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INCHRON

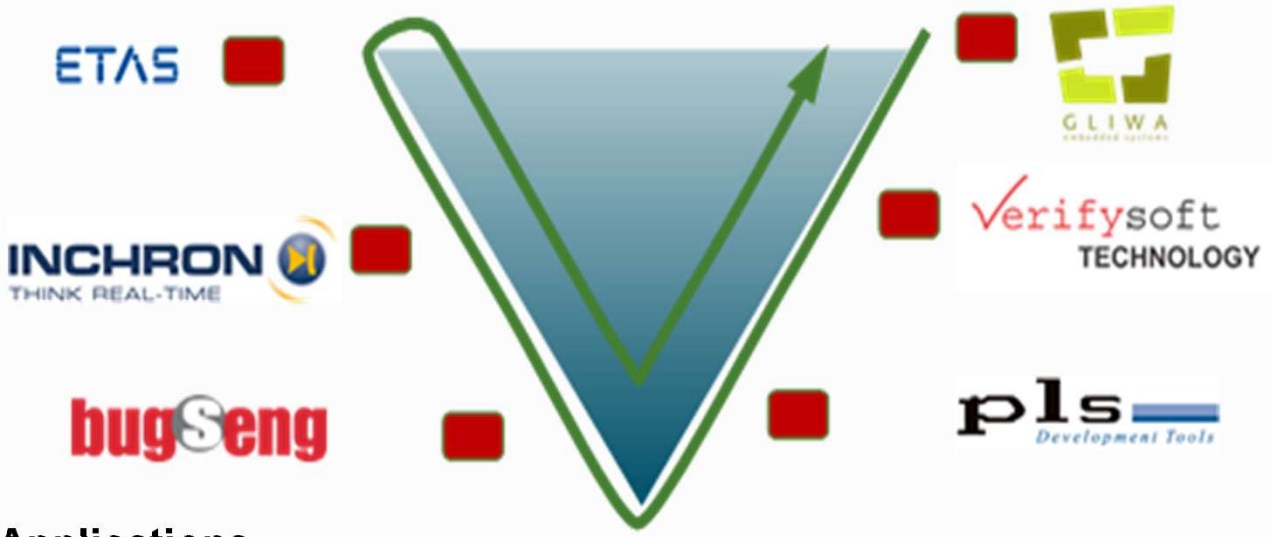
THINK REAL-TIME

Feb. 2020

王治国

北京西能电子科技发展有限公司

Siener Embeded Tools World



Focus Applications：

- ✓ BMS, Inverter and VCU in HEV/EV
- ✓ ECU for Powertrain in Diesel Engine and Gasline Engine
- ✓ ECU for Function Safety (ISO 26262 and IEC 61508）
- ✓ ECU Compliance AUTOSAR
- ✓ ADAS and Fuel Cell Vehicle

INCHRON Tool-Suite Agenda

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INCHRON公司介绍

INCHRON Tool-Suite产品介绍

ChronSIM with INCHRON Tool-Suite

Multi-core in AUTOSAR OS

ADAS Radar Example

The Real-Time Aspect

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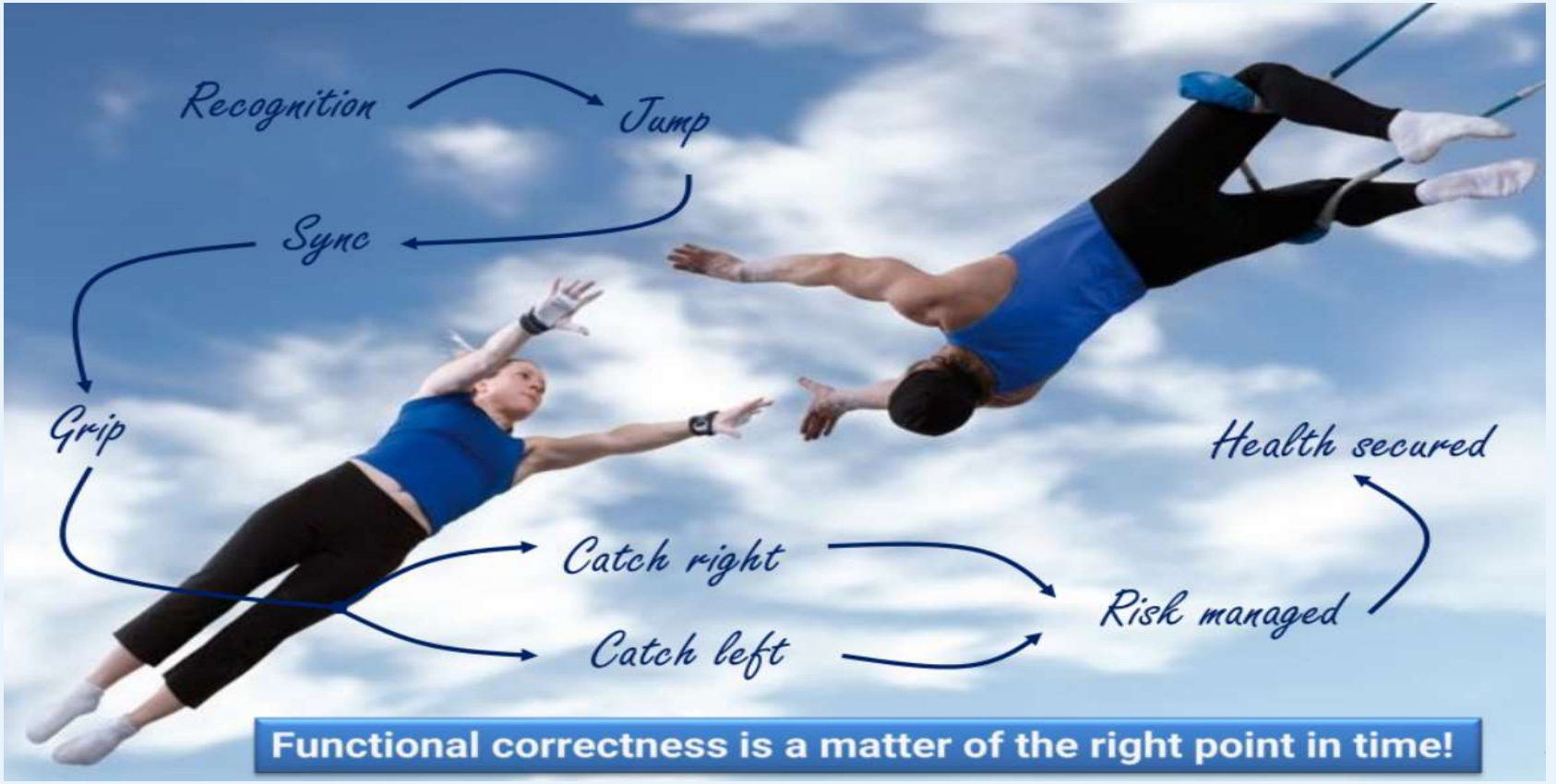

INCHRON From Pioneer to Strong Partner

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INCHRON是全球领先的实时系统架构设计和自动优化解决方案提供商, INCHRON Tool-Suite提供了强大的功能:

- 涵盖了从单核到多核再到多CPU到分布式系统的汽车电气架构
- 建立嵌入式系统架构的设计模型，包括C/C++语言输入
- 基于时间特性仿真，对嵌入式系统的功能和动态性能进行分析，并自动优化
- 支持AUTOSAR Task, runnable, ISR, IOC, Semaphor,Spinlock, 核间任务激活
- 支持Hypervisor, CAN/Ethernet/Flexray
- 支持状态图，甘特图，历史统计，事件链，负荷率、需求图等图形显示
- 支持3rd party trace信息输入，eg. GLIWA T1, PLS trace, Lauterbach Trace
- 支持Python script脚本命令，支持集成IBM Rational DOORS需求管理

Successfully Proven by Our Customers

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Real-Time Solutions

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Seamless Integration of Tools and Services

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INCHRON Tool-Suite Agenda

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Multi-core in AUTOSAR OS

ADAS Radar Example

INCHRON Tool-Suite

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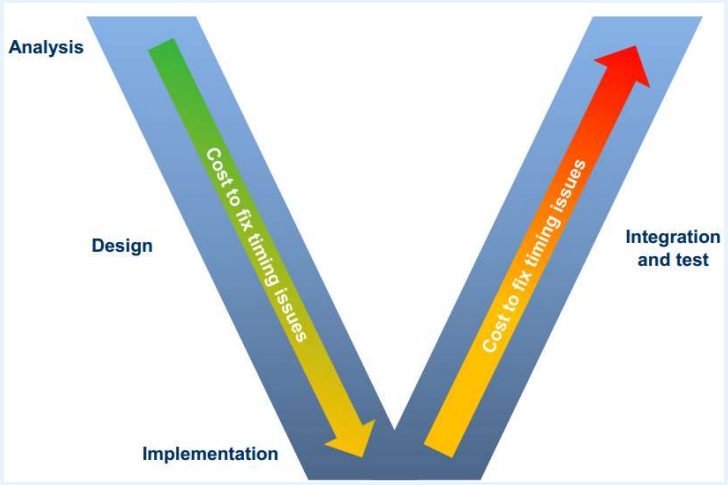
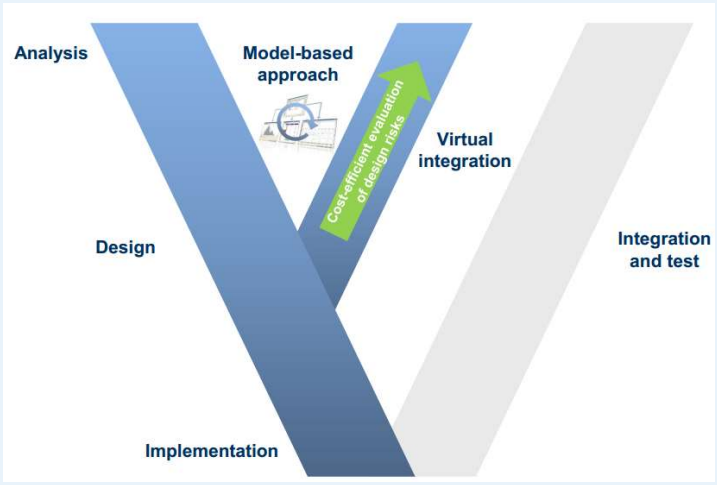
- INCHRON Tool-Suite是一个嵌入式系统的设计、诊断和测试工具
- 基于MS Windows的应用程序
- 在虚拟原型上仿真、分析和深入预测嵌入式系统（含C源代码）的功能和动态行为





INCHRON Tool-Suite的典型用户

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INCHRON Tool-Suite适合以下用户：

- 系统工程师：在嵌入式系统的设计阶段使用INCHRON Tool-Suite来寻找最佳系统架构。
- 开发工程师：在开发阶段使用INCHRON Tool-Suite来分析和优化嵌入式软件或所选软件模块的动态行为。
- 测试工程师：在测试阶段使用INCHRON Tool-Suite验证动态行为，以验证嵌入式系统的实时功能。

INCHRON Tool-Suite的基础专业性：

- 电气工程或计算机科学。
- 熟悉嵌入式系统和C编程语言，以及相应的实践经验

INCHRON Tool-Suite典型应用领域

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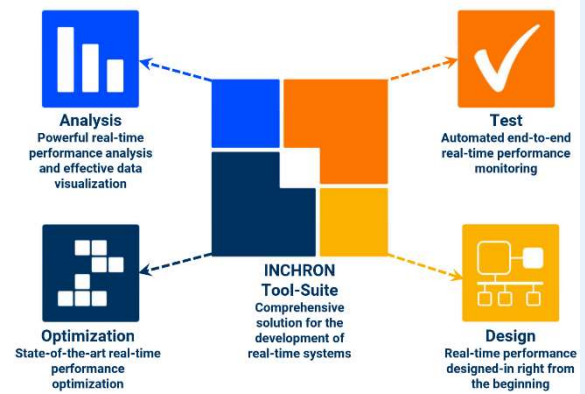

- 设计嵌入式系统
  - 设计时间预算、系统需求和初始软件架构
  - 仿真和分析，对系统功能和动态性能进行评估
- 嵌入式软件的分析与测试
  - 优化架构后，编写代码替代软件架构的时间预算
  - 分析系统动态行为，预防时间问题，优化并验证系统需求
- 已有代码的重用
  - 将已有代码和新的架构集成，评估已有代码在新的系统架构中的效果
- 嵌入式系统的扩展功能的评估
  - 容易改变系统设置和变量值
  - 避免扩展功能对系统功能和动态性能的不利影响

