

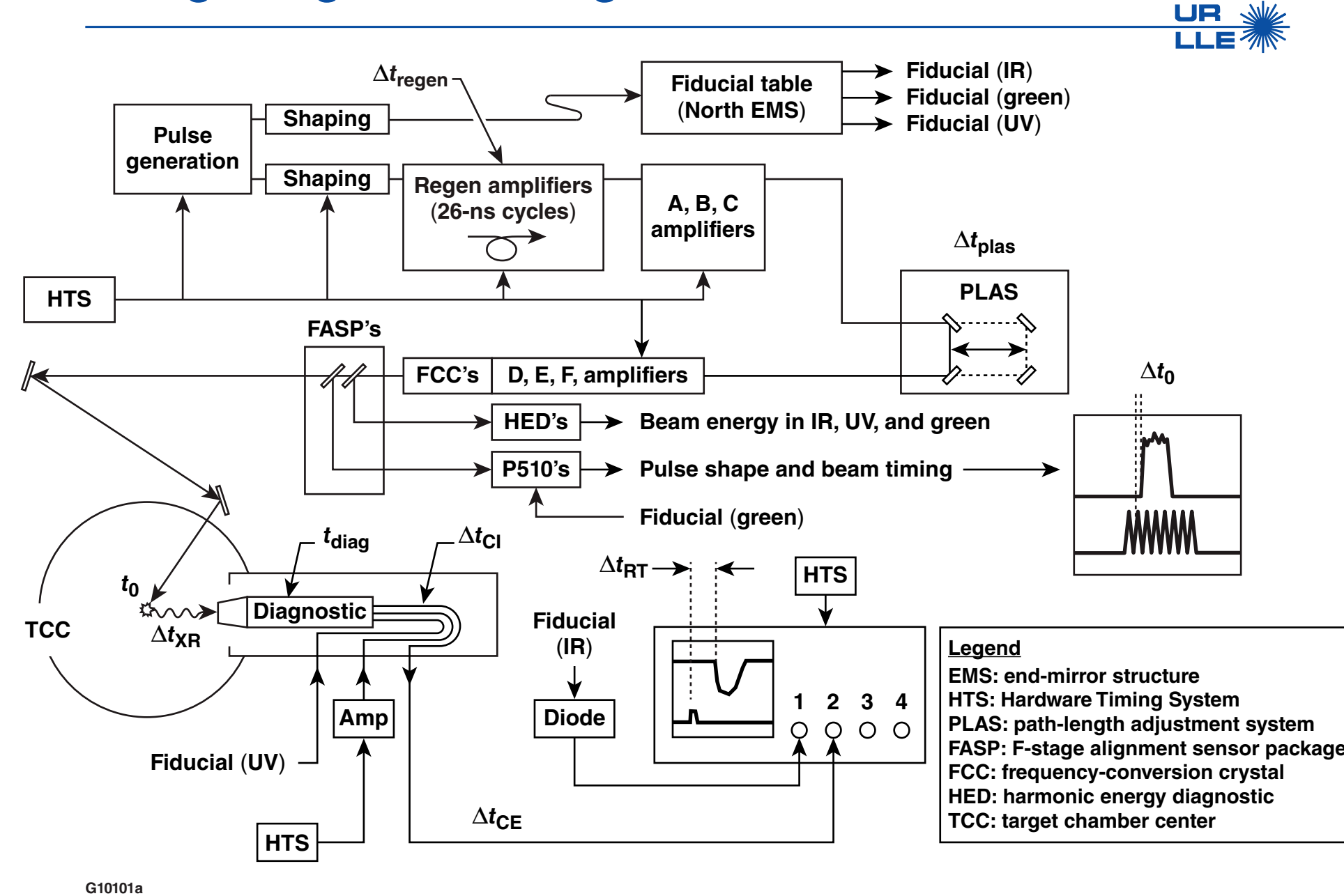
Target Diagnostic Timing Manager



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Omega diagnostic timing



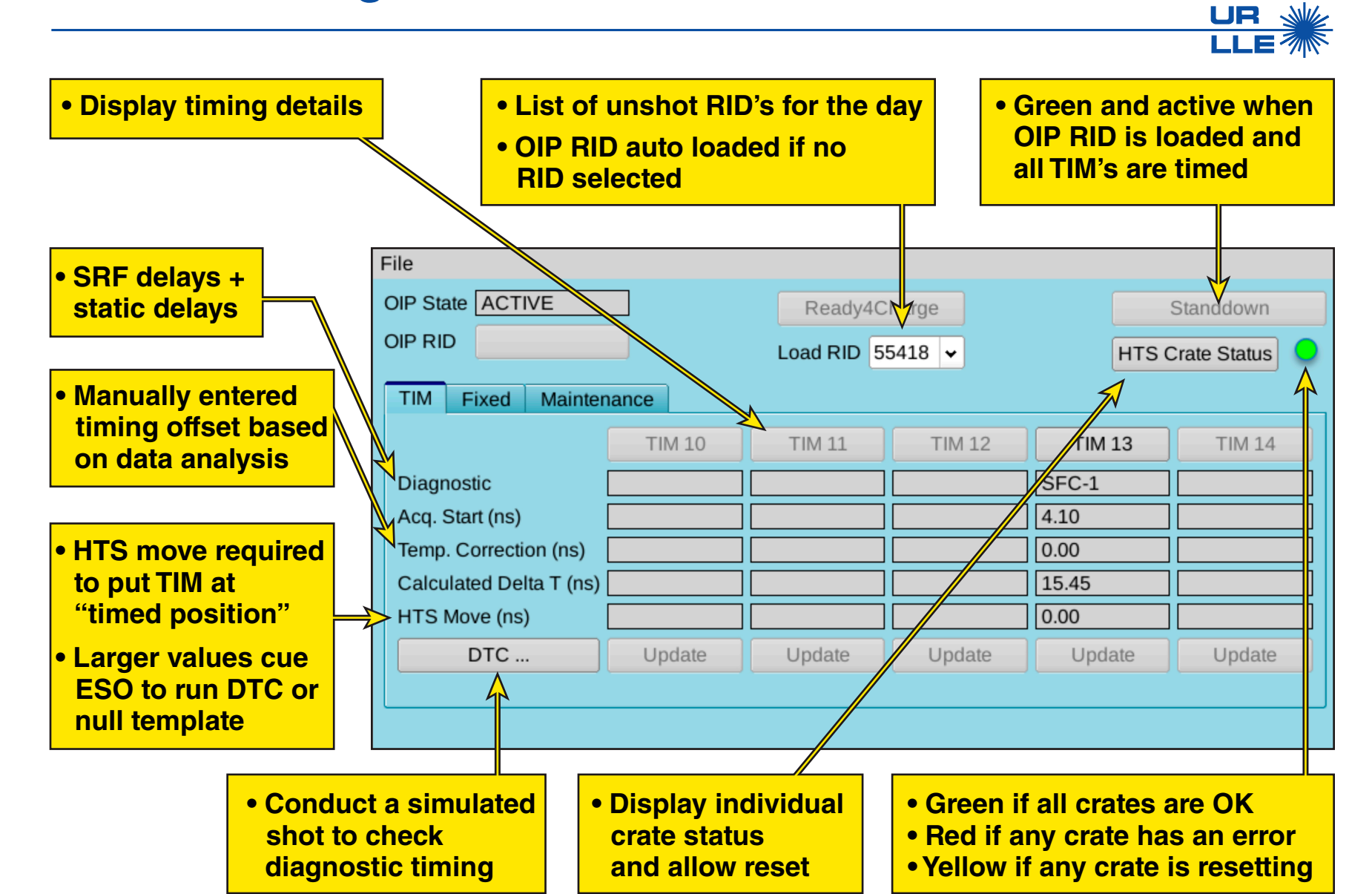
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TDTM features summary

- Previous procedures used two Excel spreadsheets and manually repetitive, error-prone steps to determine the proper timing; TDTM will replace the spreadsheets with a single automated application, controlled by the LLE Software Development Group
- Phase I has replaced the delay calculator spreadsheet, establishing proper timing for diagnostics to acquire the expected data on a target shot (2014)
- Phase II has replaced the separate diagnostic timing check (DTC) application, incorporating its functions and all timing data acquisition and archiving functions into TDTM (2015)
- Phase III will replace the timing checker spreadsheet, automating some timing-analysis functions and creating a mechanism for easy storage and retrieval of data
- TDTM has been designed to automate repetitive steps and use database tables to facilitate retrieval of historical information

