



Honorable Squires

Supportive tools and environment for a high availability Smalltalk application

About ...



Authors

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- Taylan Kraus-Wippermann, Consultant from Georg Heeg eK

Project

- "CEI Baseline"

Relationship

- Georg Heeg eK is working for AMD since 2002
- Consulting, design and implementation in "CEI Baseline" team
- Workshops and Smalltalk training for AMD developers



Agenda

- **AMD and Georg Heeg eK Company overview**
- **Equipment Integration and CEI Baseline**
- **Role of Testing**
- **Support Tools**
 - Log File Viewer
 - Remote Service Tool
 - Replay Tool
- **Vision and Outlook**



Company Overview AMD

About AMD



Advanced Micro Devices is a leading global provider of innovative processing solutions in the computing, graphics and consumer electronics markets.

Founded:
1969

Headquarter Sunnyvale, California
(Silicon Valley), USA

Employees ~ 16,000 worldwide

Sales Mix 79 % international

2006 Revenue > \$ 5.6 billion (incl. ATI)



AMD in Dresden

1996

Future AMD Site



2007

DDC/OSRC Fab 36 Bump/Test Facility Fab 30/38 EVC 2 EVC 1



Highly Successful 130nm → 90nm → 65nm Technology Transition

The diagram illustrates the technology transition for AMD Opteron and Athlon processors. It is divided into two horizontal sections. The top section, labeled 'Opteron', shows a progression from a 130nm processor to a 90nm processor, then to a 'Dual-Core' 90nm processor, and finally to a 'Quad-Core' 65nm processor. The bottom section, labeled 'Athlon', shows a progression from a 130nm processor to a 90nm processor, then to a 'Dual-Core' 65nm processor. A green callout box on the right lists key factors for the success of this transition.

Opteron

- 130nm
- 90nm
- Dual-Core 90nm
- Quad-Core 65nm

Athlon

- 130nm
- 90nm
- Dual-Core 65nm

High yield at start of volume production

Builds on SOI success

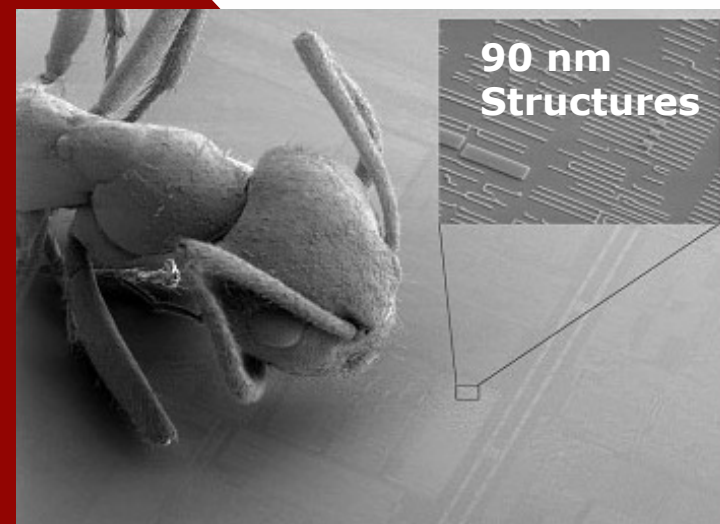
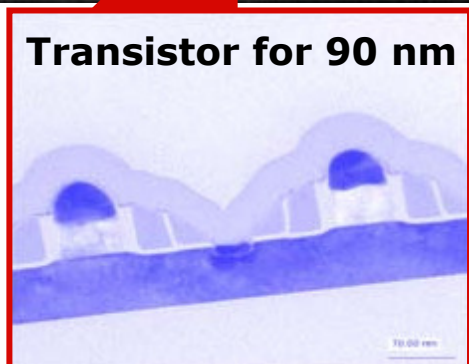
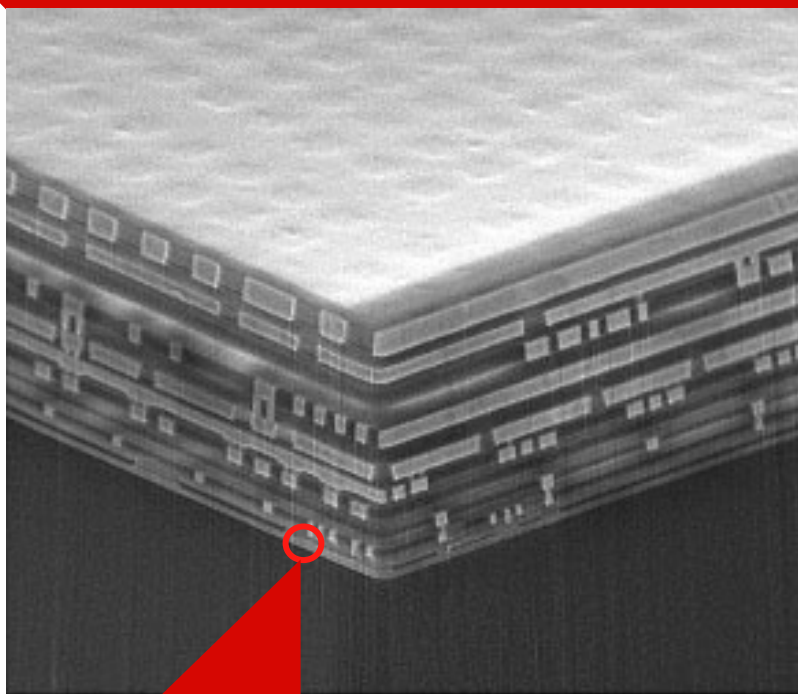
Increased thermal efficiencies

Significant value addition

Addition of strained silicon transistor technology



Cross sections & dimensions





Company Overview Georg Heeg eK

About Georg Heeg eK



Founded 1987, headquarter in Dortmund, since 1996 in Zurich, since 1999 in Koethen/Anhalt

Consulting- and training company in Smalltalk

Hotline support, maintenance, bug-fixes for ObjectStudio, VisualWorks and Visual Smalltalk

VM-laboratory for VisualWorks and ObjectStudio

Porting service of old VisualWorks applications to 5i/7

Technology-partner of  CINCOM

Corporate Mission:

**Make Sophisticated Projects a Success for
the Customer!**



Equipment Integration

Equipment Interfaces

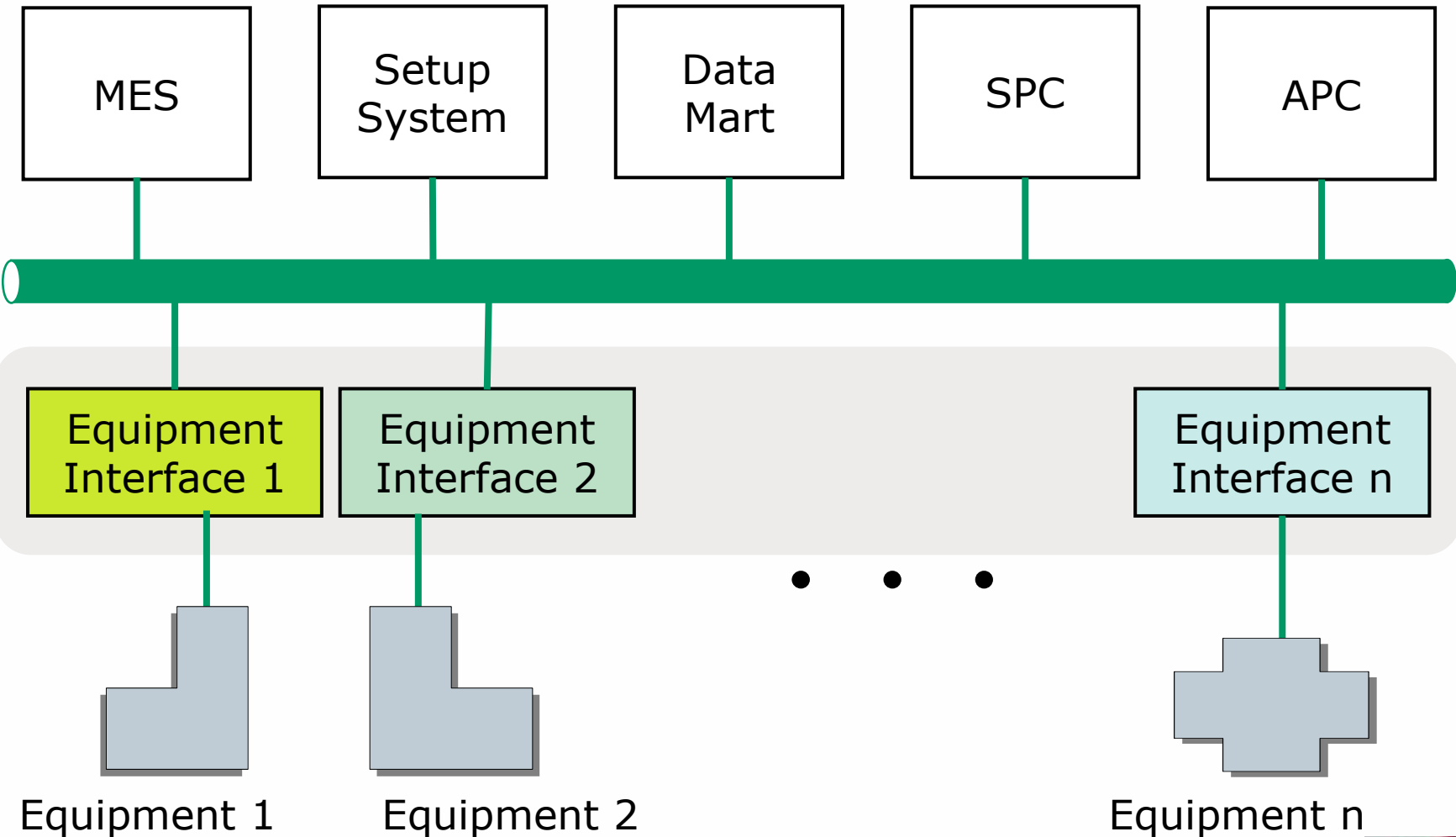
Functional Scope

- Connection between production equipment and Factory Control Systems (FCS)
- Controls the processing of the equipment based on jobs from the Manufacturing Execution System (MES)
- Collects and reports data to various FCS components to
 - tune this or a dependent process
 - monitor process quality and tool health
 - allow other offline analysis (e.g. tool utilization)
- updates the MES with process status and material location