Safety-Critical Systems: Design Challenges

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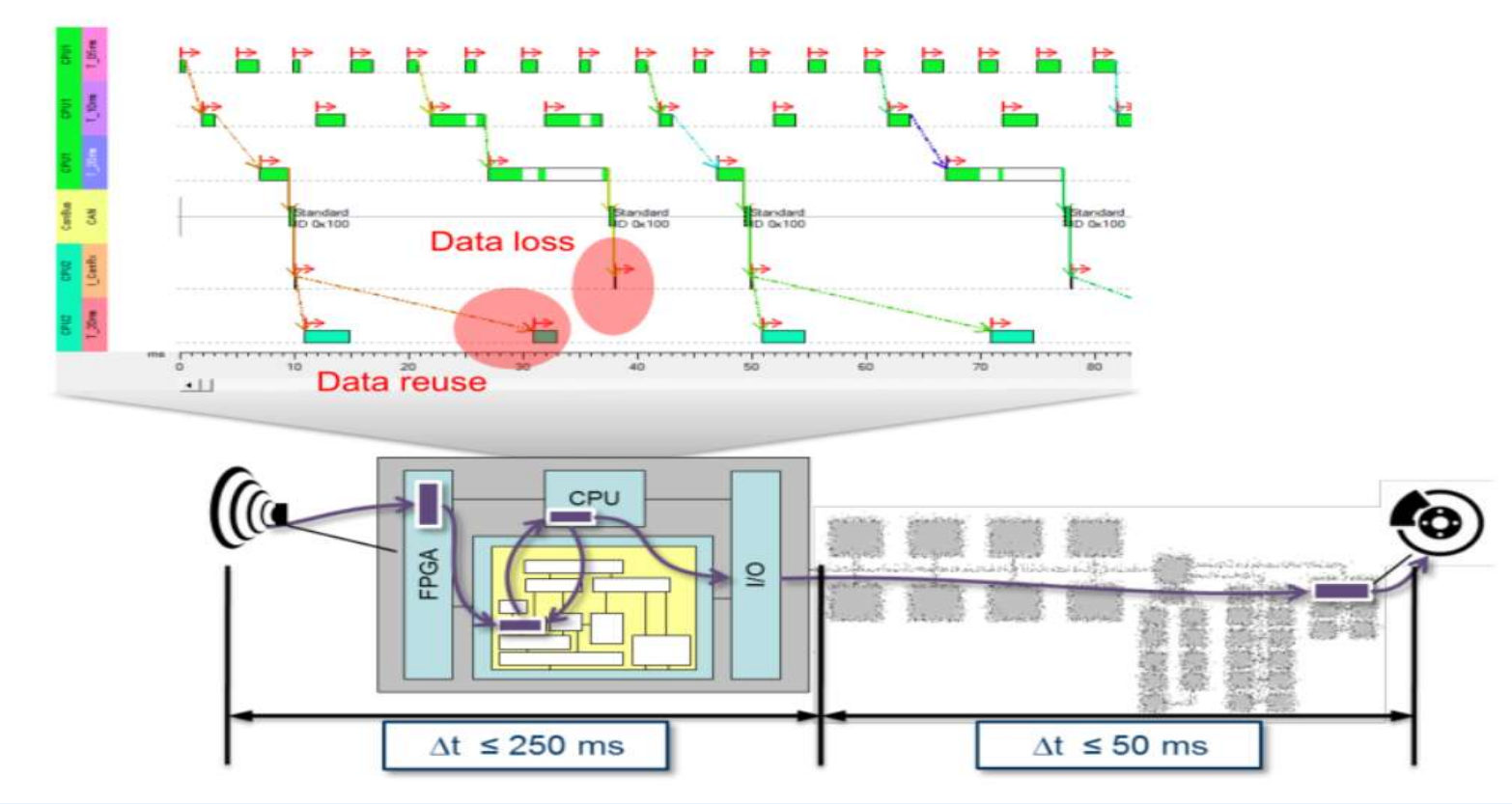

ISO 26262 Part 4 and 6 Recommend Simulation

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Table 3 — System design verification

	Methods	ASIL			
		A	B	C	D
1a	System design inspection[a]	+	++	++	++
1b	System design walkthrough[a]	++	+	o	o
2a	Simulation[b]	+	+	++	++
2b	System prototyping and vehicle tests[b]	+	+	++	++
3	System design analyses[c]	see Table 1			

[a] Methods 1a and 1b serve as a check of complete and correct implementation of the technical safety requirements.

[b] Methods 2a and 2b can be used advantageously as a fault injection technique.

[c] For conducting safety analyses, see ISO 26262-9:2011, Clause 8.

ISO 26262 Part 4 and 6 Recommend Simulation

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Table 6 — Methods for the verification of the software architectural design

	Methods	ASIL			
		A	B	C	D
1a	Walk-through of the design[a]	++	+	o	o
1b	Inspection of the design[a]	+	++	++	++
1c	Simulation of dynamic parts of the design[b]	+	+	+	++
1d	Prototype generation	o	o	+	++
1e	Formal verification	o	o	+	+
1f	Control flow analysis[c]	+	+	++	++
1g	Data flow analysis[c]	+	+	++	++

[a] In the case of model-based development these methods can be applied to the model.

[b] Method 1c requires the usage of executable models for the dynamic parts of the software architecture.

[c] Control and data flow analysis may be limited to safety-related components and their interfaces.

INCHRON Tool-Suite工具套件的主要license

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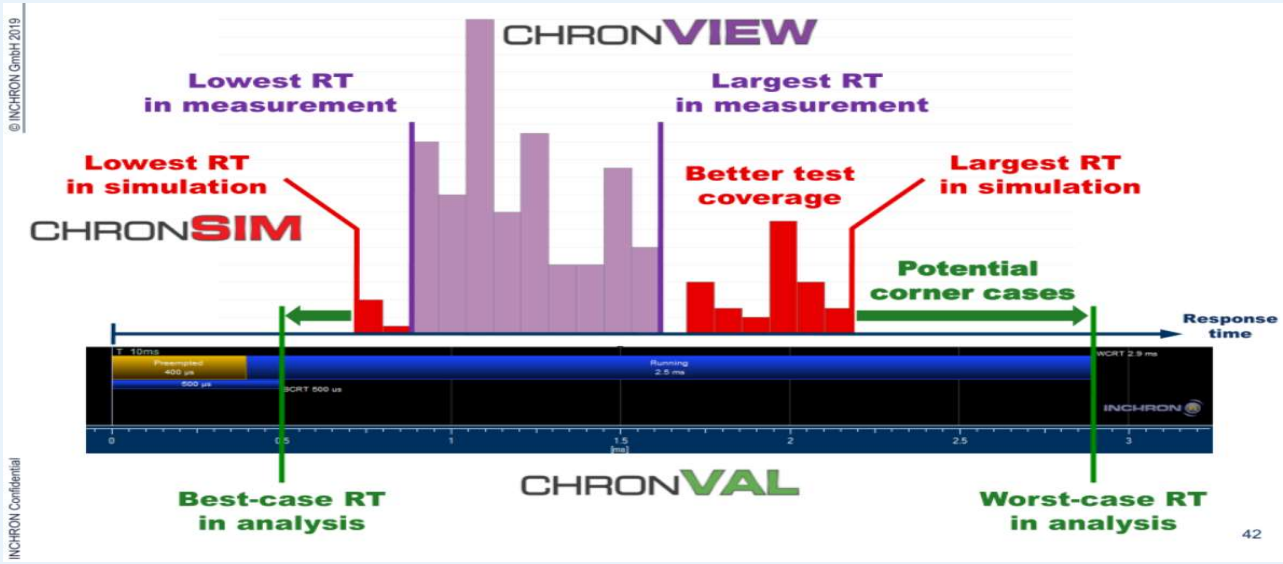
- CHRONSIM
- CHRONVAL
- CHRONVIEW
- CHRONOPT
- CHRONBUS



- 单机版
- 浮动版
- 年软件升级和技术服务

INCHRON Tool-Suite 公开应用手册

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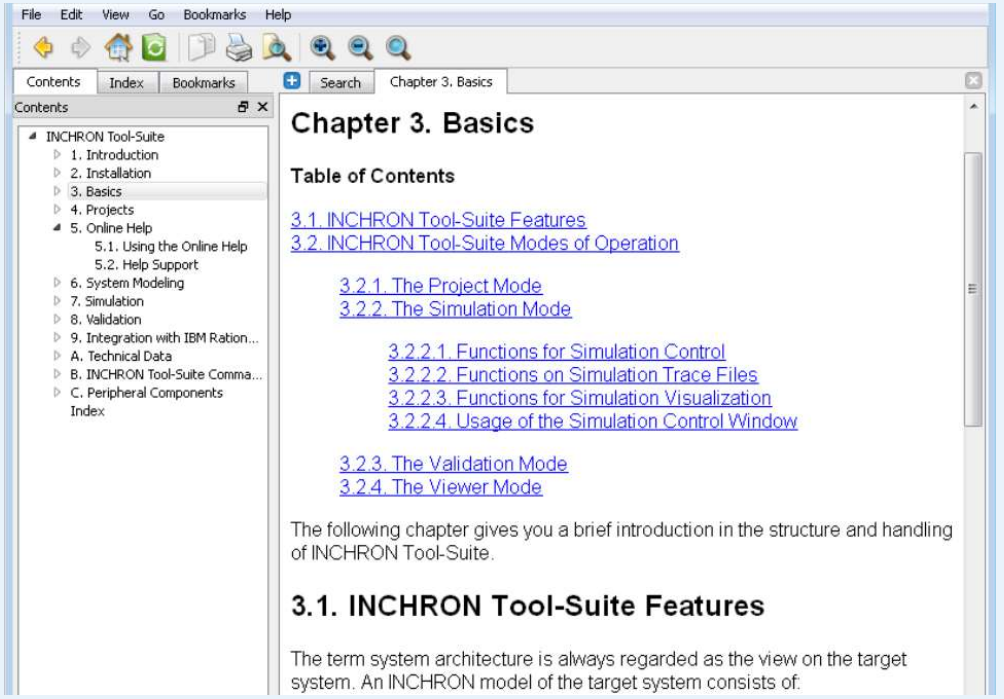
- User Manual _ INCHRON Tool-Suite Software Version 2.9
- AN001 Reference Manual of Macros and Functions
- AN003 Importing Trace Files with chronVIEW
- AN002 User Defined Schedulers
- Online help

- Examples
  - doc\examples 安装文件夹下

- Demo
  - AUTOSAR OS
  - Multi-Cor Optimization
  - ADAS Radar SDF



使用INCHRON Tool-Suite工具流程

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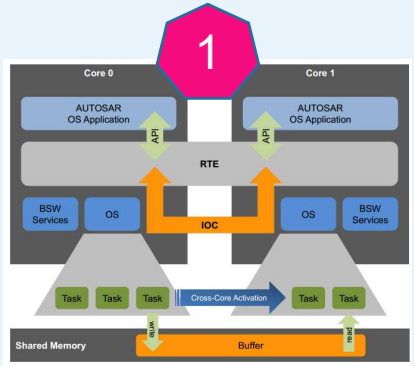

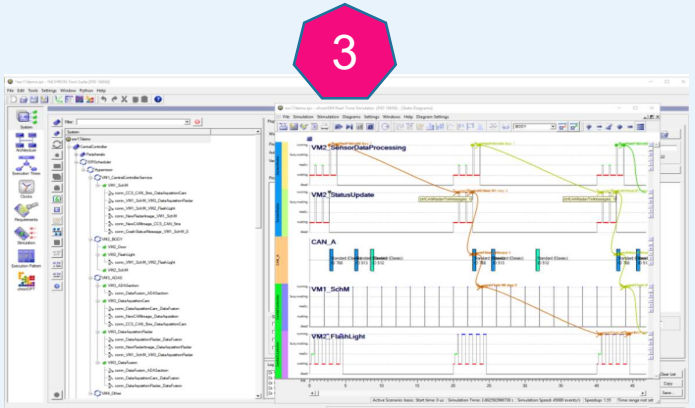

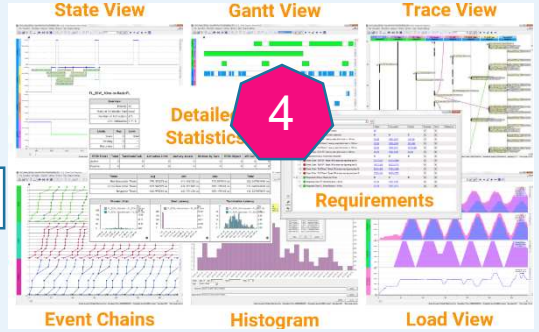

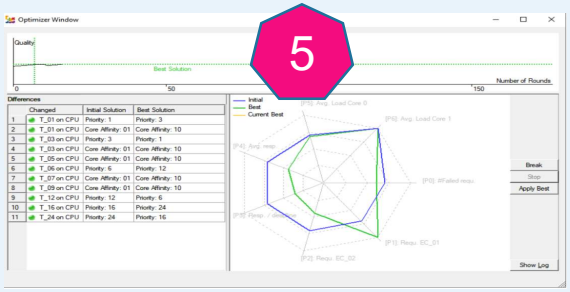

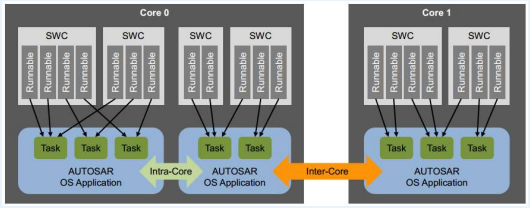

INCHRON Tool-Suite各文件格式

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- *.IPR –INCHRON Project file
- *.ISM--INCHRON Target Models file
- *.ISL--Stimulation Scenarios file
- *.IRQ--Requirements file
- *.IVP--View Profiles file
- *.CSV or *.TXT--Stimulation Data file

- *.ISF-- INCHRON simulation trace data
- *.ITA--INCHRON Trace Archive
- *.IDX--INCHRON simulation trace index data