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TDTM TIM diagnostics GUI



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Diagnostic timing—HTS, fiducial, and t_0

- Diagnostic trigger timing is controlled by the HTS and measured against a fiber-delivered laser fiducial pulse
- The HTS delivers synchronized trigger pulses to the OMEGA laser-driver line, amplifiers, and all target diagnostics
 - ten-inch manipulator (TIM)-based diagnostic triggers are either transistor-transistor logic (TTL) or amplified TTL pulses at t_0 , $t_0 - 10$ s, or 0.1 Hz (continuous, every 10 s)
 - trigger delays are variable in 100-ps increments
- The fiducial laser pulse is generated from the OMEGA seed pulse to ensure stable timing
 - the fiducial pulse consists of eight peaks spaced at 548 ps
 - 1 ω , 2 ω , and 4 ω (1054, 527, and 263 nm) fiducial signals are available
 - the timing monitor system uses the IR fiducial, directed into a photodiode, to generate oscilloscope reference pulses at a fixed time relative to t_0
- The nominal time that the main OMEGA drive beams reach the target is defined as t_0
 - beam timing can be varied by shifting driver timing or changing the path length of individual beams
 - time changes are specified in nanoseconds relative to t_0
 - the P510 streak cameras measure on-shot pulse timing versus the green fiducial

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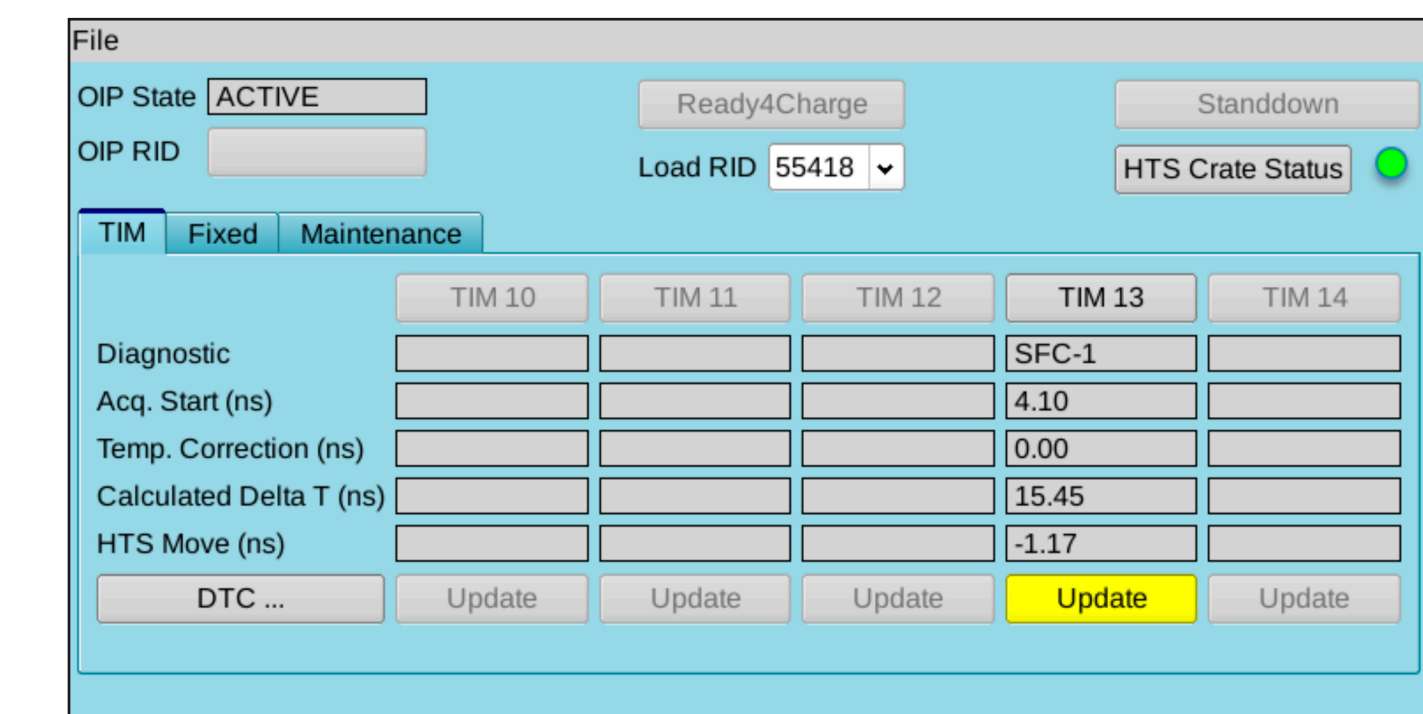
Requirements