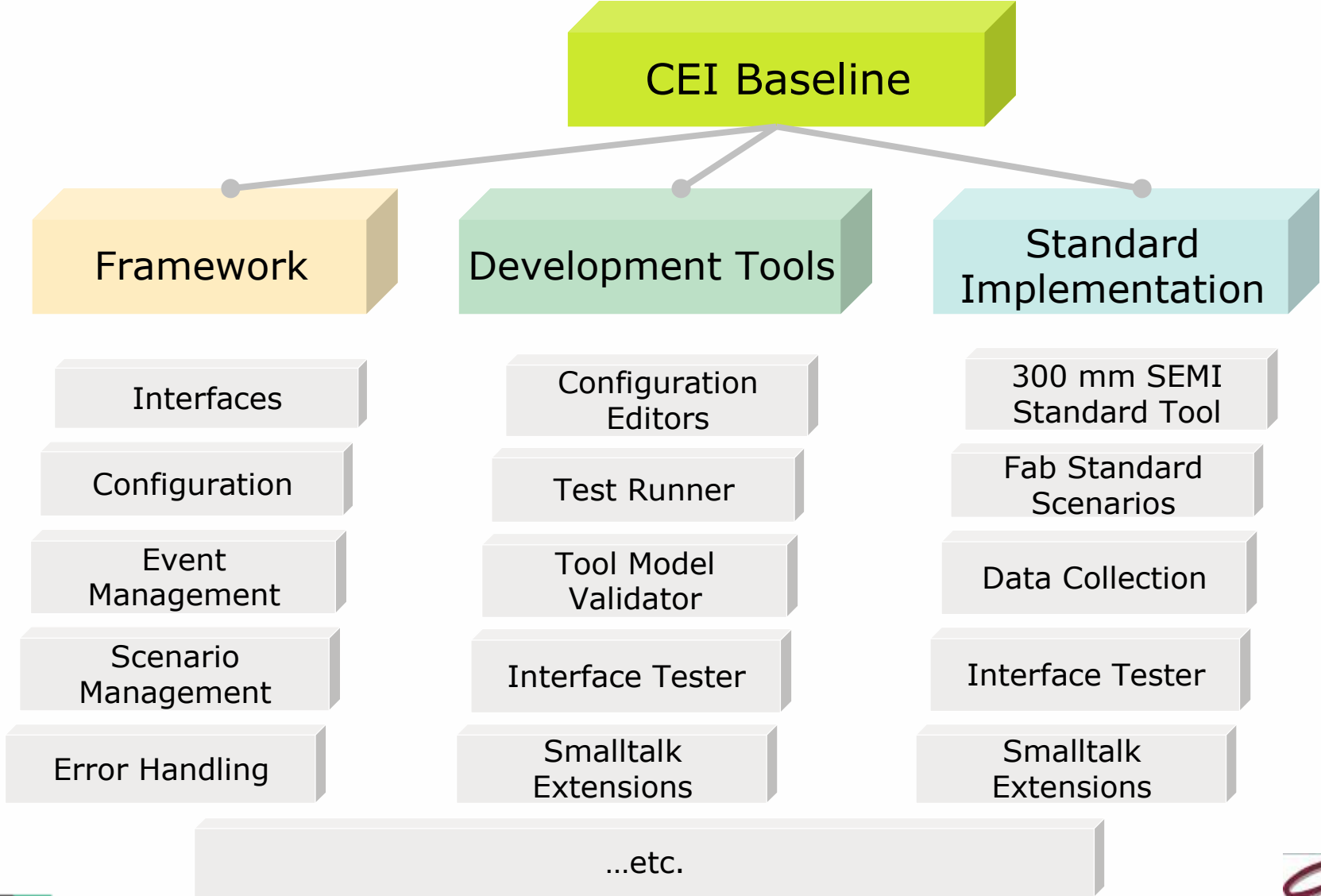
Complexity

- > 50 Tool Types with different level of behavior specifics
- > 500 Entities running 7 x 24
- little to no idle times

Equipment Interfaces (EI's) in the Factory Control System (FCS)



CEI Baseline – what is it?