- *.HTML, *.CSV, *.CVR, *.IPR--File Format for Reports

- *.EPS, *.JPG, *.PNG, *.PS, *.TIF--Graphic Formats

使用INCHRON Tool-Suite工具套件的好处

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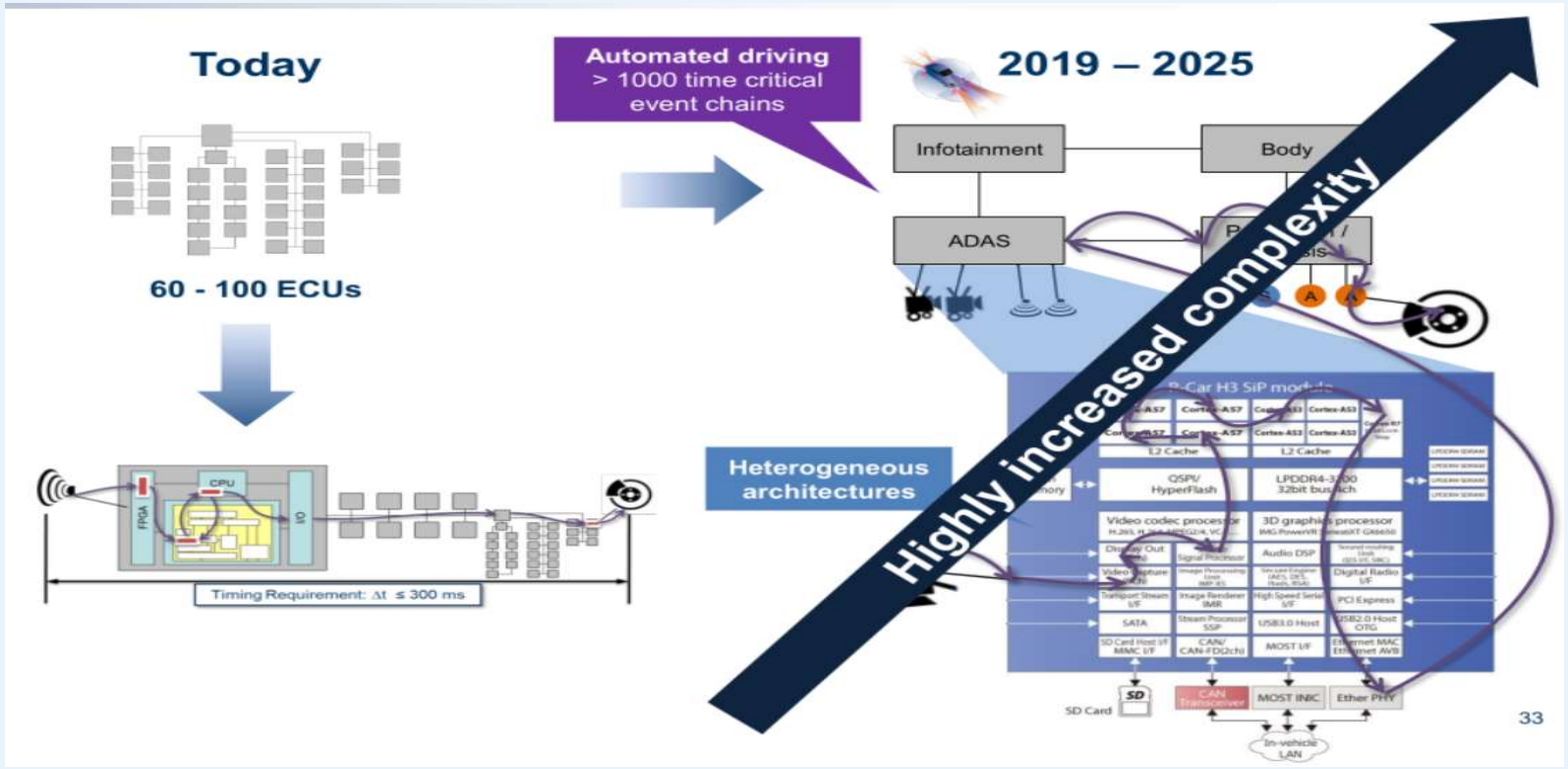
未来汽车电子构架会走向更集成化：



使用INCHRON Tool-Suite工具套件的好处

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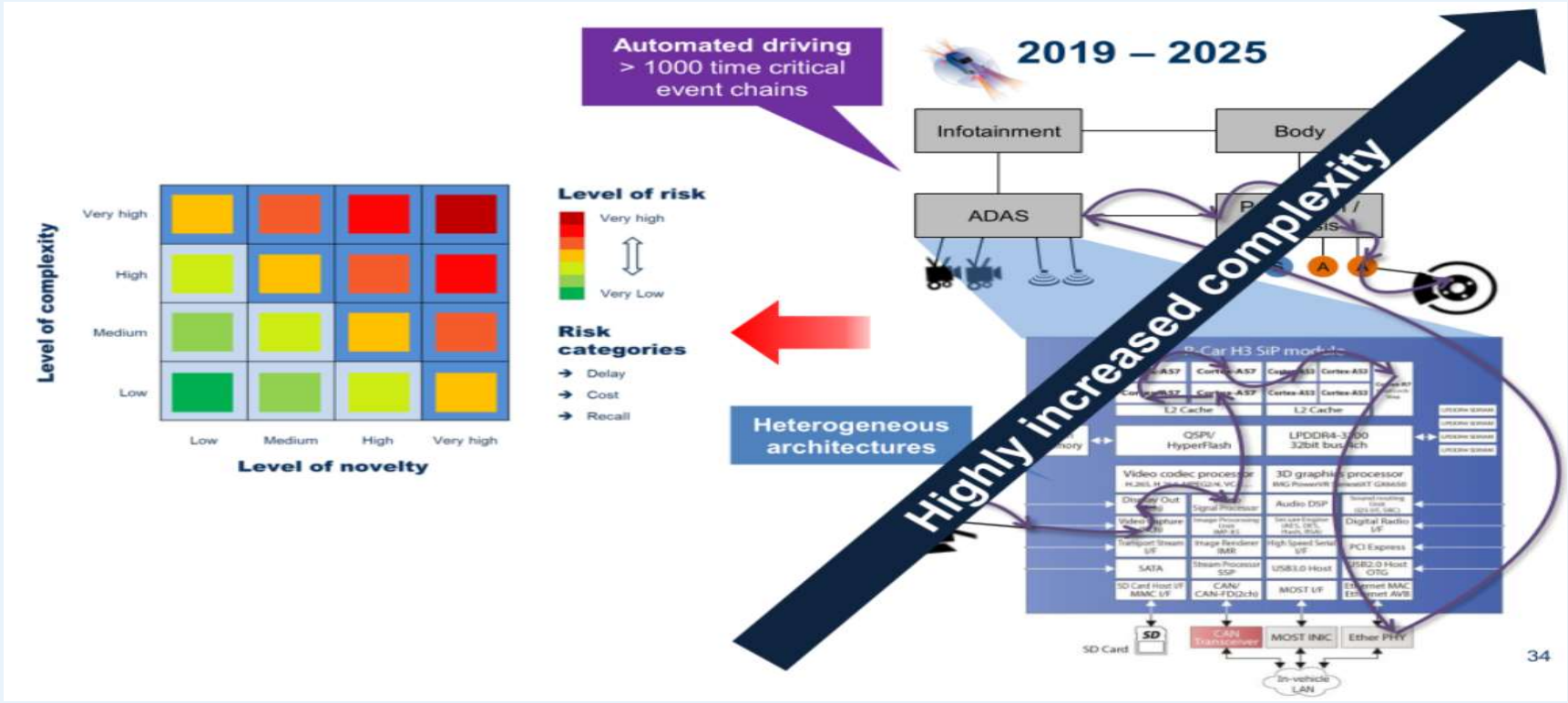
项目风险评估越来越高：



使用INCHRON Tool-Suite工具套件的好处

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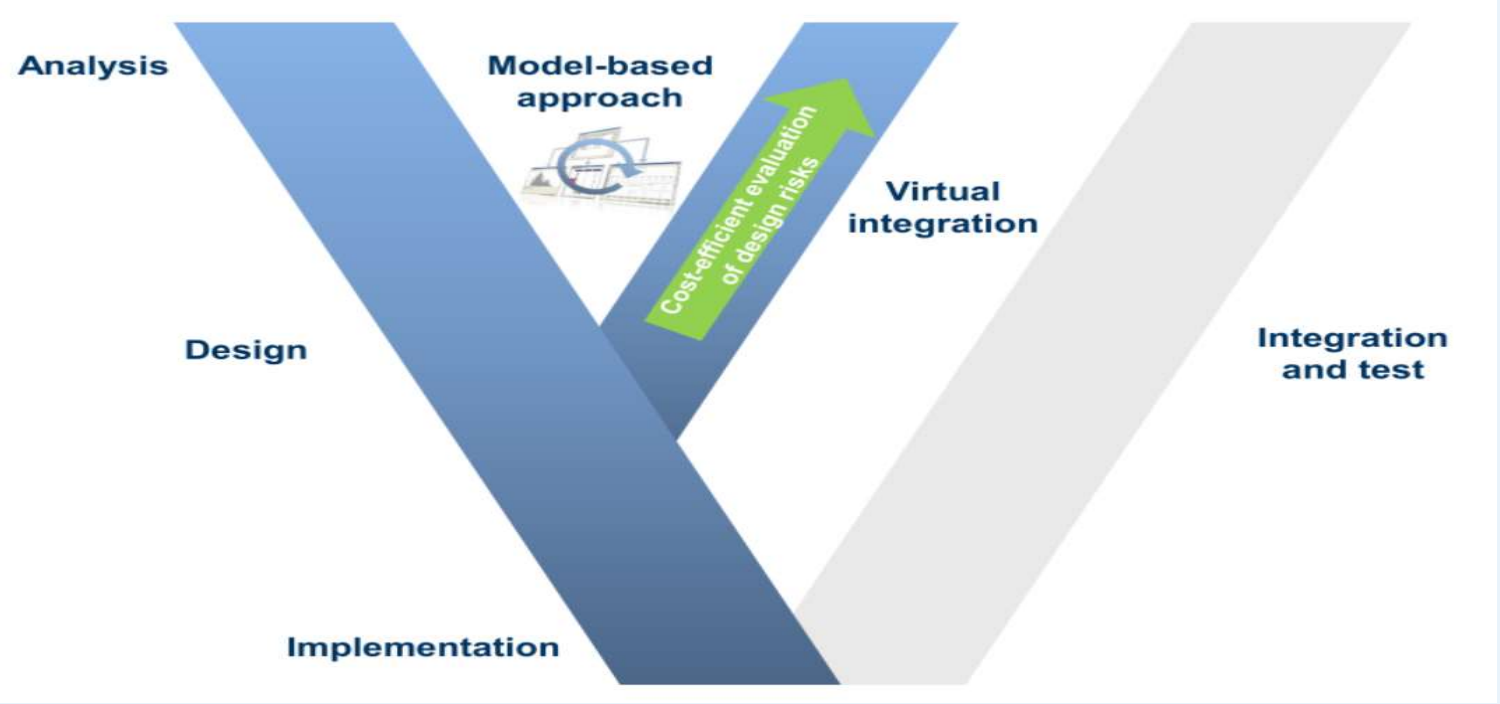
通过INCHRON Tool-Suite工具套件可以在早期就能检查出时间错误：



INCHRON Tool-Suite工具套件的好处

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INCHRON Tool-Suite使您及早能够识别时间问题，并消除设计缺陷，从而带来以下受益：

- 缩短产品上市时间
  在构建真正的原型之前，INCHRON Tool-Suite使系统工程师在开发过程中尽早分析、优化和验证设计，减少重新设计，直接缩短产品上市时间。
- 减少研发支出
  工程师可以分析和优化设计，而无需构建原型，减少重新设计，避免项目延迟和缩短产品上市时间，会直接减少研发成本。
- 降低产品成本
  INCHRON Tool-Suite可在不同的硬件架构上模拟嵌入式软件，使工程师能够选择最具成本效益的设计。
- 降低产品召回风险
  通过避免实时问题提高了嵌入式系统的质量。工程师可以在开发阶段检测并消除实时问题，从而大大降低产品召回的风险。
- 新产品功能的影响
  INCHRON Tool-Suite可以快速回答是否可以将新功能集成到现有系统架构中，还是需要进行重大调整。

Design: Example

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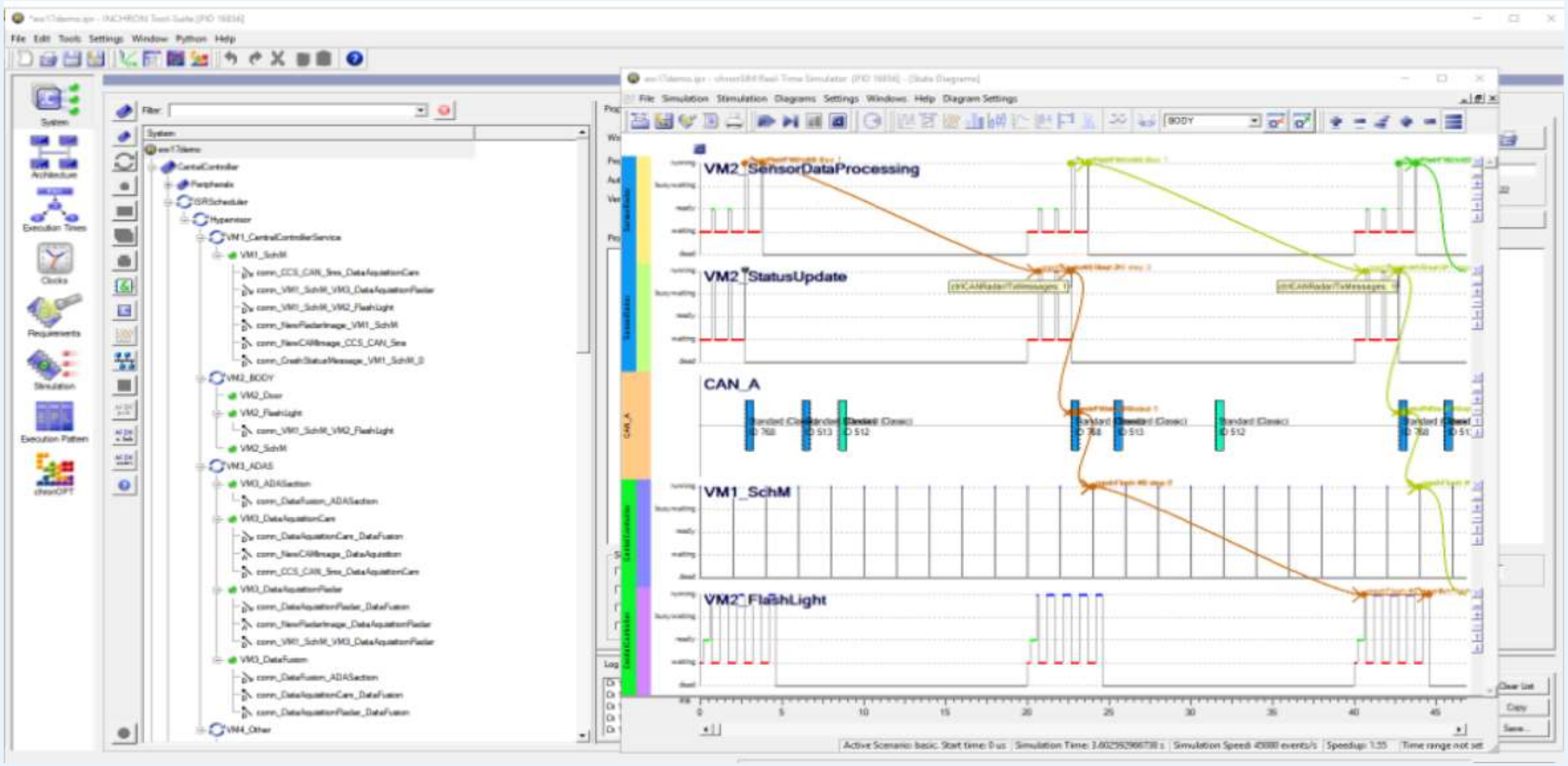

