 0.0 +... 18:43 19:13 19:43 20:13 20:43 21:13 21:43 Sun Oct 20 18:13:38.181 2019 3 Hours Parameter Units Cursor Now Description /XFEL/ARCHIVER/A17.L3[Mod.Current] Mod Current 1266.30 1188.80 /XFEL/ARCHIVER/A17.L3[Mod.Voltage] | Mod High Voltage k۷ 8.15 8.14

# **Monitoring and Displaying Status Information**

How are status information stored? Different Strategies...

## 01 Status Information as Integers

- Read-out of Hardware as 32-Bit Integers
- Packed into Integers for convenience

### 02 The Strategy used in the Current Gui on:

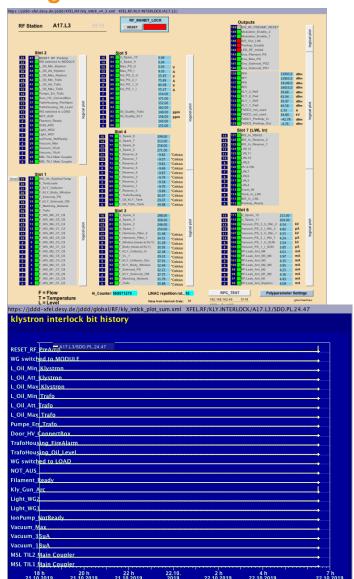
- Trip of RF Station A17.L3 on 20.Oct.2019
- 03 Display Foreground Values (Live)
- Current Status: Bit Value: 1/0 Red/Green
- RF-Interlock Info but not Modulator Info

## 04 Display Background Values (Archived)

 Histories of the values of each bit of the selected Status-Word.

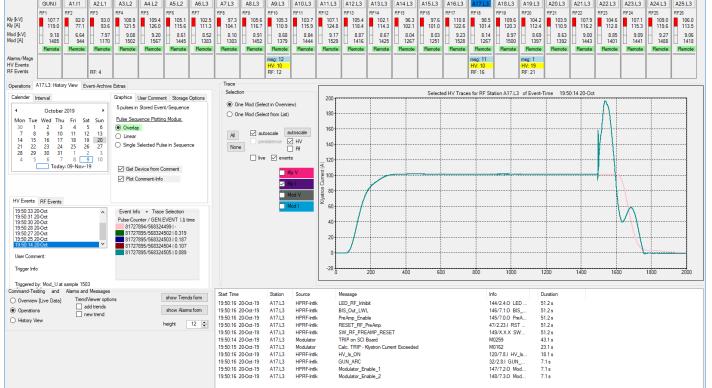
#### 05 Documentation

 Screenshots posted in the XFEL Logbook as documentation of the Trip-Event



Display of Background Monitoring Info from the Alarm- and the Event-

**Archive Systems.** 



- Status Changes are stored as alarms [not integers] in the Alarm System with a Start-Time and a Duration: just the Information needed!
  - View with Alarm Viewer.
  - Game Change: Easy to integrate the Alarm Data into a customized Alarm-View!
- Out-of-Tolerance Traces stored in the Event Archiver: just the traces needed!
  - View with Event-Archive Viewer
  - Easy to integrate the Event Data into a customized Event-Viewer!
- Cut-to-the-Chase [CAS and Events] and One-Stop-Shopping [integrating in Gui]!

# **Summary and Conclusions**

## 01 Revisiting the XFEL HPRF Gui: The Strategy

- One-Stop-Shopping and Cut-to-the-Chase
  - Provide access to all data needed for Subsystem Monitoring
  - Present in an easy-to-digest fashion.
- Utilize the Alarm System and the Event Archiving System
  - Foundation: Connect the HPRF Servers to these Central Services
  - Integrate these Services into the Gui

#### 02 Tool-Kit of Choice: Rich Client in VS 2015 ACOP.NET TINE

- Goals and Functionality not new
  - Requirements of pulsed HPRF haven't changed (TTF)
- But the Tools in the Tool-Kit are better than ever!
  - · Combobulator to easily build MCA Arrays for efficient transport/browsing
  - Can do a lot with the ACOP Smart Graphical Elements
  - Easily integrate Alarm- and Event Archive- Systems in the Gui
    - Rich client programming to tailor to the use case

#### 3 Status

- Gui is still a Baustelle, but...
- Well on the way to successfully fulfilling the Goals!
- I am working on getting the AlarmsViewer in all my Rich-Client Programs

#### Contact

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