Conflicting Objectives



CEI Baseline



Continuous Enhancements
➤ Increasing Complexity

Automated Error Handling

Resource Constraints

Minimize Production Tests

Minimize Restarts

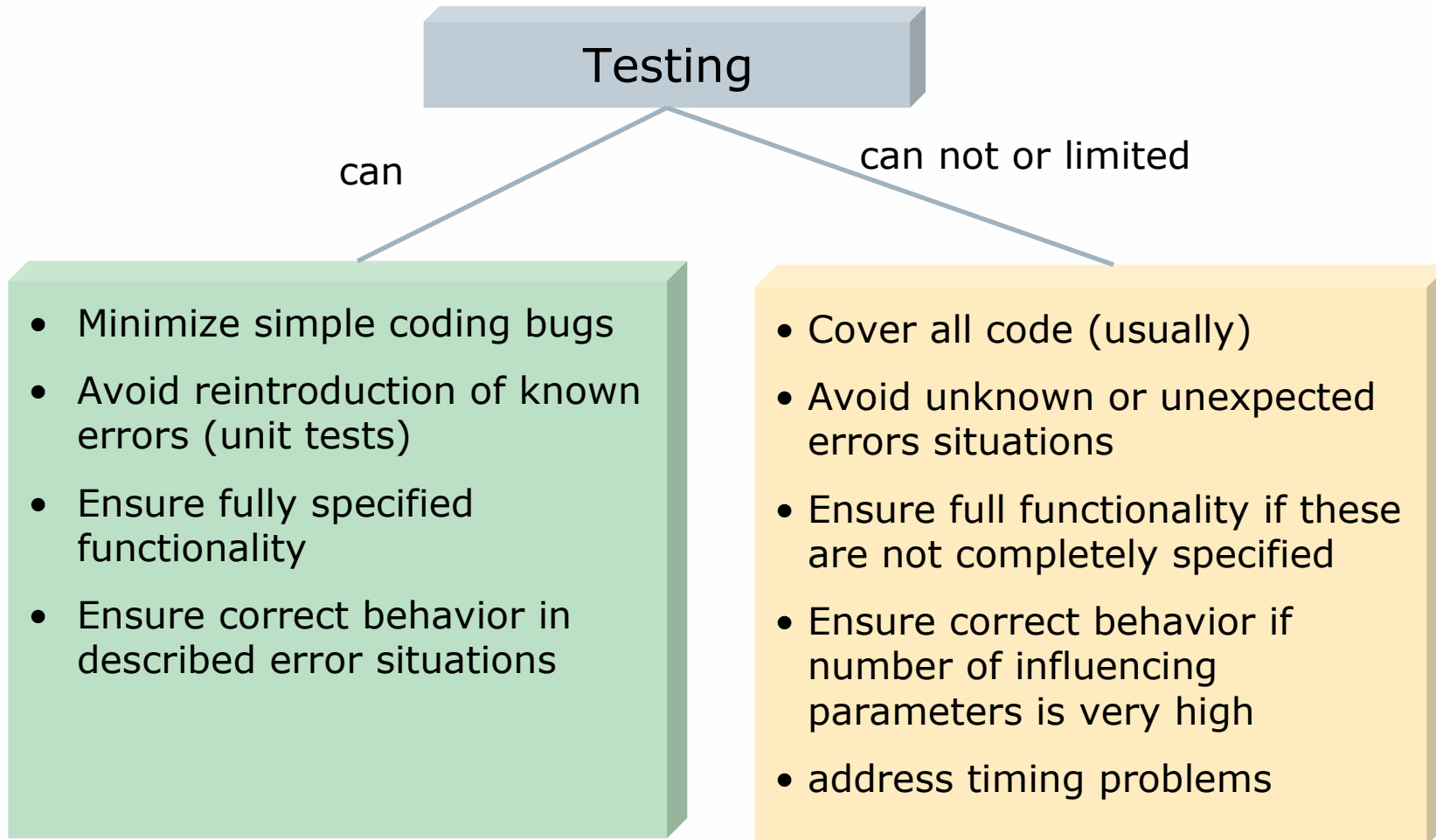
Minimize Failure Events

Minimize Service Calls

Minimize Production Impact



The Role of Testing



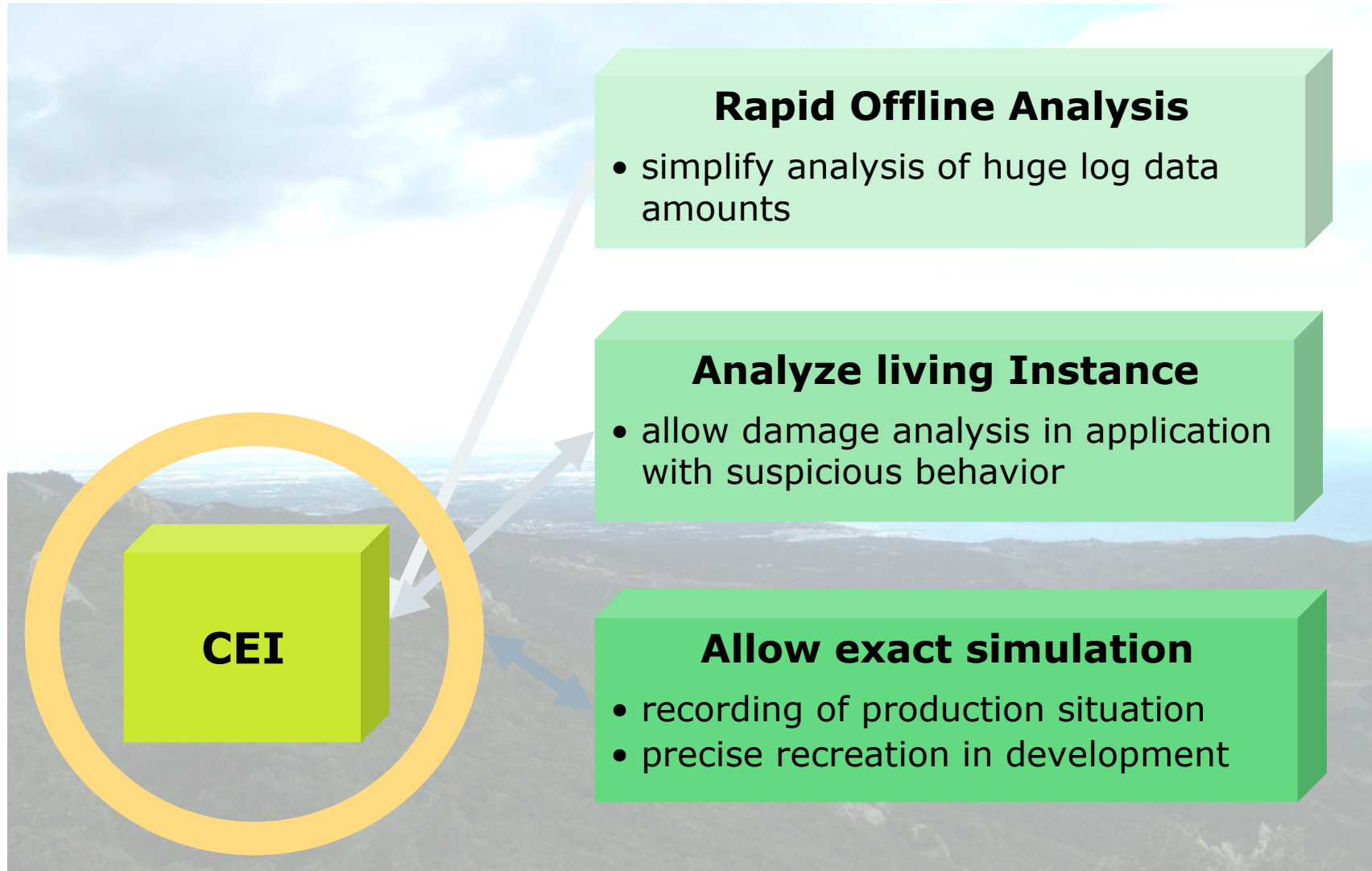
The Application needs more Support....



- Testing needs to be continuously improved
- We have to accept that errors in production occur
- Error will be more rare and more complex with improved testing
- ... but

- We want to understand and eliminate each issue after 1st occurrence
 - we need support for the analysis of issues
 - we want to be able to reproduce issues in development

... but what Support



Analysis - Log File Viewer

Background

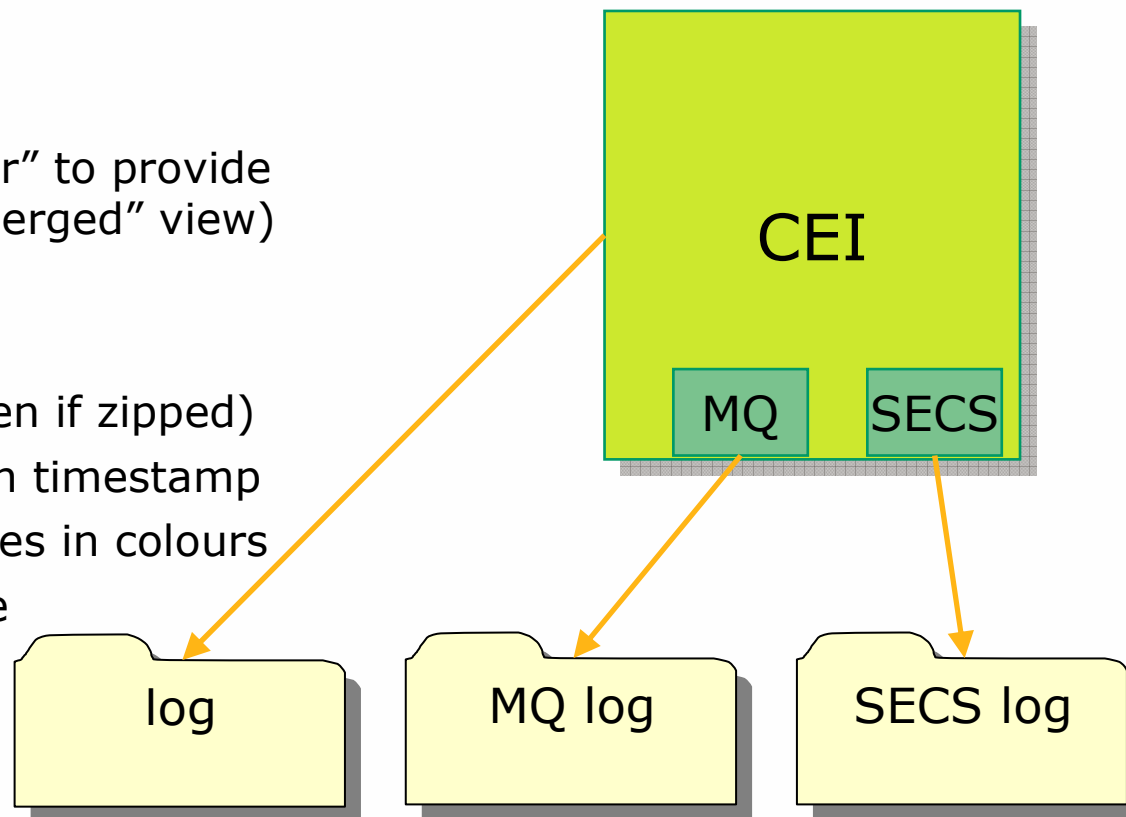
- for support reasons EI creates log
- there are many different log categories (interface level logging)
- support staff needs to look into more than one log file

Solution

- Tool “Log File Viewer” to provide better overview (“merged” view)

Features

- open/close files (even if zipped)
- merge files based on timestamp
- mark/un-mark entries in colours
- store sessions to file



Analysis - Log File Viewer (cont.)