Visualization & Analysis Deliver Deep Insights

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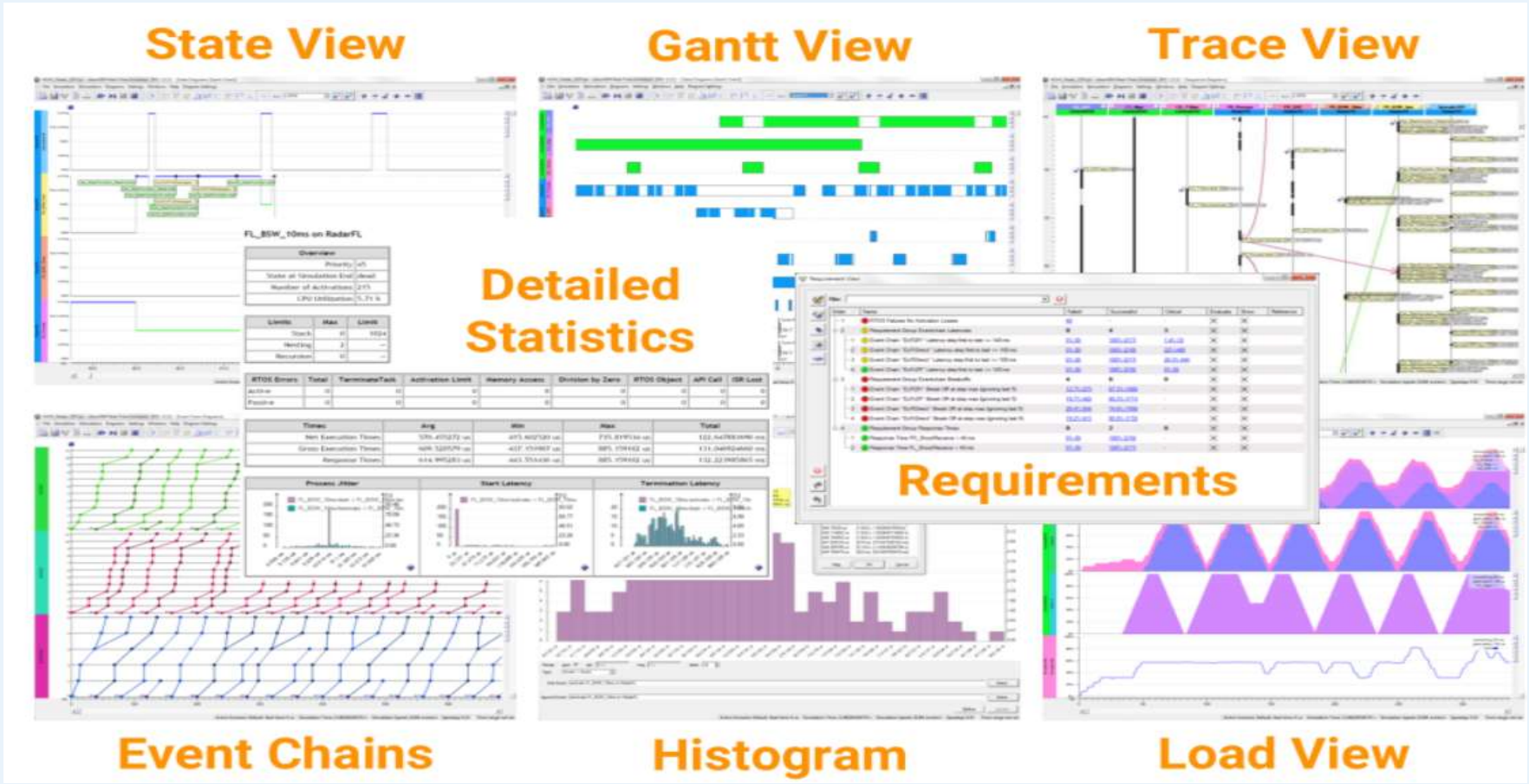

Optimization (Example)

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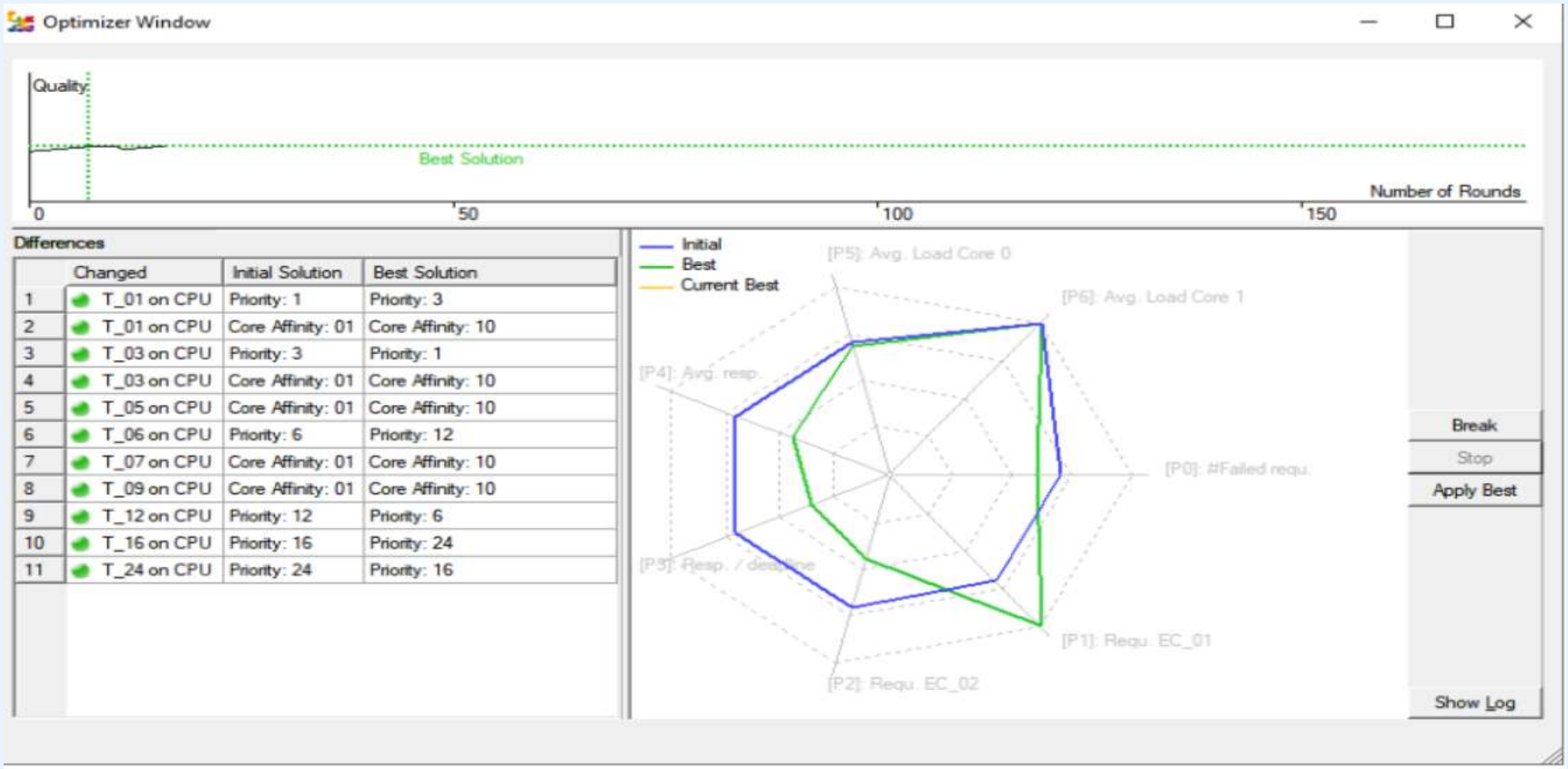

ADAS--Heterogenous Distributed Systems

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Analyzing Distributed Systems Comprising Hypervisors

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INCHRON Agenda

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ChronSIM with INCHRON Tool-Suite

Multi-core in AUTOSAR OS

ADAS Radar Example

ChronSIM: Simulation Feature Overview

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Scheduling

- OSEK, AUTOSAR OS, cooperative / preemptive, fixed-priority, round robin with time slices, EDF, TDMA, Thread X, ARINC 653
- Dedicated scheduling API for the definition of any custom scheduling algorithm

Simulation / Worst-case analysis

- Full support of multi-core and multi-MCU systems
- Multiple non-synchronized time bases
- CAN, Flexray, LIN, Ethernet (with TCP/UDP over IP and QoS), AS5643, AFDX, SPI, UART
- chronSIM fully supports C/C++ as a modeling language and provides various APIs for the definition of customer specific models
- Stochastical distribution models for CET and stimulation
- Fault injection

Requirements

- Formalized timing requirement definitions
- Event chains

INCHRON Tool-Suite:chronSIM

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ChronSIM: Abstraction level

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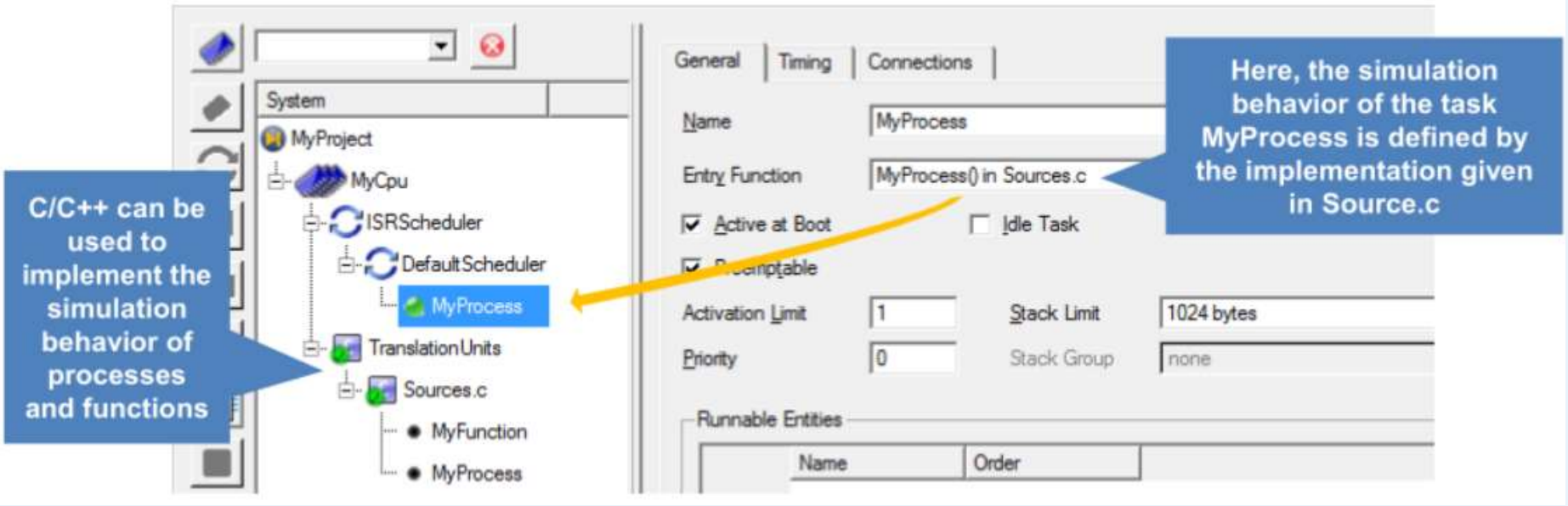
A chronSIM model can comprise different levels of abstraction:

– Tasks and ISRs

– Tasks, ISRs, and Runnables (basically first-level functions under a task or ISR)

– Tasks, ISRs, and Runnables with C/C++ implementation

These abstraction levels can be combined as required by the progress of a project and the availability of sophisticated model information.