- Measure firing times of TIM-based diagnostics to less than 100 ps
- Store configuration data in easy to update database
- Archive timing monitor scope traces in hierarchical data format (HDF) files
- Collect and archive data on-shot
- Allow for test firing of diagnostics without "burning a shot"
- Experimental system operator (ESO) client to accurately time diagnostics using TDTM
- Provide a visual display (e.g., plot/chart) of the scope traces from test fires and target shots
- Provide a dedicated client for TIM-based HTS channels

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TDTM is operational on OMEGA and EP

- Calculates the expected Δt and HTS delay values
- Selects the correct timing parameters based on SRF configuration
- Calculates HTS delay values correctly and updates them as desired



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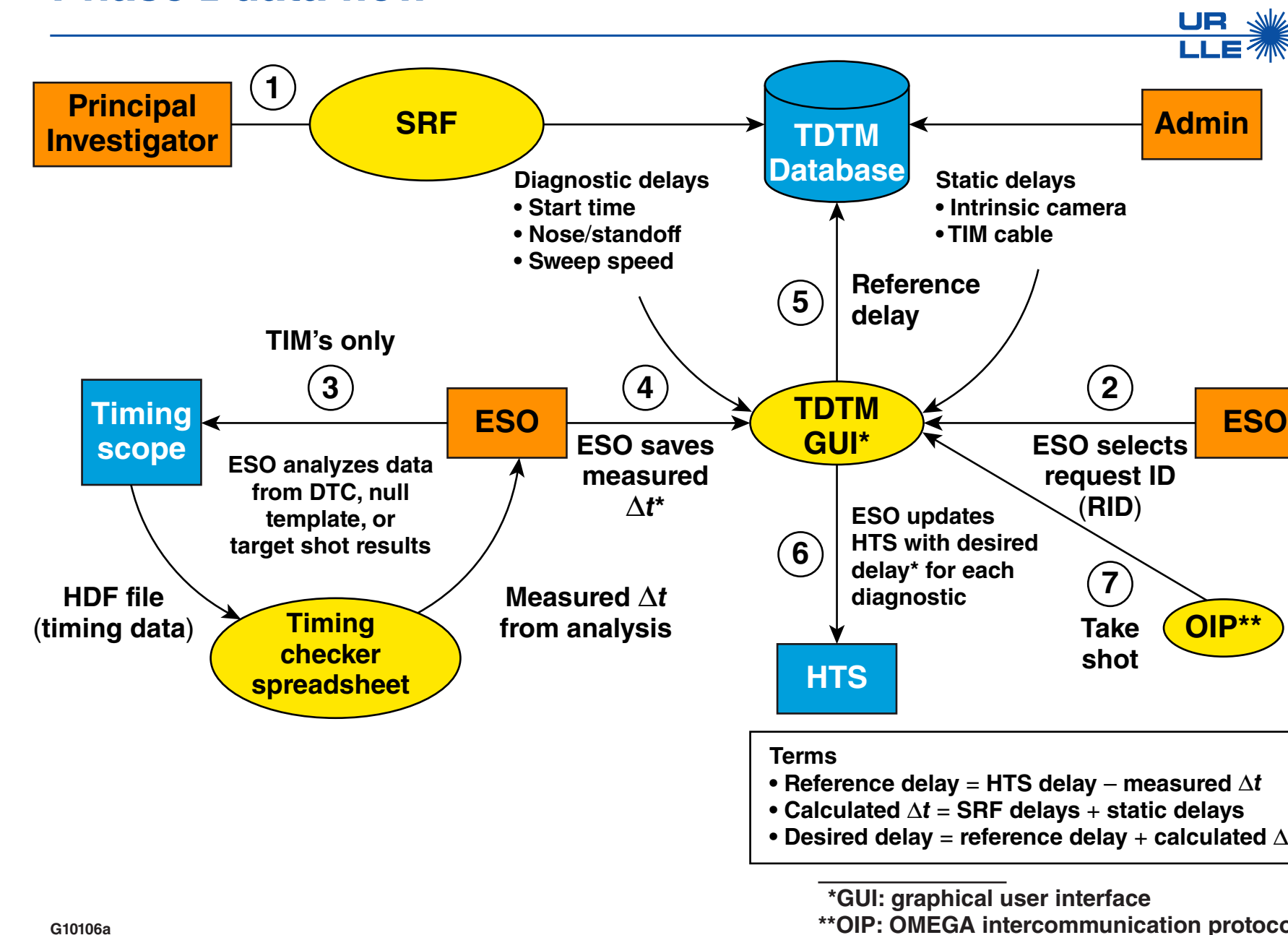
Current timing-management tools