log

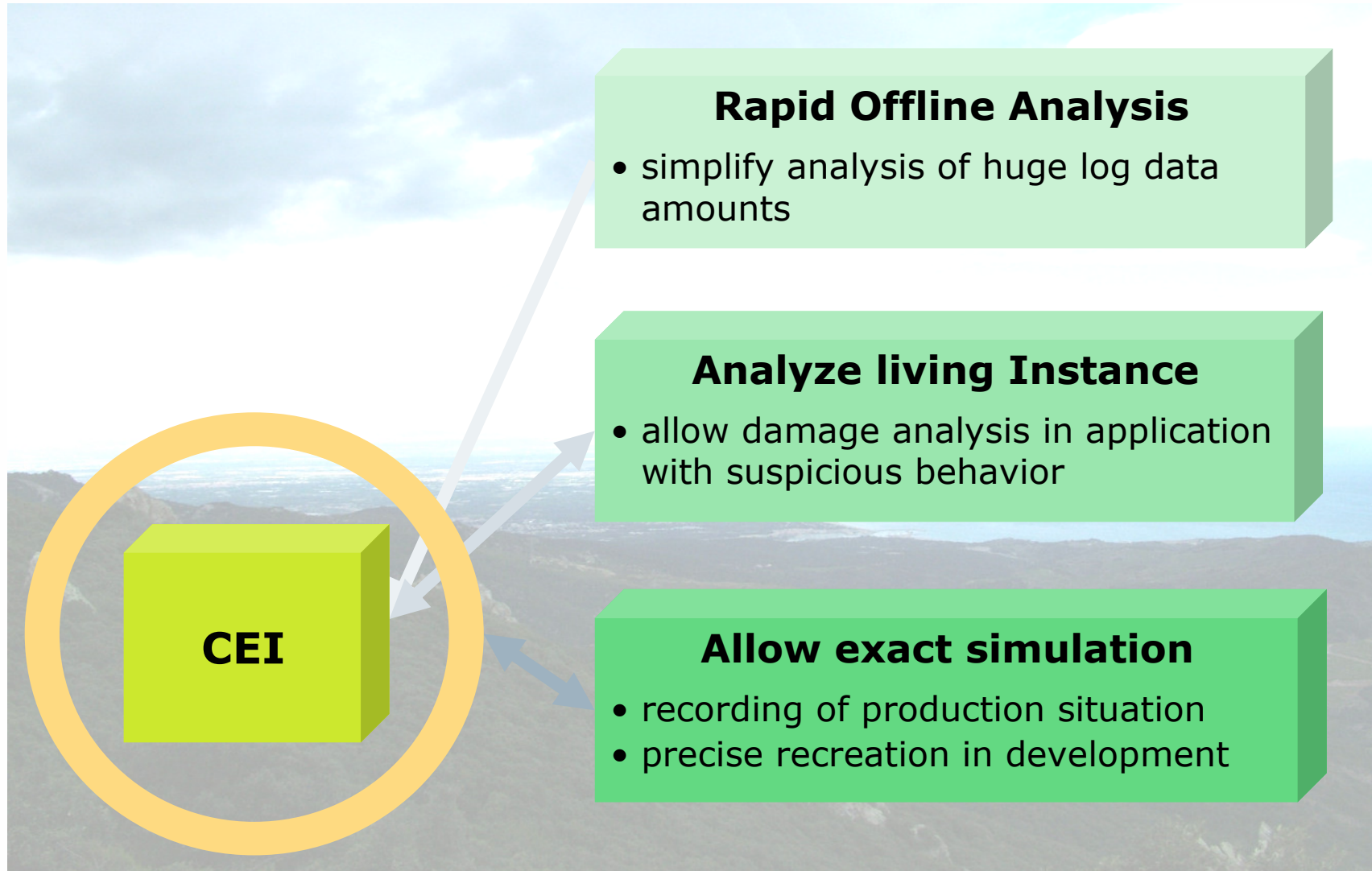
MQ log

SECS log

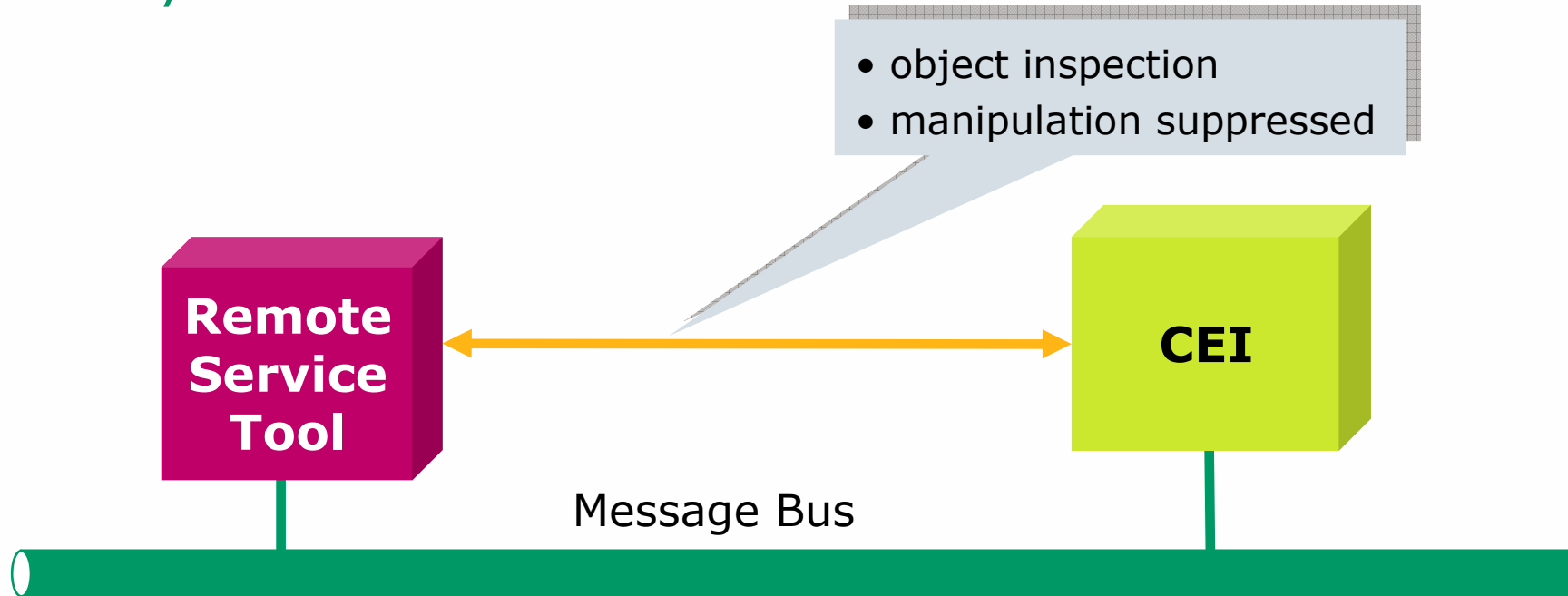
Timestamp	PID	Category	Level	Log
2007-08-03 11:38:08.074	15756	secs	info	Received S16F9 [00024A4B] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.110	15756	secs	info	Received S6F11 W [00024A4C] <L [3] <U4 [1] 58425 > <U4 [1] 1530 > <L [1]
2007-08-03 11:38:08.112	14831	default	info	EventID=PJSM2_QUEUEUED_SETTINGUP EquipmentID = 'ACS100' CEID = 1530 PRJobID = '20
2007-08-03 11:38:08.113	15756	secs	info	Received S16F9 [00024A4D] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.163	15756	secs	info	Received S16F9 [00024A4E] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.202	15756	secs	info	Received S16F9 [00024A4F] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.235	15756	secs	info	Received S16F9 [00024A50] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.375	15756	secs	info	Received S16F9 [00024A51] <L [4] <L4 [1] 1 > <A [16] '2007080311382000'> <A [24
2007-08-03 11:38:08.404	15756	secs	info	Received S6F11 W [00024A53] <L [3] <U4 [1] 58427 > <U4 [1] 931 > <L [1]
2007-08-03 11:38:08.405	14831	default	info	EventID=CJSM3_QUEUEUED_SELECTED EquipmentID = 'ACS100' CEID = 931 CtrlJobID = 'AC
2007-08-03 11:38:08.467	15756	secs	info	Received S6F11 W [00024A54] <L [3] <U4 [1] 58428 > <U4 [1] 933 > <L [1]
2007-08-03 11:38:08.468	14831	default	info	EventID=CJSM5_SELECTED_EXECUTING EquipmentID = 'ACS100' CEID = 933 CtrlJobID = '
2007-08-03 11:38:08.470	14997	default	info	OperationStart prepares ClusterToolMaterialJob(ACS100-20070803-0025) with carrier-loadPc
2007-08-03 11:38:08.471	14997	default	info	ClusterToolMaterialJob(ACS100-20070803-0025) entered JobStarted state.
2007-08-03 11:38:08.600	15756	secs	info	Received S6F11 W [00024A55] <L [3] <U4 [1] 58429 > <U4 [1] 1532 > <L [1]
2007-08-03 11:38:08.601	14831	default	info	EventID=PJSM4_SETTINGUP_PROCESSING EquipmentID = 'ACS100' CEID = 1532 PRJobID
2007-08-03 11:39:40.256	15756	secs	info	Received S6F11 W [00024A5A] <L [3] <U4 [1] 58434 > <U4 [1] 1431 > <L [1]
2007-08-03 11:39:40.258	14831	default	info	EventID=SLOSM1_UNOCCUPIED_OCCUPIED EquipmentID = 'ACS100' CEID = 1431 SubstID
2007-08-03 11:39:40.259	1368	default	info	Wafer(7V01V023SO) moved into location TransferChamber2
2007-08-03 11:39:40.268	15756	secs	info	Received S6F11 W [00024A5B] <L [3] <U4 [1] 58435 > <U4 [1] 1434 > <L [1]
2007-08-03 11:39:40.271	14831	default	info	EventID=SOSM2_ATSOURCE_ATWORK EquipmentID = 'ACS100' CEID = 1434 SubstID = '7V
2007-08-03 11:39:40.437	1368	default	info	Disallowing the cancellation of job ACS100-20070803-0025
2007-08-03 11:39:40.829	14997	default	info	Attempt to update SiViews process status to 'ProcessStart' for Lot (U738Q.00).
2007-08-03 11:39:40.830	14997	siview	debug	To SiView: txProcessStatusRpt:equipmentID:controlJobID:lotID:actionCode: withArgs: #((P
2007-08-03 11:39:40.831	14997	siview	debug	To SiView (Parameters): txProcessStatusRpt:equipmentID:controlJobID:lotID:actionCode:
2007-08-03 11:39:40.916	14997	default	info	Successfully updated SiViews process status to 'ProcessStart' for Lot (U738Q.00)!