ChronSIM: Abstraction level

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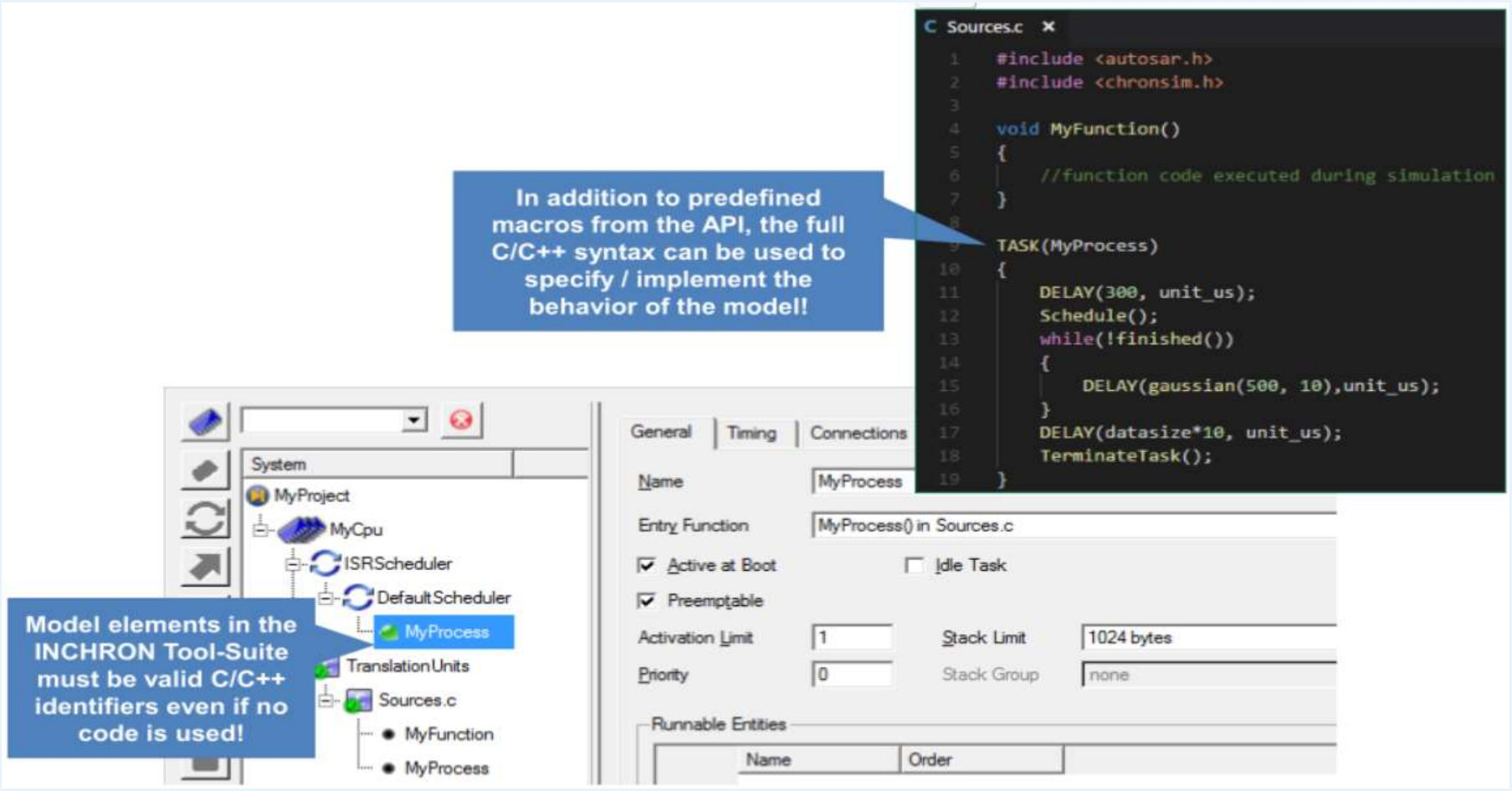

ChronSIM: Abstraction level

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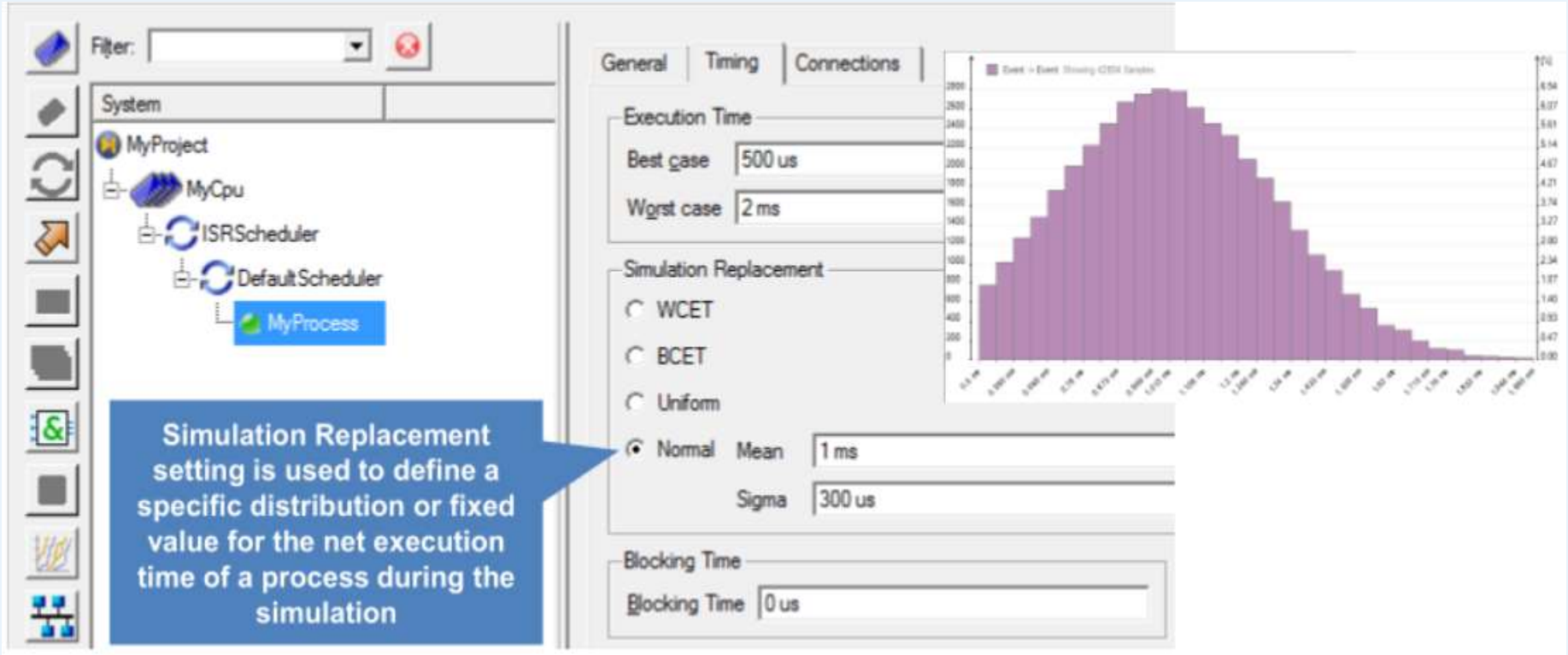
If no implementation is provided, the real-time simulation behavior is determined by the settings in the Timing tab:



ChronSIM: Execution time distribution

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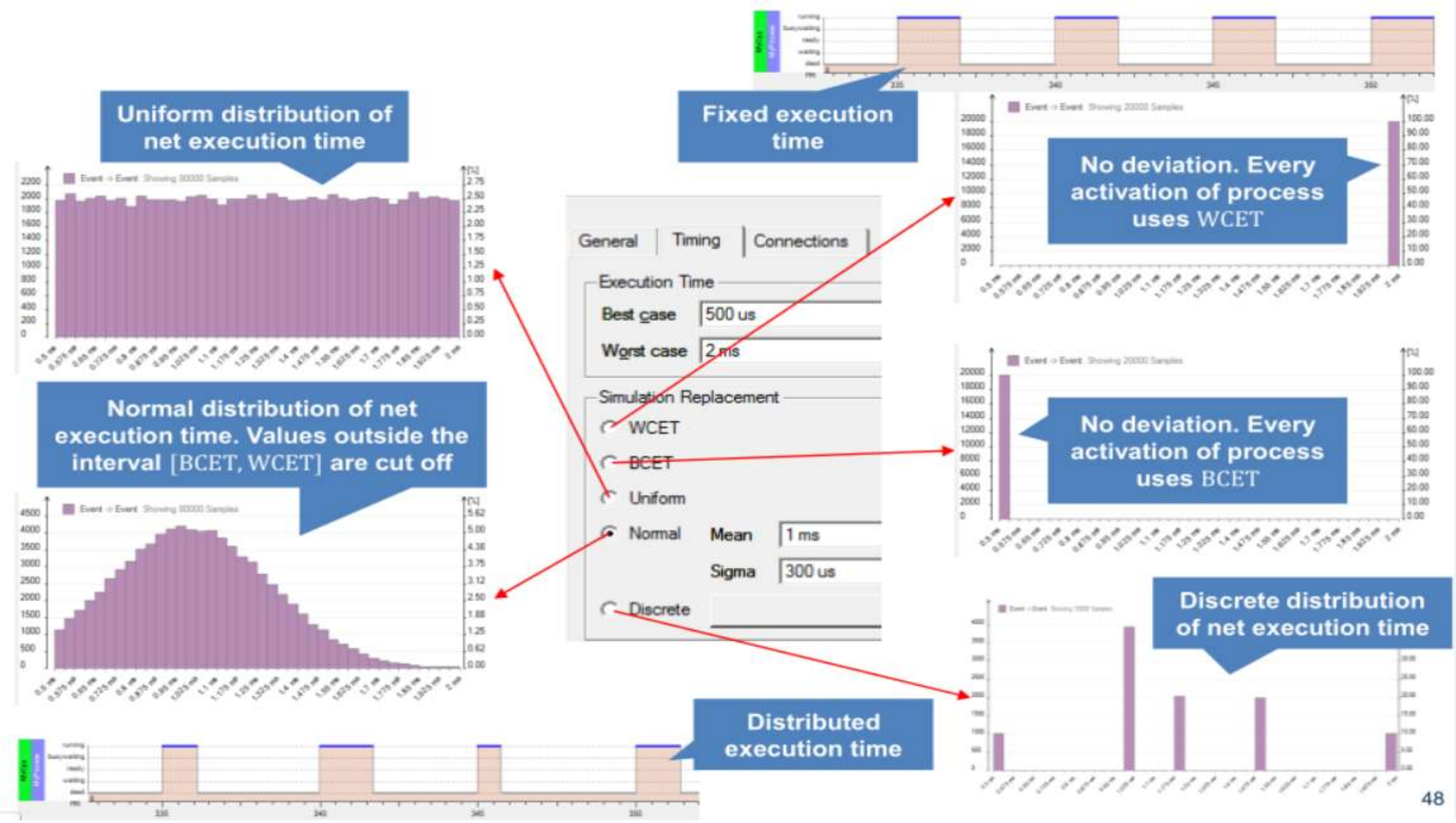

ChronSIM: Stimulation scenarios

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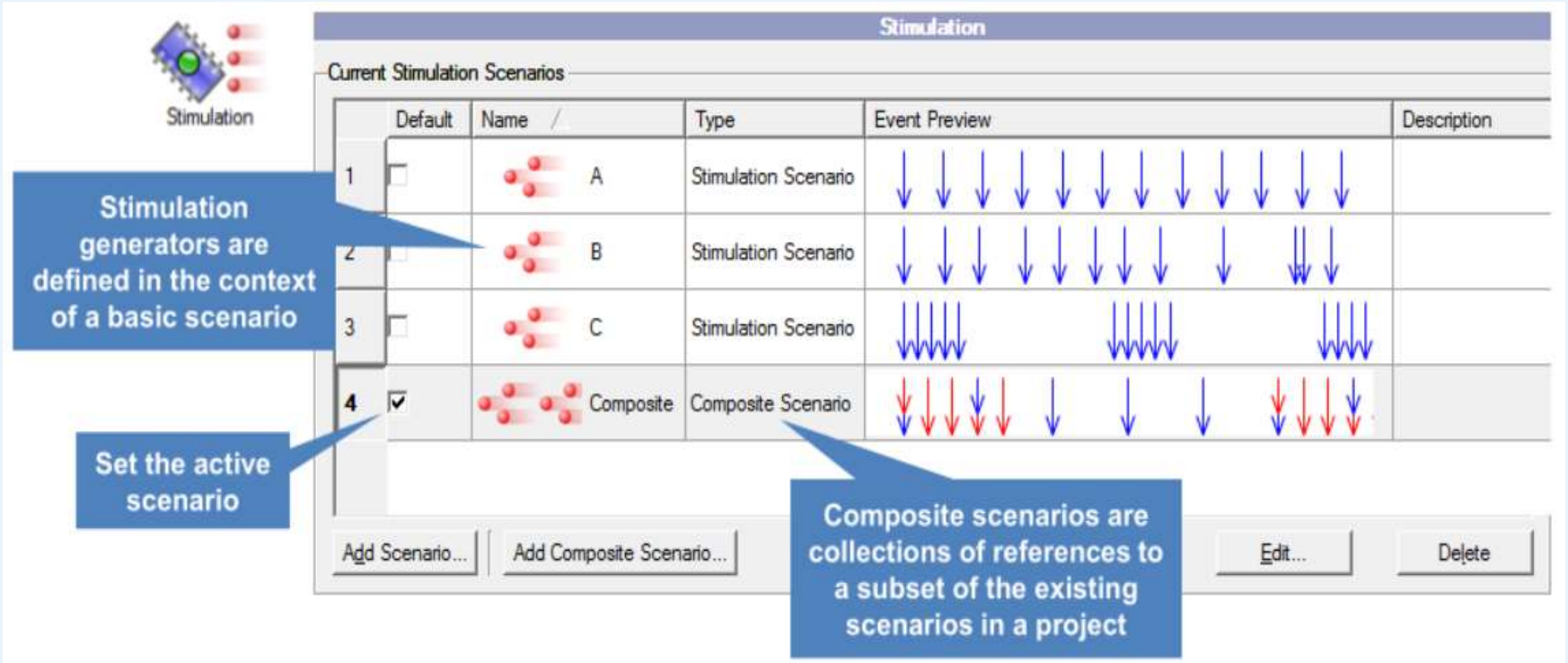
A Tool-Suite project can contain multiple stimulation scenarios.
In order to use several scenario definitions at the same time, a composite scenario must be defined.