- Target diagnostic timing manager (TDTM) stores reference information, calculates, and lists desired Δt for each diagnostic
- Values are calculated for each diagnostic as configured in the shot request form (SRF)
- The timing checker spreadsheet displays timing monitor scope traces, measures the on-shot Δt , and compares it to the calculated value



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Phase I data flow



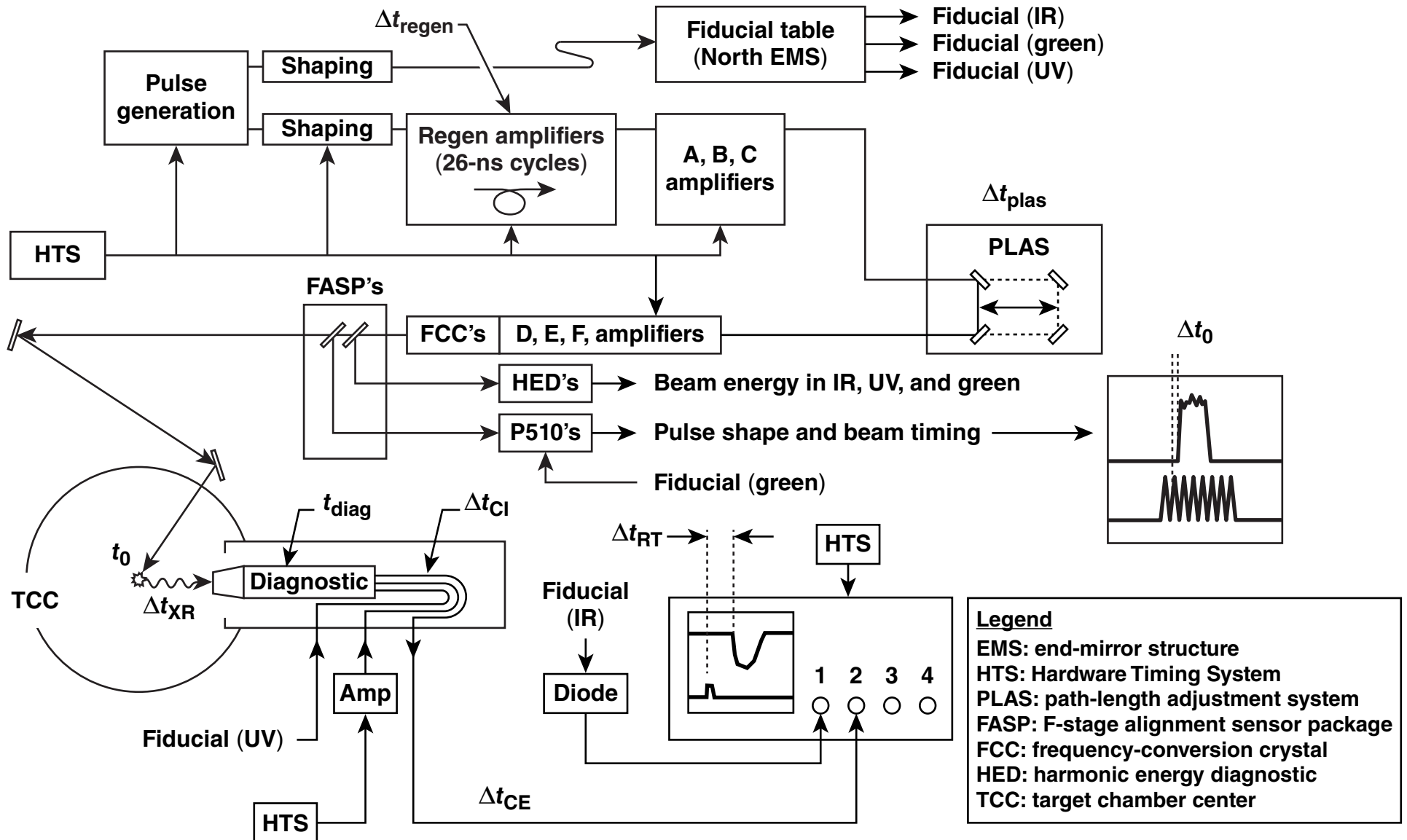
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TDTM software status