... but what Support



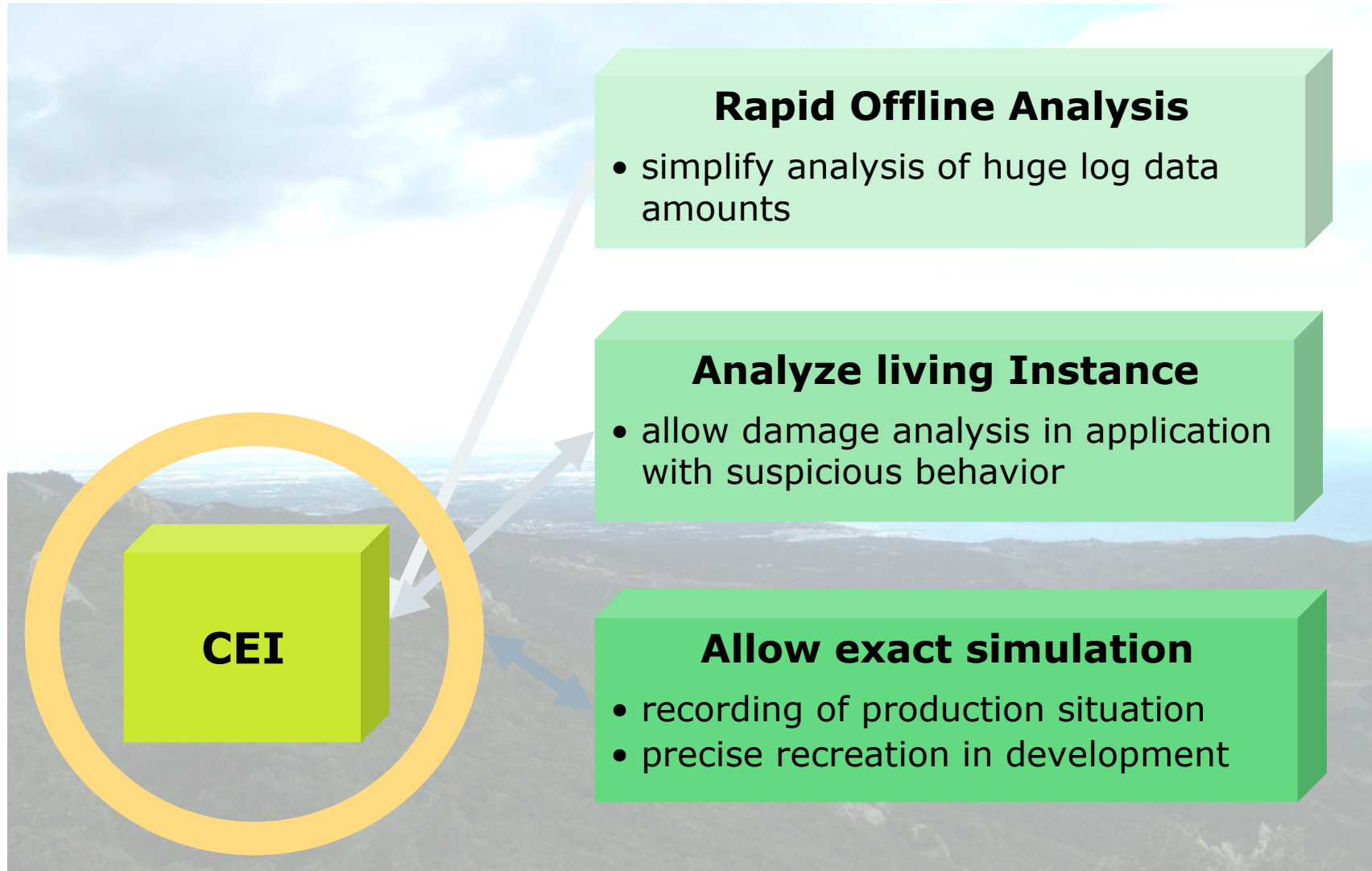
Analysis - Remote Service Tool



- call defined services to generate reports
 - memory
 - process stack
 - instance reports
- reports can be saved for later developer review
- specific service opens port for passive inspection via STST



... but what Support



Exact Simulation – Replay Tool

“Flight Recorder” for the Equipment Interface

- Analysis of crash and error situations
- Replay error situations many times with all development tools available
- Recording in production – Replay in development

Recording all data traffic with external systems

- Deterministic behaviour

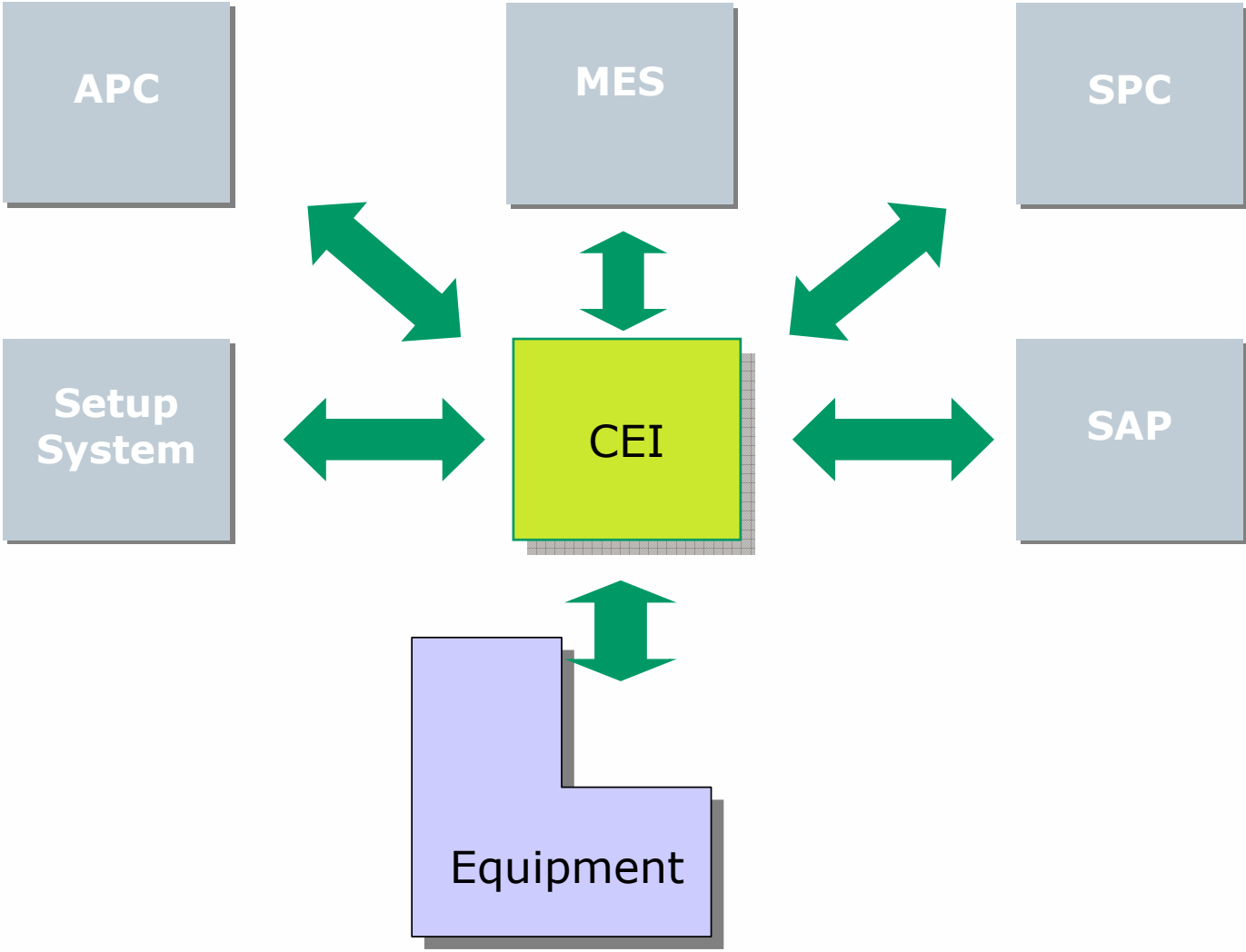
Writing snapshots of application state

Reading snapshot and replay recorded traffic

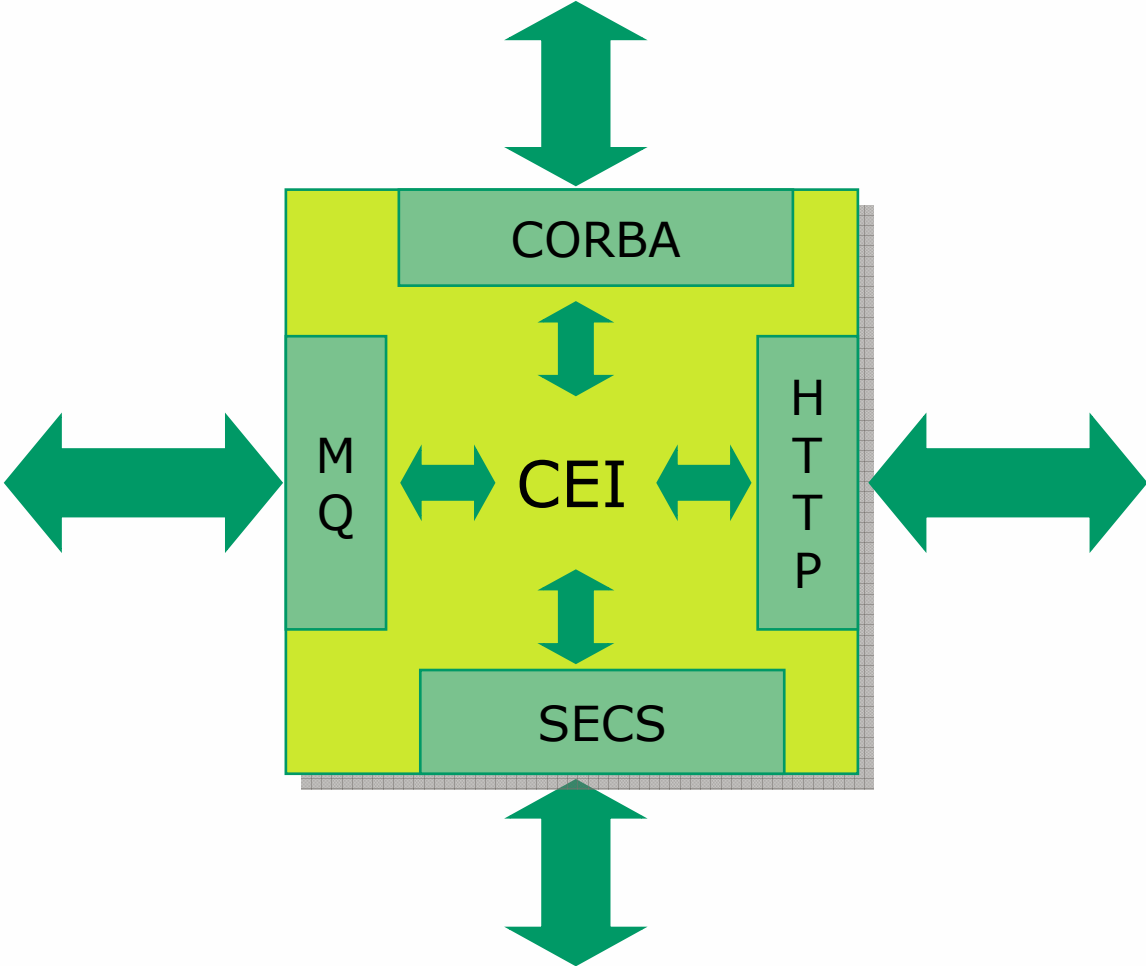
- Simulation of interfaces to external systems
- Application runs without changes
- No simulation of internal processes