ChronSIM: Stimulation dialog

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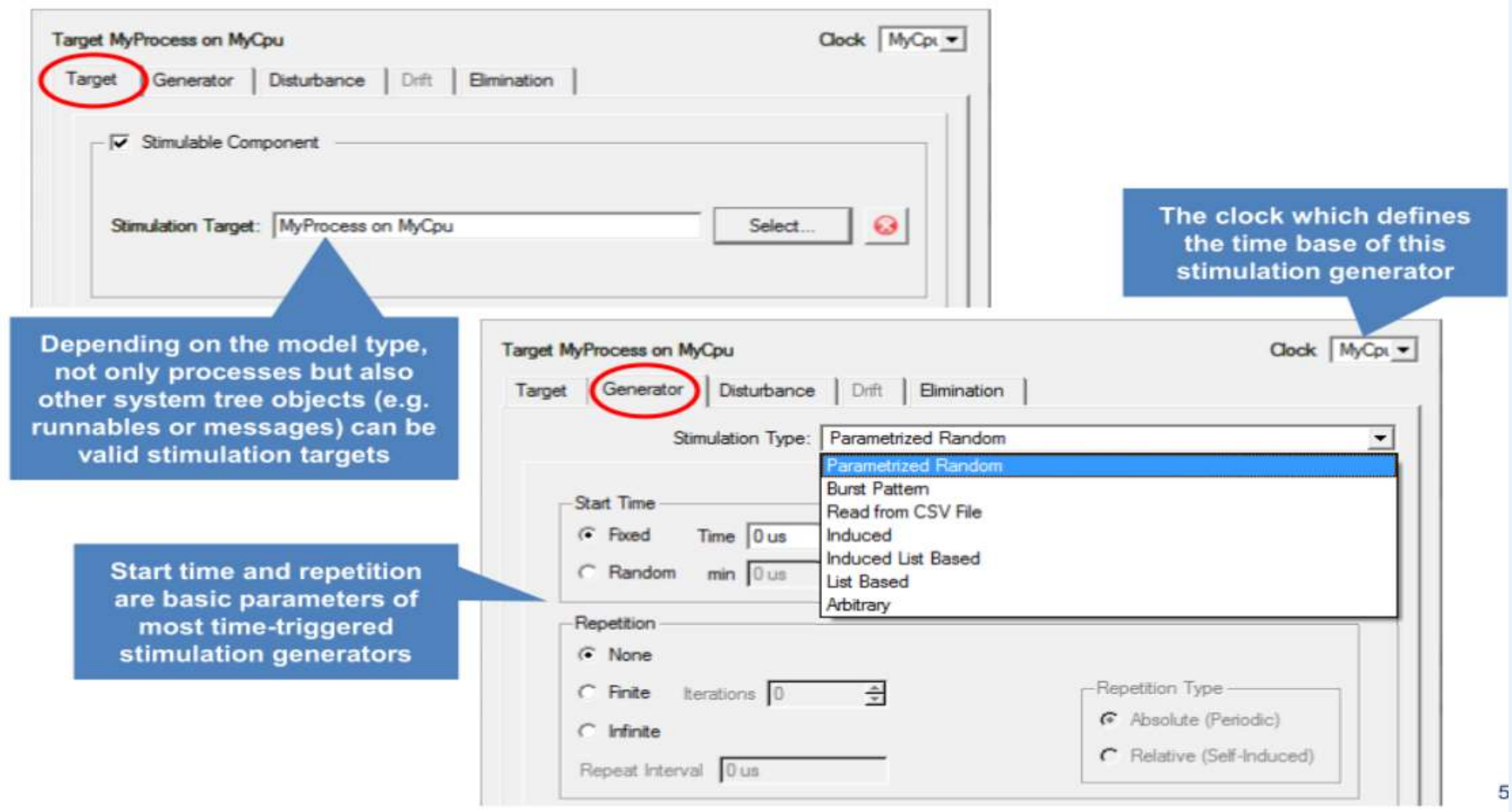

ChronSIM: Parametrized random stimulation

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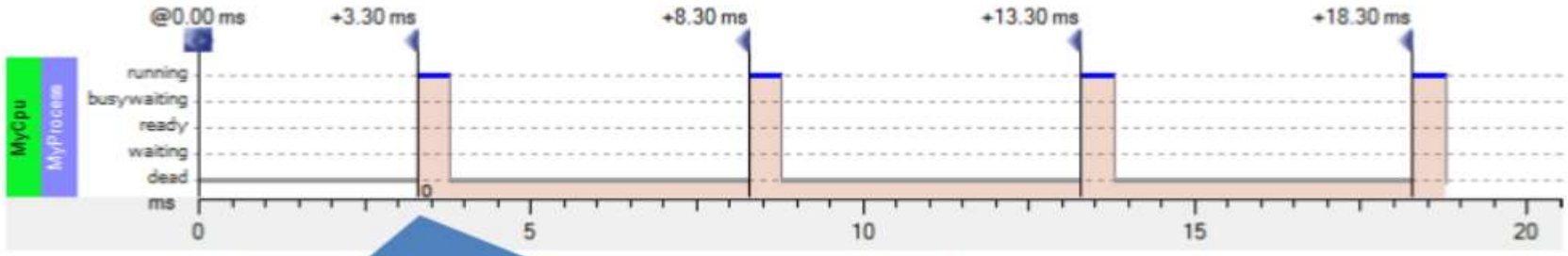

Fixed start time of 3.3 ms, finite repetition with 3 iterations, and repeat interval of 5 ms

Stimulation Type: Parametrized Random

Start Time
- Fixed — Time: 3.3 ms
- Random — min: NaN — max: NaN

Repetition
- None
- Finite — Iterations: 3
- Infinite

Repeat Interval: 5 ms

Repetition Type
- Absolute (Periodic)
- Relative (Self-Induced)

Stimulation generators with infinite repetition will keep activating the target process until the simulation is halted manually

ChronSIM: Absolute (periodic) with normal distribution

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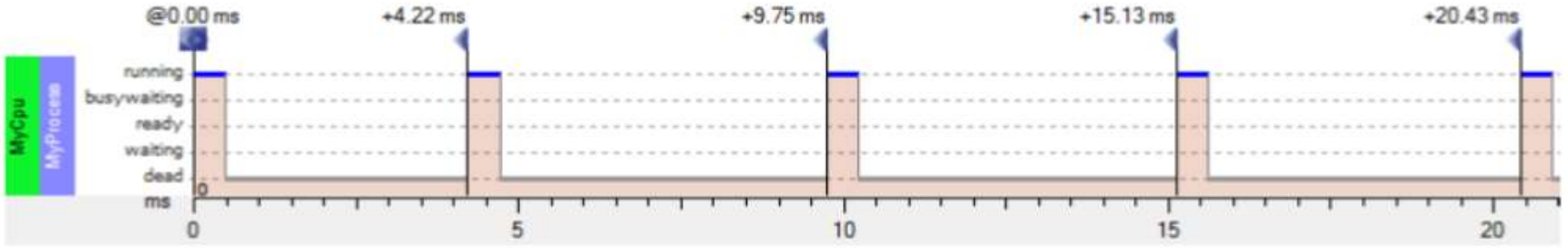


Repetition

None

Finite Iterations 0

Infinite

Repeat Interval 5 ms

Repetition Type

Absolute (Periodic)

Relative (Self-Induced)

The repeat interval is also the mean value for the normal distribution

Random Variation

None

Normal sigma 500 us

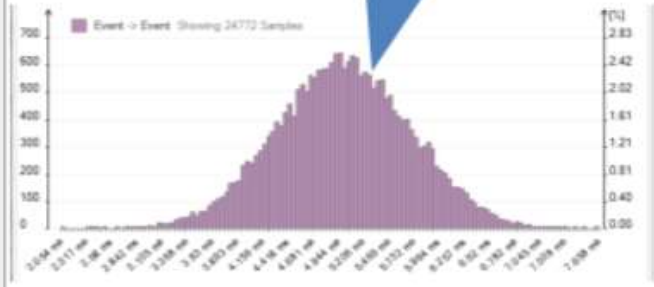
Uniform min max

Limitation

Minimum Inter Arrival Time 1 ms

The minimum time distance between two consecutive activations

Resulting distribution of stimulation events



ChronSIM: Burst pattern

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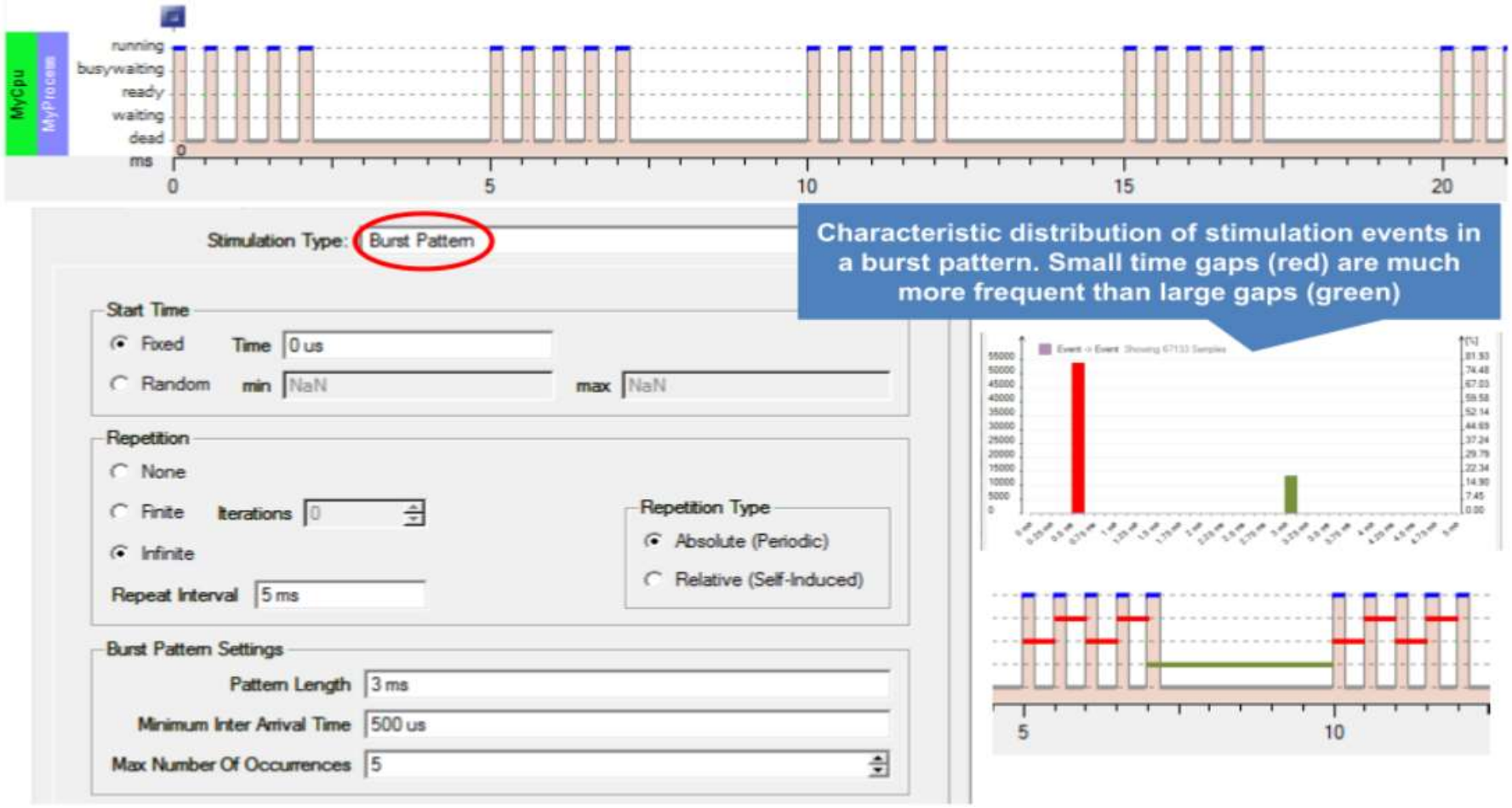