- Phase I is operational at the OMEGA and OMEGA EP ESO stations and has replaced the weekly "delay calculator" spreadsheet
- Phase II has replaced the "autolaunch" script and "DTC" application
- Phase III (future) will automatically update the "measured Δt " value from the timing scope and replace the "timing checker" spreadsheet
- A Microsoft-Access application has been created for Omega XOPS to maintain administrative tables in the database
- SRF diagnostic setup sheets have been changed to include standoff distances, in cm, for all timed diagnostics for TDTM x-ray time-of-flight calculations
- Updates are database driven; no code changes are required

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File

OIP State: ACTIVE Ready4Charge Standdown

OIP RID: Load RID: 55418 HTS Crate Status: ●

TIM Fixed Maintenance

TIM 10 TIM 11 TIM 12 TIM 13 TIM 14

Diagnostic: SFC-1

Acq. Start (ns): 4.10

Temp. Correction (ns): 0.00

Calculated Delta T (ns): 15.45

HTS Move (ns): -1.17

DTC ... Update Update Update Update Update

Shot 80835
DTC Seq 0

Time Check

Diagnostic	Dev 2	TIM 1	TIM 2	TIM 3	Dev 3	TIM 4	TIM 5	TIM 6
X-ray Optic	fidu	empty	SFC 4	fidu	XFPC 1	SFC 2	empty	
	fidu	STD	STD	LINL AX	LINL AX	LINL AX	STD	
	-32.15	-1.34	-1.34	-32.21	-19.33	-1.74		
	0.39		-2.69	0.38	-2.21	-2.21		
Δt at t_0 (nsec)	--	--	30.81	--	21.21	29.85	--	
Measured Δt (nsec)	4.12	--	30.81	4.10	21.83	30.41	--	
Firing time from t_0 (nsec)	--	--	-0.09	--	0.62	0.58	--	

Non-volatility

Footworth

XFPC Pulse Times						
Pulse 1	-1.98	-6.98	-1.34	-10.52	-1.74	0.00
Pulse 2	3.98	-6.98	2.84	-8.66	2.48	1.10
Pulse 3	8.94	-6.98	7.10	-7.76	6.68	2.22
Pulse 4	13.90	-6.98	11.26	-6.56	10.88	3.22

Interstrip Times						
Pulse 1	--	--	0.00	0.00	0.00	--
Pulse 2	--	--	4.18	1.26	4.26	--
Pulse 3	--	--	8.44	2.56	8.42	--
Pulse 4	--	--	12.62	3.76	12.60	--

Pulse Voltages						
Pulse 1			-2.69	-2.23	-2.22	
Pulse 2			-2.12	-2.54	-1.93	
Pulse 3			-2.32	-1.97	-2.75	
Pulse 4			-1.60	-0.79	-2.51	

Pulse Times Relative to t_0						
TIM 1	TIM 2	TIM 3	TIM 4	TIM 5	TIM 6	
--	--	-0.09	0.62	0.58	--	
--	--	0.18	0.90	0.92	--	
--	--	0.44	1.14	1.18	--	
--	--	0.69	1.40	1.61	--	

Manual Timing Offsets						
TIM 1	TIM 2	TIM 3	TIM 4	TIM 5	TIM 6	
0.00	0.00	0.00	0.00	0.00	0.00	