Simulation GUI – Replay Runner

Replay Tool – CEI Connections



Replay Tool – CEI Multiple Interfaces



Replay Tool – Recording

Low level interface extension

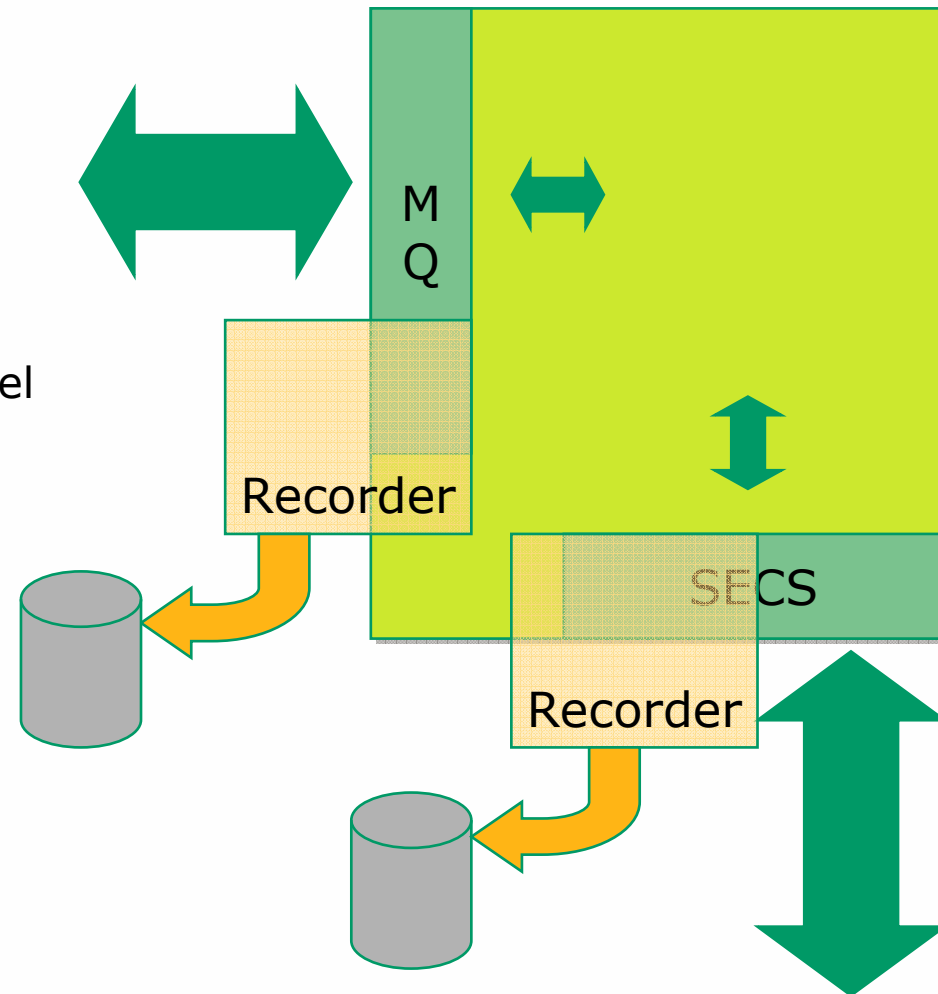
- Minimal impact to existing code
- Minimal performance impact

Not changing application code

- All changes kept on interface level
- Invisible for application

Persistence

- Binary format
- No message transformation
- One file for each interface



Replay Tool – Writing Snapshots

Taking snapshots

- Long time recording leads to high data amounts
- Long time winding to find a suitable simulation position
- Simulation acceleration is limited

Replay needs configuration and environments

- Different production and development configuration
- Different replay in development with production records

Replay Tool – Simulation

Low level interface extension

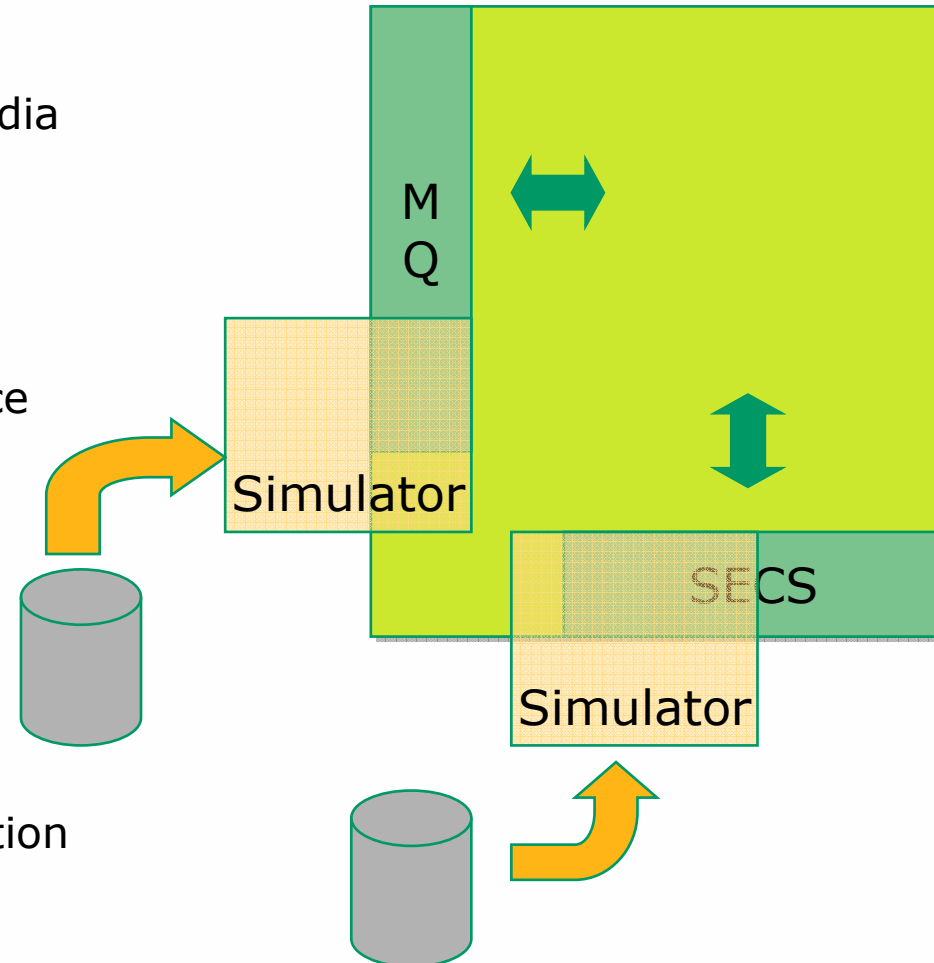
- Disconnecting interface from media
- Moderate changes necessary

Simulator

- Feeds recorded messages into the interface
- Receives messages from interface

Virtualization of external interfaces

- Simulation of TCP/IP based communication
 - Virtual Sockets
 - Simulators for CORBA-IIOP, HTTP, SECS, ...
- Simulation of queue communication
 - Virtual Queues (MQ series)