ChronSIM：Induced list based stimulation

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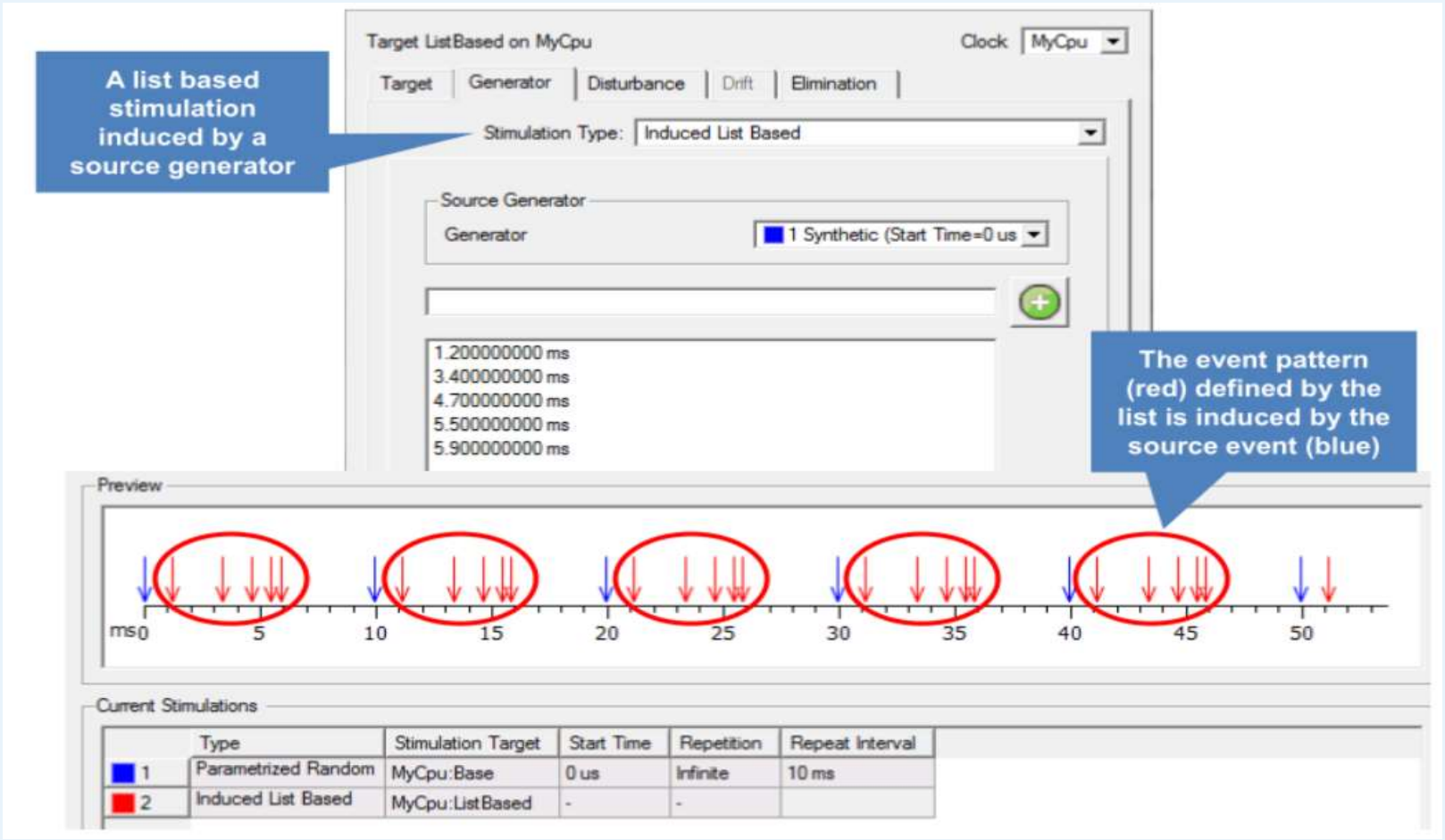
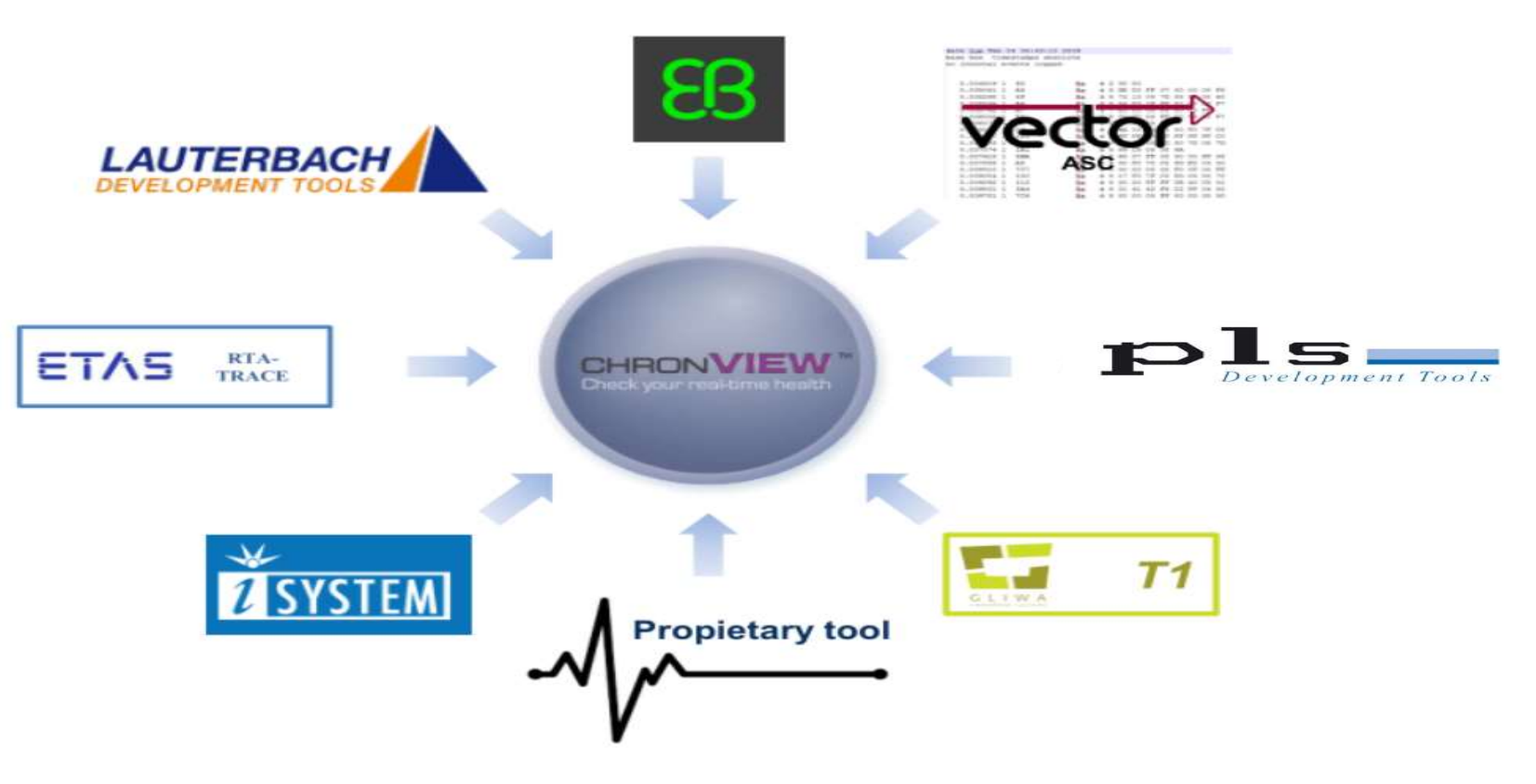


Import execution time and stimulation information from trace and debug tools



ChronSIM： Fixed-priority preemptive scheduling

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ISRs always have a higher priority level.

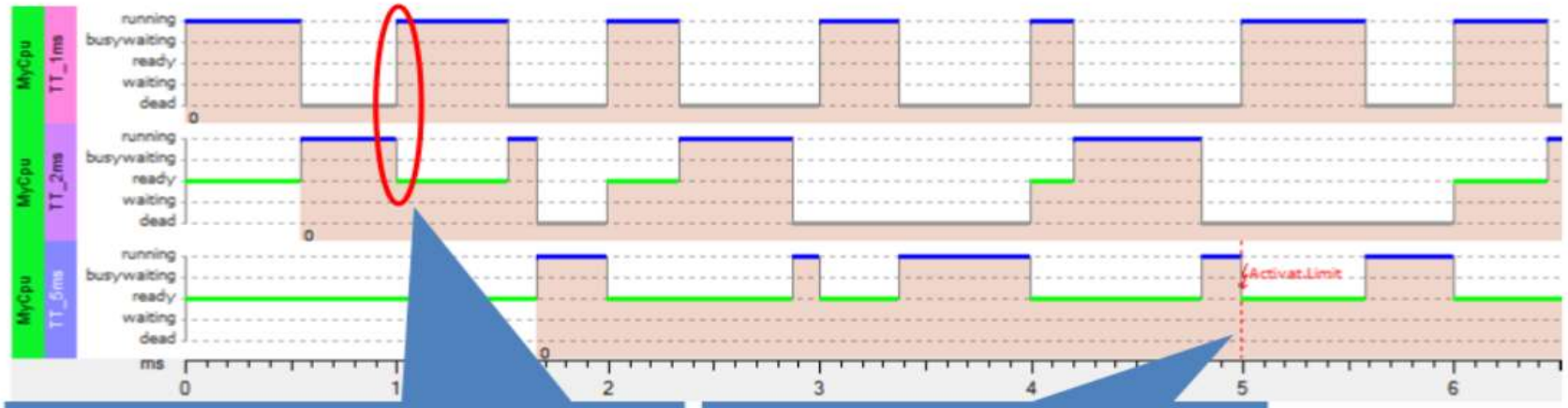
Processes

	Name	Priority	Stack Limit (Bytes)
1	I_Demo	100	1024
2	DefaultScheduler		

Rate-monotonic priority assignment (RMA) is considered optimal. However, integration of sporadic processes can be difficult.

Processes

	Name	Active at Boot	Priority	Preemptable	Activation Limit	Stack Limit (Bytes)
1	TT_1ms	☐	10	☑	1	1024
2	TT_2ms	☐	9	☑	1	1024
3	TT_5ms	☐	5	☑	1	1024

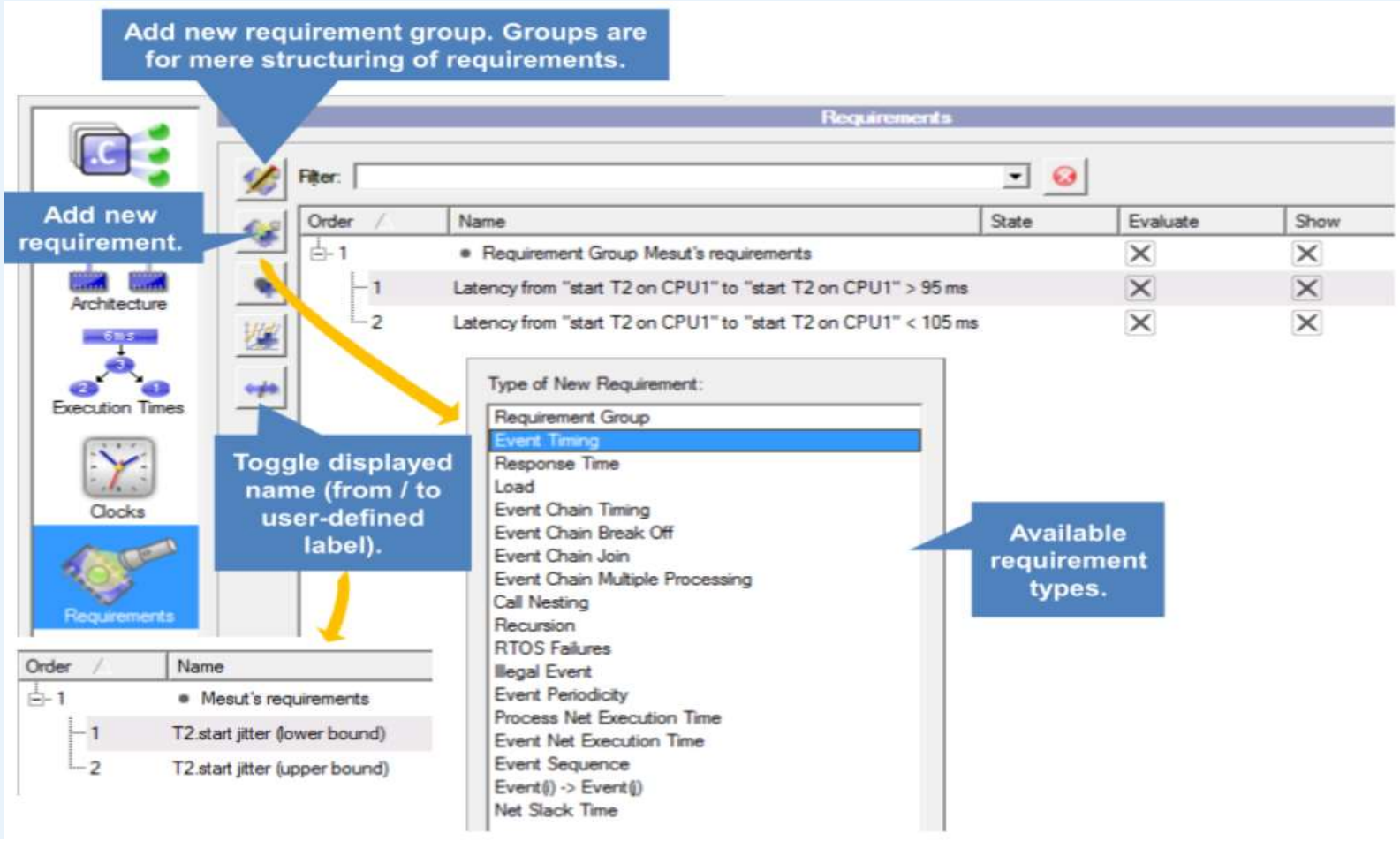


Lower priority tasks are preempted by those with higher priority. Thus, the system can more rapidly respond to real-time events.

Activation limit violations occur when a new activation arrives before the previous activation has terminated.