TDTM features summary



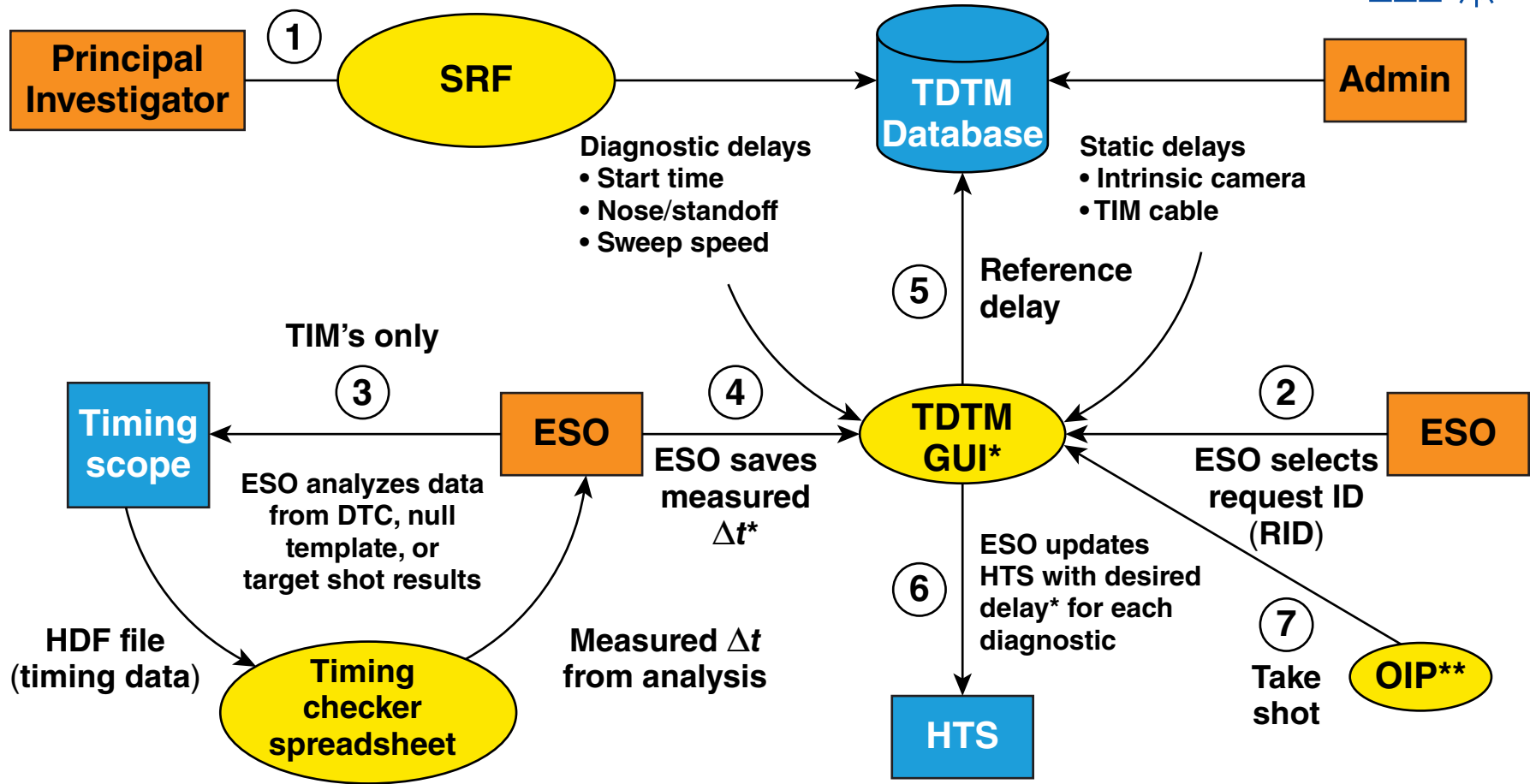
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Phase I data flow

