Cradle-7
From concept to creation...

3SL

Cradle-PERF

The **Cradle-PERF** module applies user-defined calculations to an architecture model, to compare the performance of alternative architectures and apportion performance budgets to subsystem, component and equipment designs.

Simulation is an activity to reproduce a system's behavior in an artificial environment to test the system in a variety of scenarios. Simulation is used where testing the real system is either dangerous, impracticable or too time-consuming or expensive.

The most fundamental behavioral characteristics of systems are set early in the design process, as alternative architecture topologies are assessed and performance budgets are set. But as there is no behavior allocated to the components, it is not possible to build a simulation.

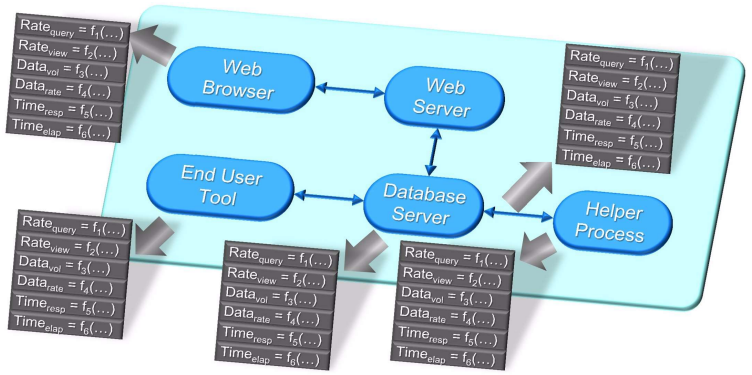
Performance assessment solves this problem. It is used before behavior is known and allocated and so before simulation can be used. It can be used to confirm if a proposed architecture is viable. It can be used to compare performance characteristics of candidate architectures. It can be used to define budgets for lower design levels (apportionment). Later, it can be used to aggregate actual values.

Performance assessment is expressed in user-defined characteristics, typically concerned with timing, data error or precision, such as:

- Bandwidth
- Utilization
- Size
- Cost
- Data rate
- Staleness
- Weight
- Power

They can be subdivided, for example to study best case, worst case and typical conditions. They are held as user-defined formulae in the specifications and data definitions of the symbols in the diagrams of the architecture models.

Any number of performance characteristics can be defined and associated with each diagram symbol. Each has its own formula. These are defined using a function library and user-defined calculation routines. This library contains logical, arithmetic, logarithmic, exponential, ladder, table lookup and interpolation routines, amongst others.



System performance requirements are applied as constraints to these characteristics by linking the items in the database and defining ranges of values for the performance characteristics that should not, or may not, be exceeded.

Analyses are run on state models that are sets of interconnected diagrams at appropriate levels in the architecture.

A state model can have external loads applied to it to represent different usage scenarios. An analysis can contain many such environmental loads. The environmental loads are defined as values of any of the performance characteristics at the external input(s) to the model.

Each analyses applies the environment load and calculates performance characteristics for all of the symbols in the state model's diagrams using the formulae and constraints in each symbol. The results are therefore quantitative. They are stored inside the symbols' descriptions.

The results can be reported in the same manner as other information in a Cradle database. They can also be graphed. The graphs will typically show the values of specified characteristics along a path through the model, termed a thread. Each graph will show any constraints applied from

PERF
Performance Modeling

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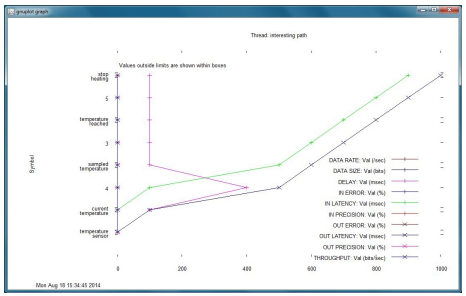
the system requirements and the effect of the constraints on the analysis results. The data in such graphs can be exported to CSV.



Any number of such thread analyses can occur.

The results will show that an architecture is viable if none of its constraints are violated.

Since the performance data is built into the architecture model, any and all changes to the model's topology (such as a change to the architecture) will be automatically reflected in changes to the performance results. This allows easy comparison between alternative architectures.

The analysis results are the characteristics of a viable architecture. Hence, they are the constraints or budgets for the next level of design. So the analysis of each level produces performance constraints for the next level. This process can continue through the design levels until the system behavior is sufficiently well defined for simulation to be practicable.

Feature Summary

Feature	Benefits
Performance assessment based on characteristics of system behavior	Can be used before behavior is decided or functions allocated to identify performance budgets
Predictive tool	Defines constraints on each design level from the level above it
Arbitrary subdivision of characteristics	Study multiple situations and contexts simultaneously, such as best case, worst case, and typical case
Budget apportionment	Allocate budgets hierarchically downwards
Result aggregation	Aggregate results from lower levels to the higher levels
Constraint assignment	Limiting and advisory constraints to impose acceptance criteria and performance requirements on analyses
Arbitrarily extensible	Add any number of performance characteristics to analyses
Extensive function library	Pre-defined functions for all common operations including table lookups, step or ladder functions, linear interpolations, and linear, exponential and logarithmic expressions
Access to external functions and simulations	Embed any external calculation or simulation routine for complete flexibility
Multi-layer environmental effects	Build environment loads using a flexible three-tier approach, to test system failure conditions and explore maximum load criteria
Define models for analysis	Define appropriate architectures or subsets of architectures for study at any level of detail
Multiple analysis results held within the design	Allows comparative assessments of alternative architectures or alternative function allocations to, or within, subsystems
Change to the model change the performance	Any change to the topology of the architecture model will directly affect its performance characteristics without any need to change the performance analysis
Graphical output	Visually presents performance characteristics along threads for easy understanding of performance throughout the system
Cross referenced to entire database	Linked to performance requirements and acceptance criteria

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