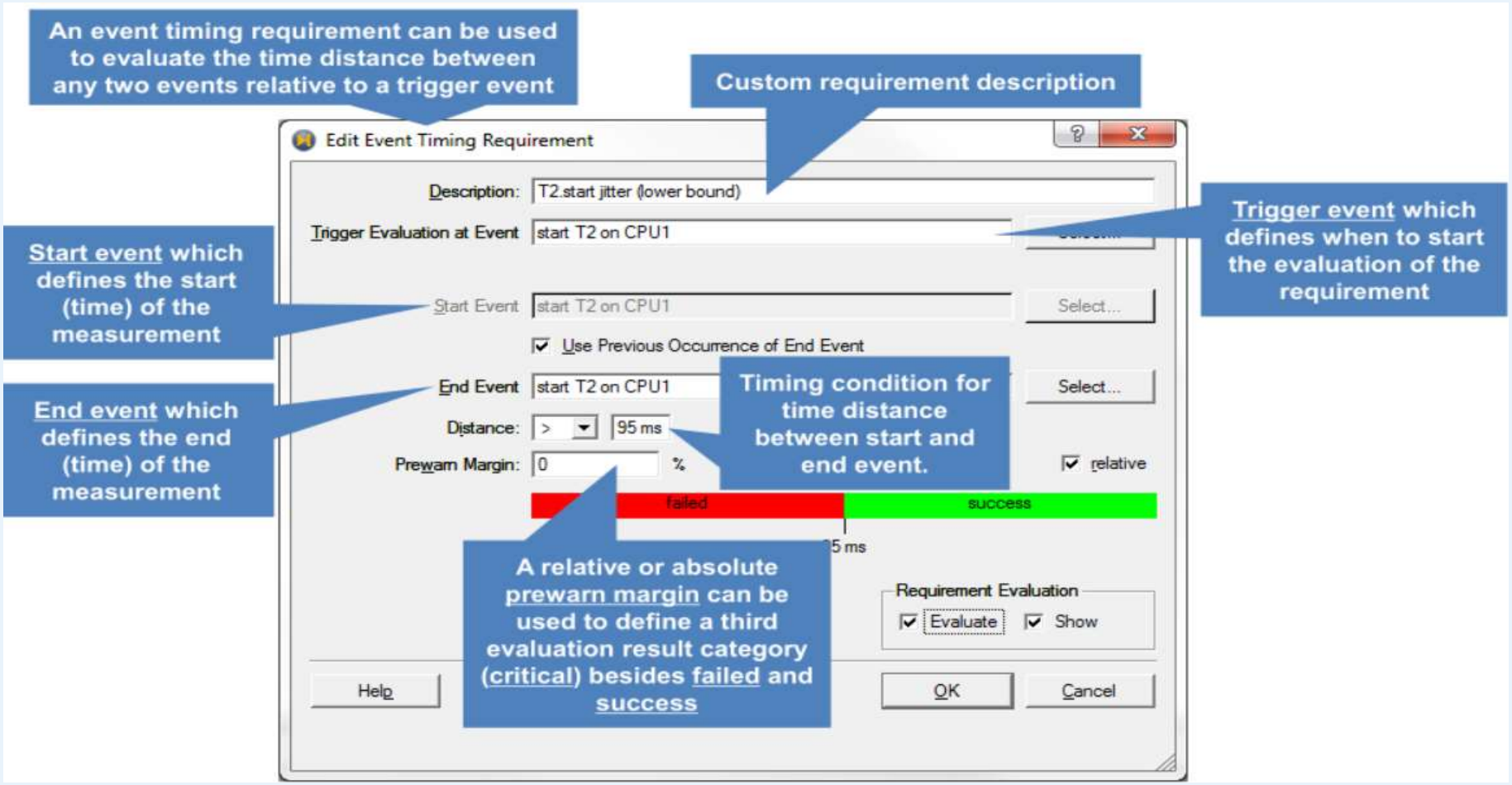
ChronSIM: Requirement editor

Siener



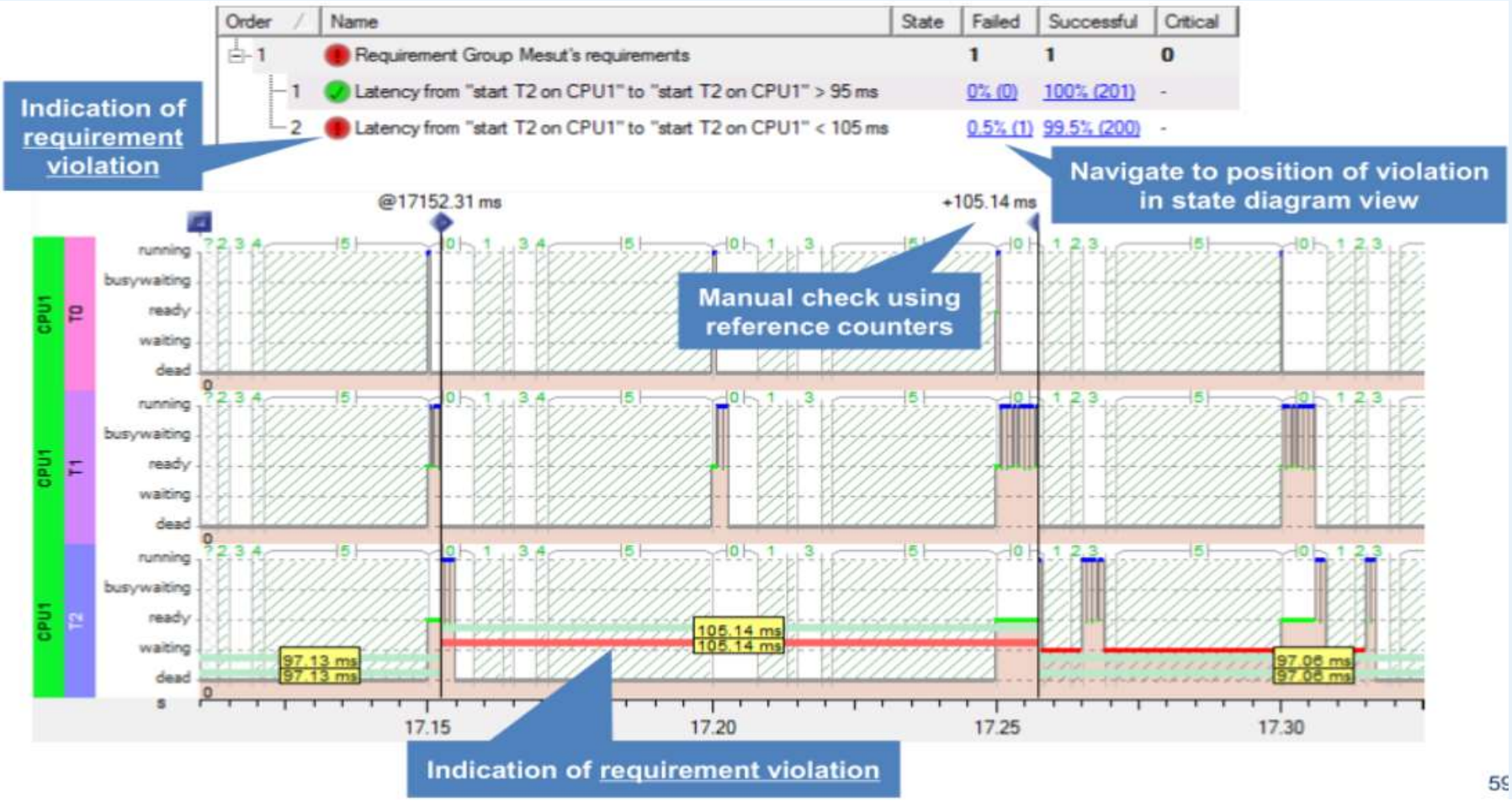
ChronSIM: Event timing requirement

Siener



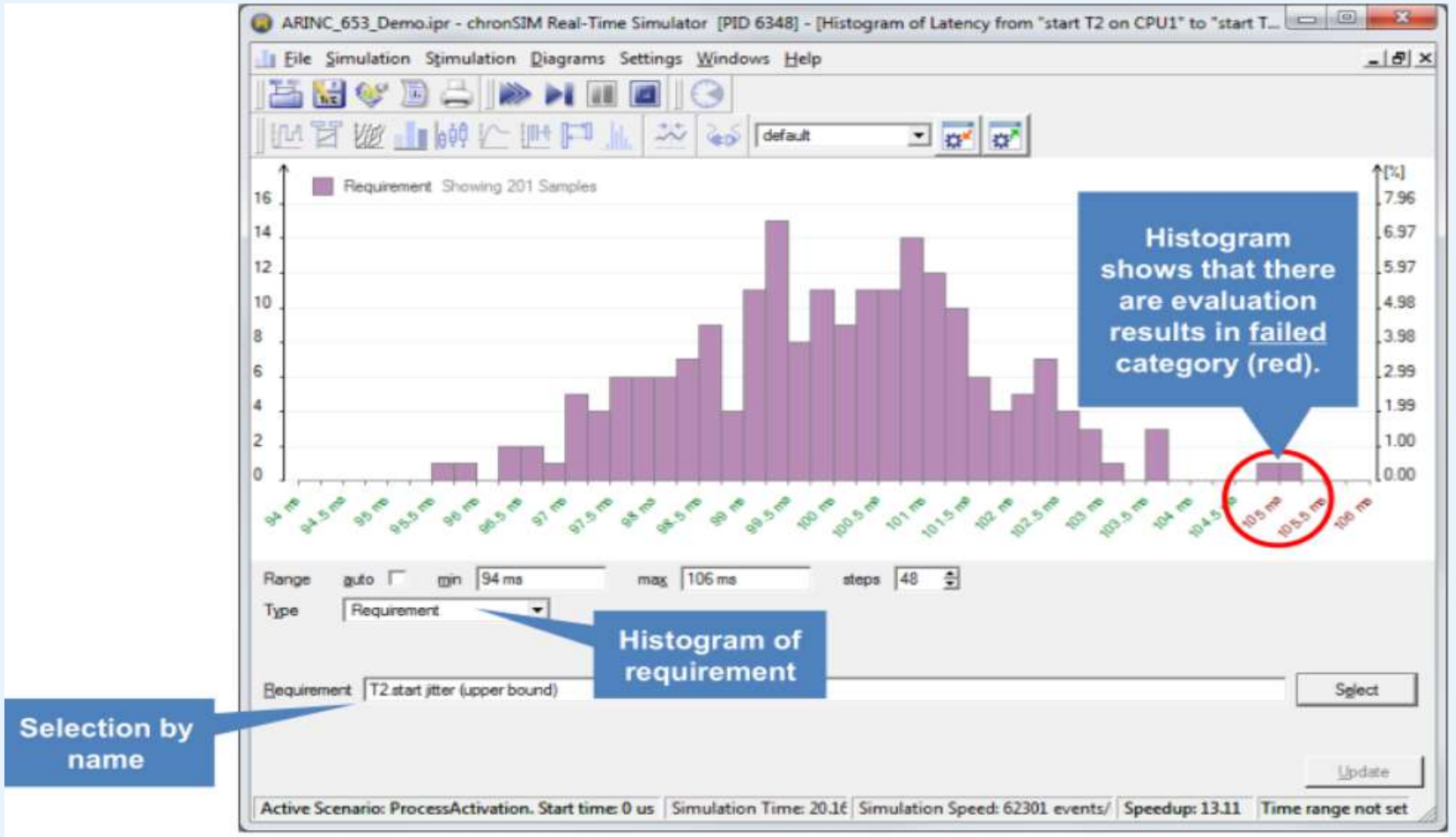
ChronSIM: Event timing requirement evaluation

Siener

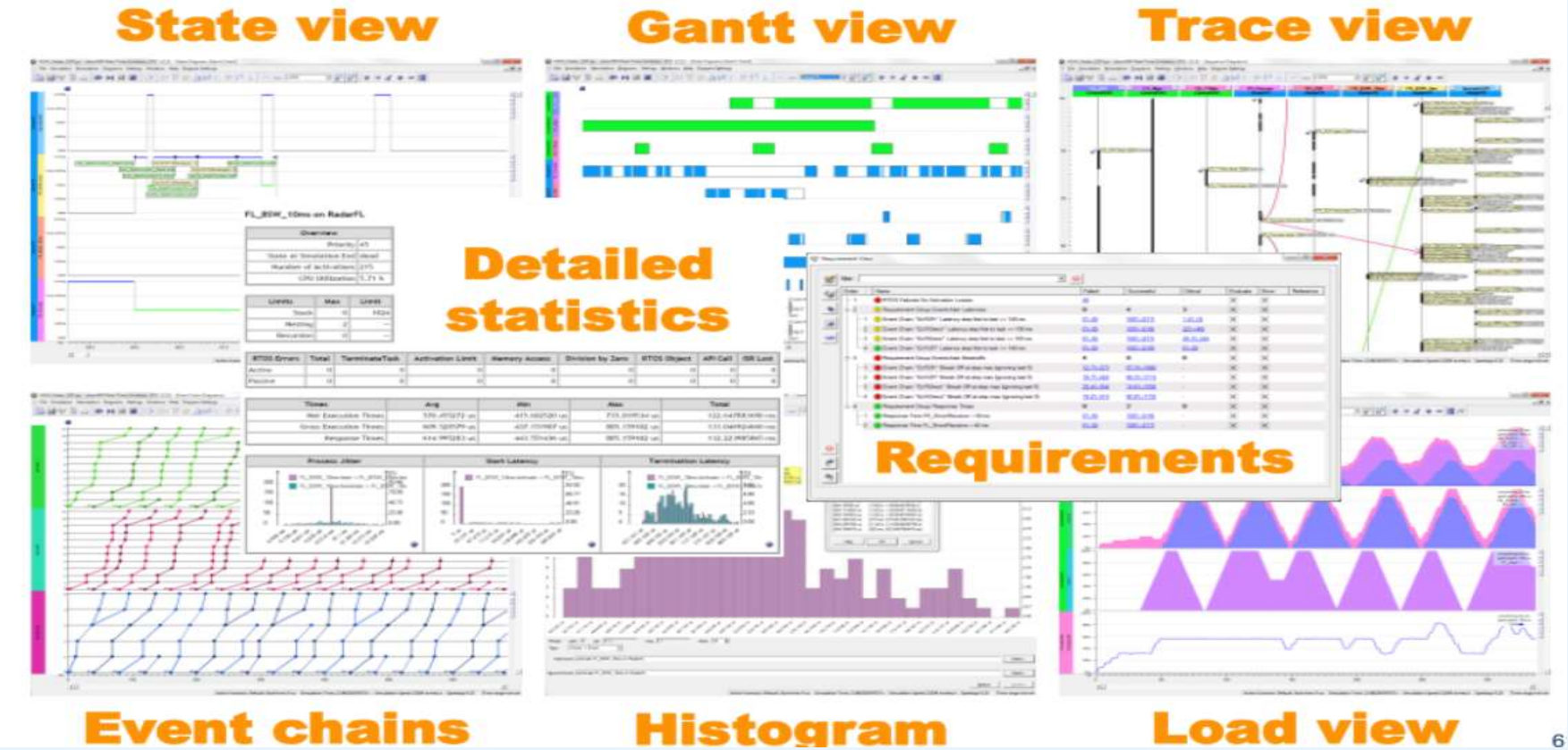


ChronSIM: Histogram of requirement evaluation

Siener



Interactive views and statistics let you explore the dynamic behavior of your system



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