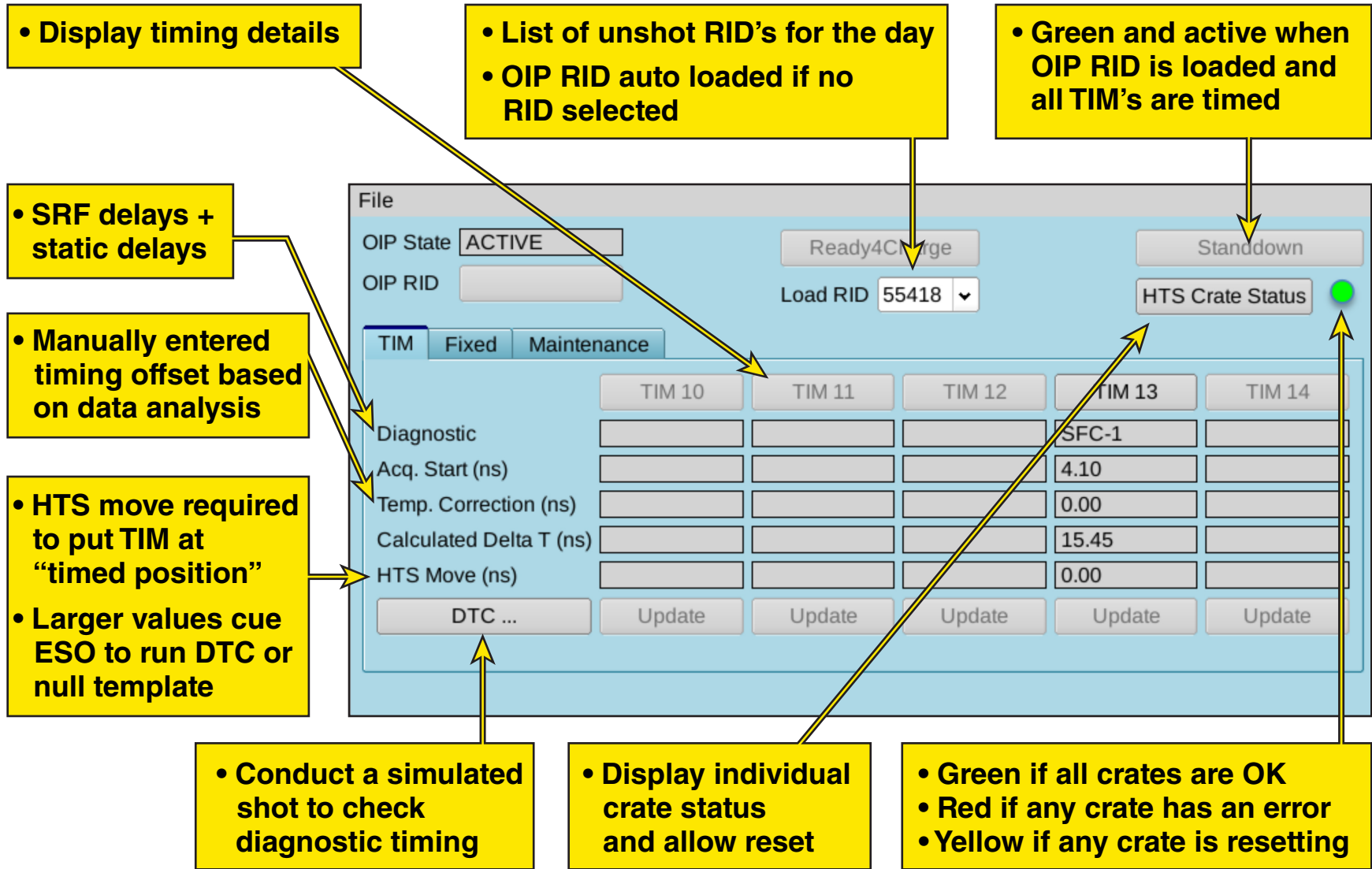


Terms

- Reference delay = HTS delay – measured Δt
- Calculated Δt = SRF delays + static delays
- Desired delay = reference delay + calculated Δt

*GUI: graphical user interface
 **OIP: OMEGA intercommunication protocol

TDTM TIM diagnostics GUI



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File

OIP State

OIP RID Load RID

	<input type="button" value="TIM 10"/>	<input type="button" value="TIM 11"/>	<input type="button" value="TIM 12"/>	<input type="button" value="TIM 13"/>	<input type="button" value="TIM 14"/>
Diagnostic	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="SFC-1"/>	<input type="text"/>
Acq. Start (ns)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="4.10"/>	<input type="text"/>
Temp. Correction (ns)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="0.00"/>	<input type="text"/>
Calculated Delta T (ns)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="15.45"/>	<input type="text"/>
HTS Move (ns)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="-1.17"/>	<input type="text"/>
	<input type="button" value="DTC ..."/>	<input type="button" value="Update"/>	<input type="button" value="Update"/>	<input style="background-color: yellow;" type="button" value="Update"/>	<input type="button" value="Update"/>

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