Replay Tool – Message Dispatching

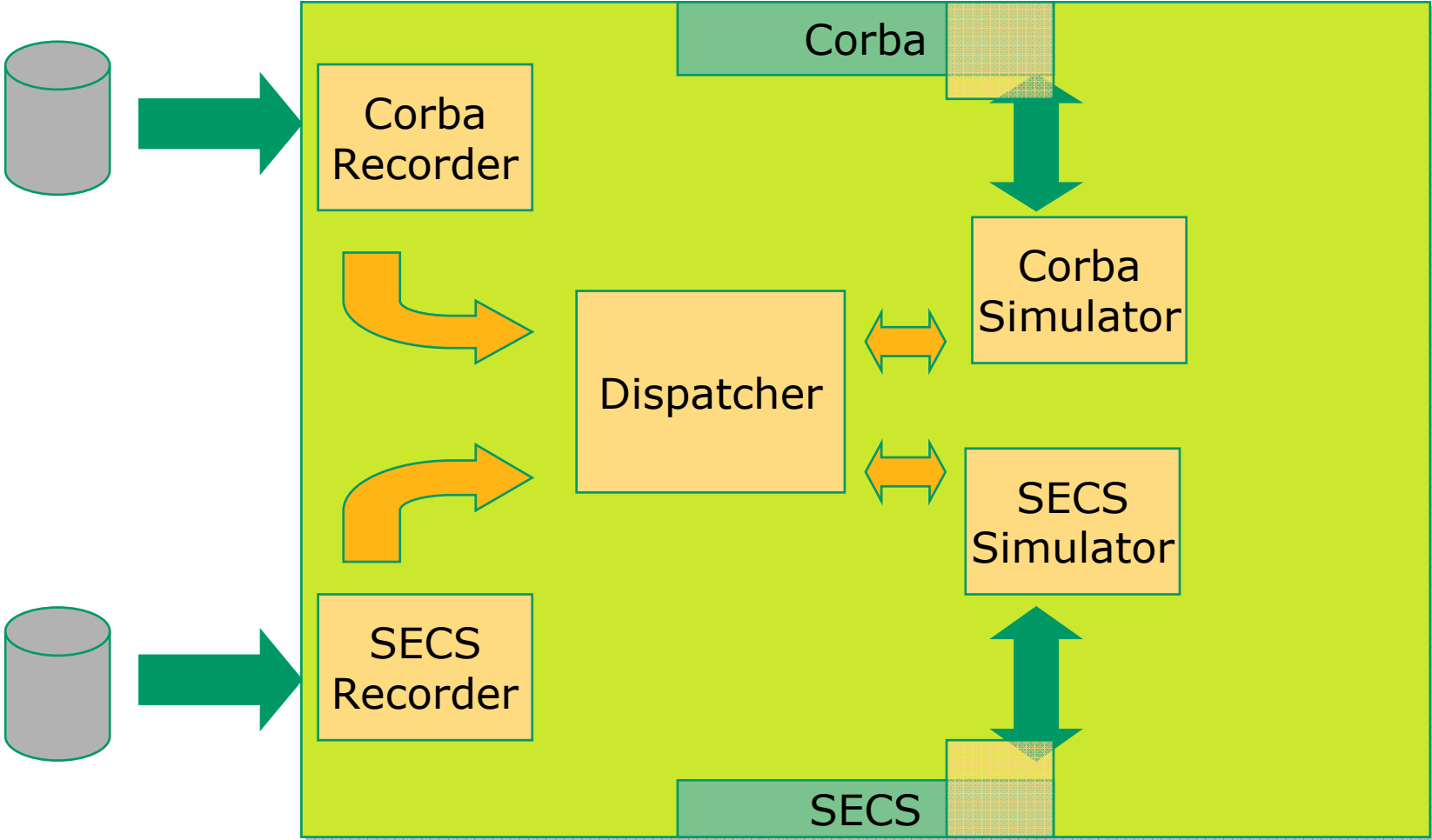
Replaying all messages in recording order

- Merge of all recording files
- Recording order is defined by timestamp
- Out of order messages are possible

Event and Time driven dispatching

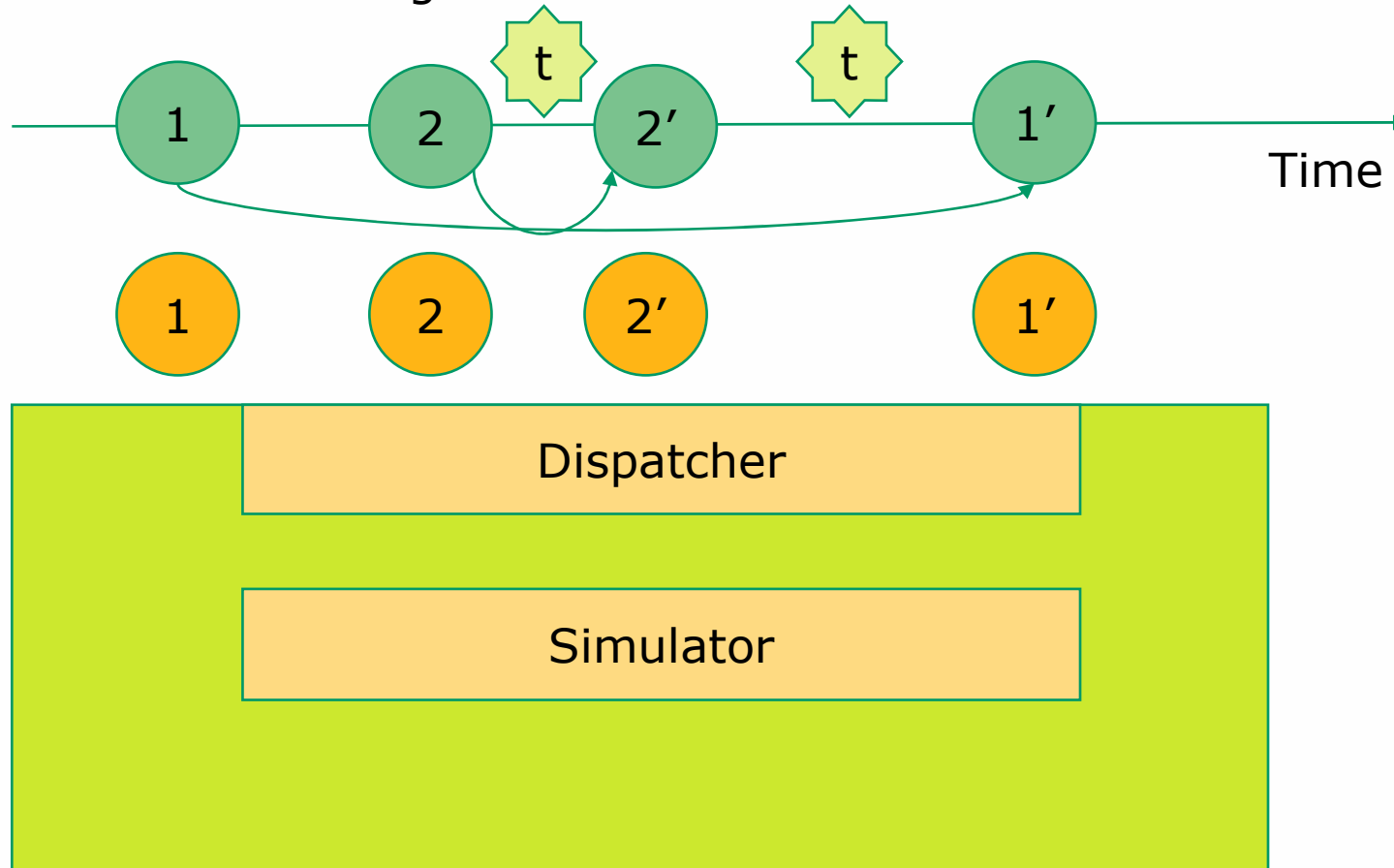
- Event dispatching for interface activity
 - Outgoing messages (Requests and Responses)
- Time dispatching for internal delays
 - Incoming messages (Requests and Responses)

Replay Tool – Simulation Components



Replay Tool – Dispatching

Recorded Message Stream



Replay Tool – Message Order Problem

Order of message sends vs. recorded message order

- Many processes using the same interface
- Execution speed differs from recording to replay machine

Consequences

- Message matching strategy needed
- Allow out-of-order execution
- Time based message triggering need prerequisites

Replay Tool – Message Matching Strategy

Replay messages differs from recorded messages

- Transport protocol using sequence ids
- Messages containing timestamps
- Messages containing timestamp derived identifiers

Message matching strategies

- Use sequence id for request-response matching
- Remove sequence id from Replay-Recording matching
- Remove Timestamps from Replay-Recording matching
- Use recorded timestamps
- Allow out-of-order messages only within a specific window size

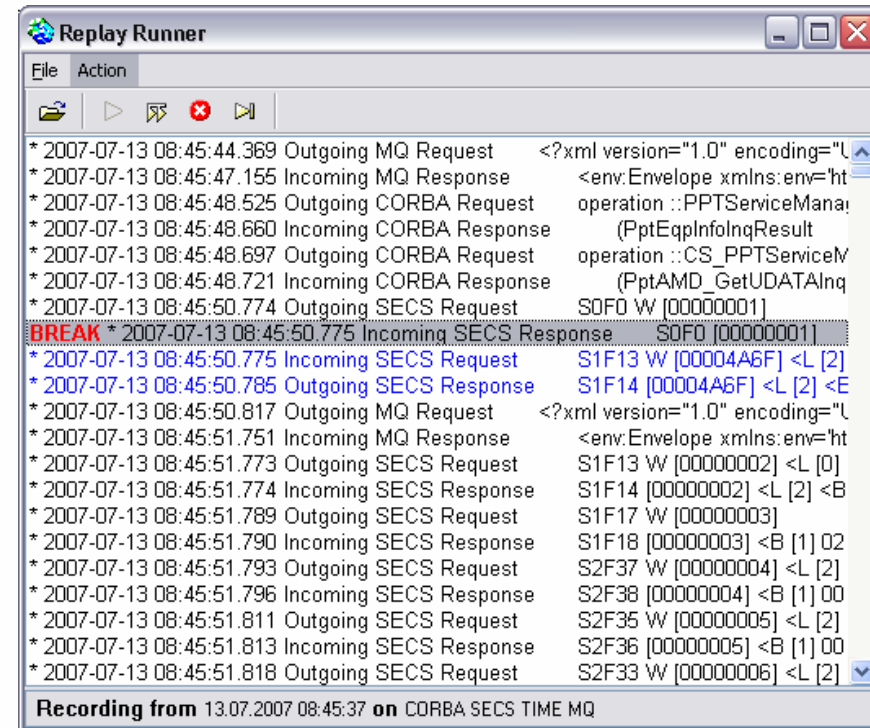
Replay-Tool GUI

Replay control

- Selecting a replay scenario
- Starting and stopping replay
- Pause replay
- Stretching or squeezing
- Proceed immediately
- Set and remove breakpoints

Visualization and inspection

- Preview of messages
- Inspection of raw and decoded messages
- Decoding recorded message format
 - CORBA objects
 - XML nodes



Replay Tool – Challenges

Recognition of recorded messages

- Timestamps, Serial numbers
- Out-of-order messages

Dispatching rules

- Finding the right prerequisites for message dispatching
- Finding the right window size for message lookup

Snapshot of application state

- What is the minimum state?
- When is the right point in time to snapshot
- Stopping application input while writing a snapshot

Memory consumption

- Keeping all recording messages in memory for simulation is expensive

Replay Tool – Status, Experiences, Outlook

Status

- Recording and Replay with limited number of involved interfaces
- Simulation control GUI ready to use
- Snapshot is in development

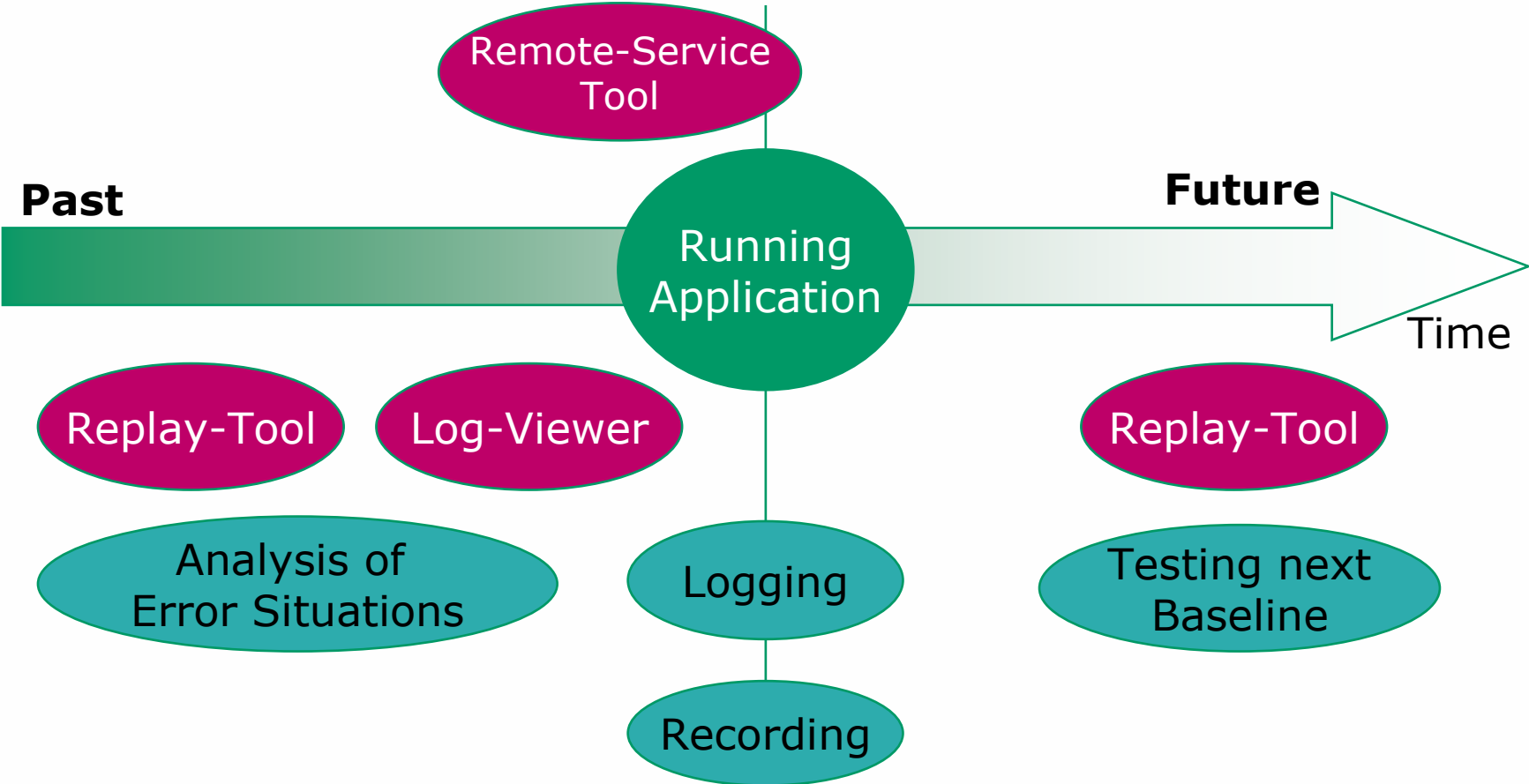
Experiences

- Number of code changes to enable recording differs between interfaces
 - CORBA needs seven code changes
 - MQ needs 10 changes
 - HTTP Opentalk does not need any changes
- Acceleration is limited!
- Detection of simulation parameter need some experiments

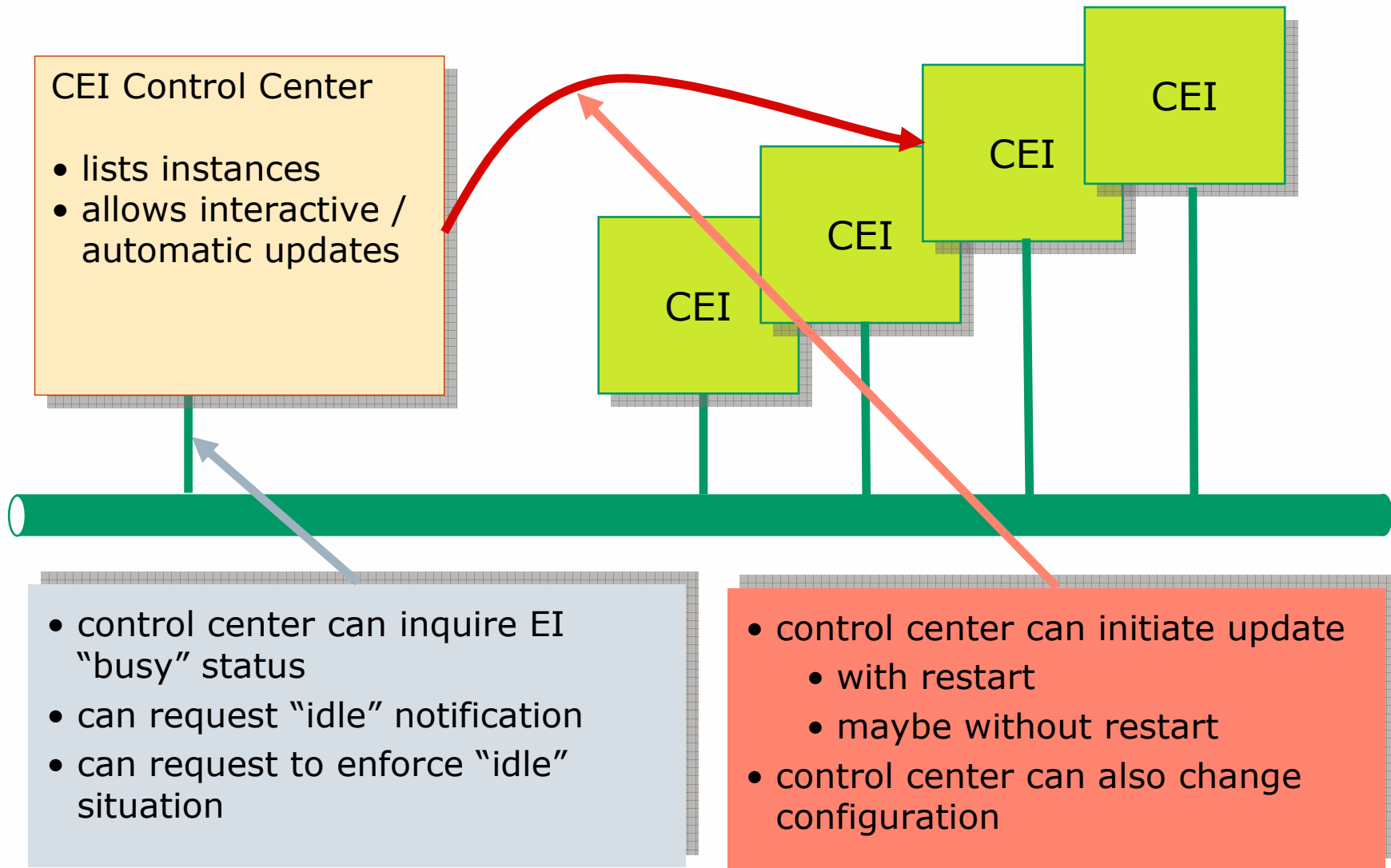
Outlook

- Showing recorded messages in Log-Viewer
- Editing of recoding files

Support Time – Temporal Classification



Visions – Optimized Updates



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