

SON Management Based on Weighted Objectives and Combined SON Function Models

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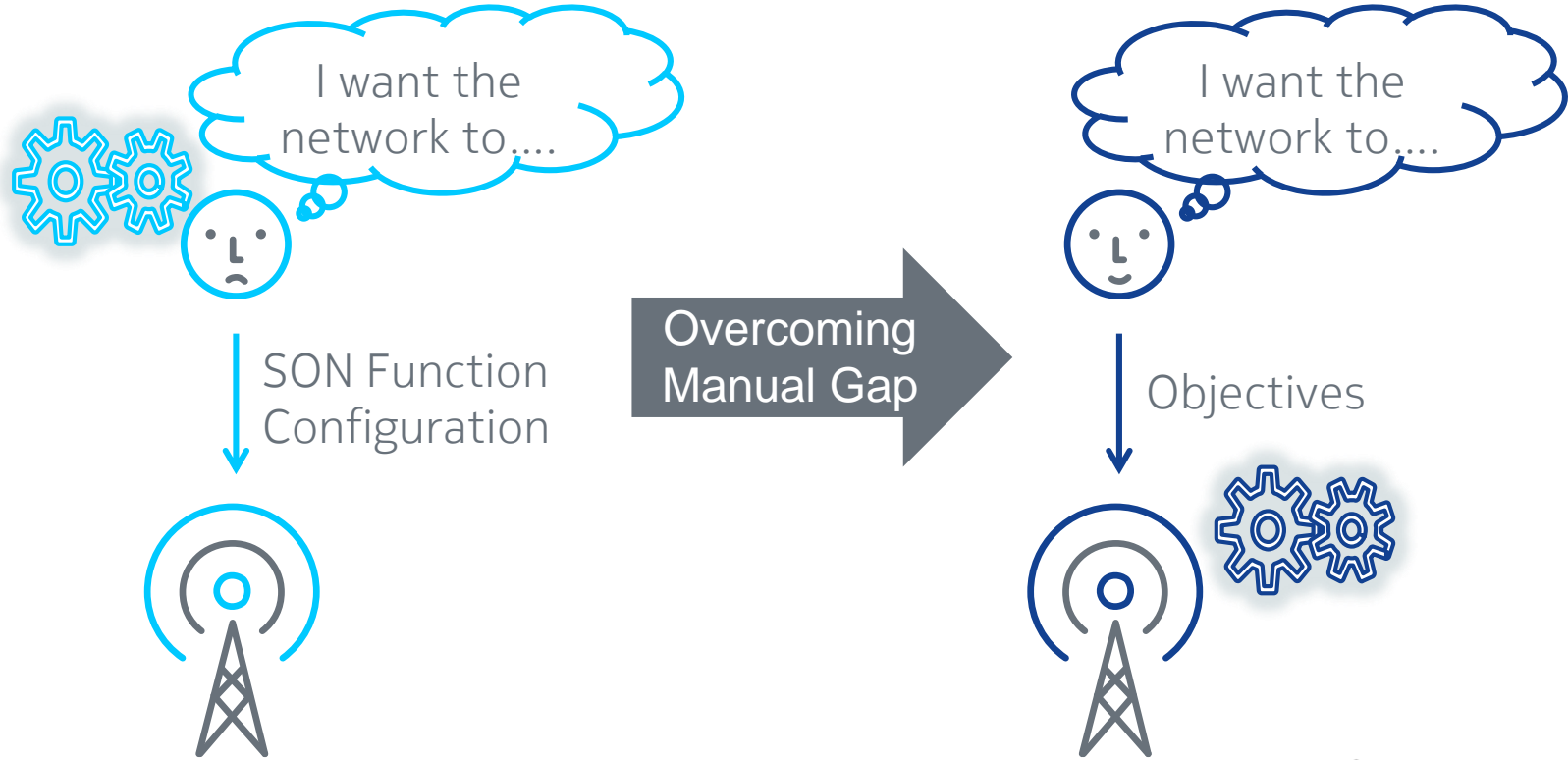
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Motivation

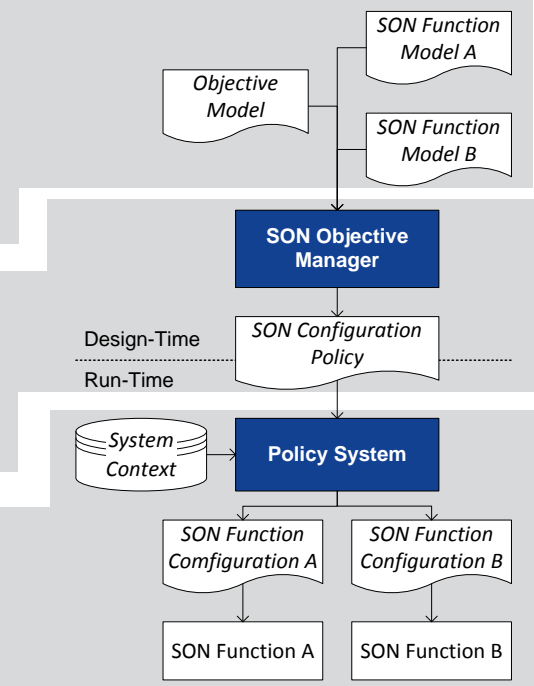
Managing a Self-Organizing Network (SON) with objectives instead of configurations



Context

SON Objective Manager introduced to fill manual gap

- Different models that separate
 - Context-dependent objectives on Key Performance Indicators (KPI)
 - Effects of a SON function configuration on KPIs
- The SON Objective Manager combines them to a policy that determines the best configuration for each network cell context
- The policy system evaluates the policy depending on the context and deploys the applicable configuration to the SON



Problem

Shortcomings of the SON Objective Manager

Limited expressivity

- SON function model and objective model can only express maximization, minimization, and neutrality regarding KPIs

Prioritized objectives

- Priorities on objectives do not allow a trade-off if not all objectives can be satisfied

Complexity

- Policy creation can lead to state space explosion since the configurations for all possible system contexts need to be computed

Goal

Overcoming the shortcomings with an improved SON Objective Manager

Limited expressivity



Set-based semantics of models

- Allows more predicates
- Well-defined model combination and utilization

Prioritized objectives



Decision theoretic selection

- Weighted objectives and utility calculation allows a trade-off

Complexity

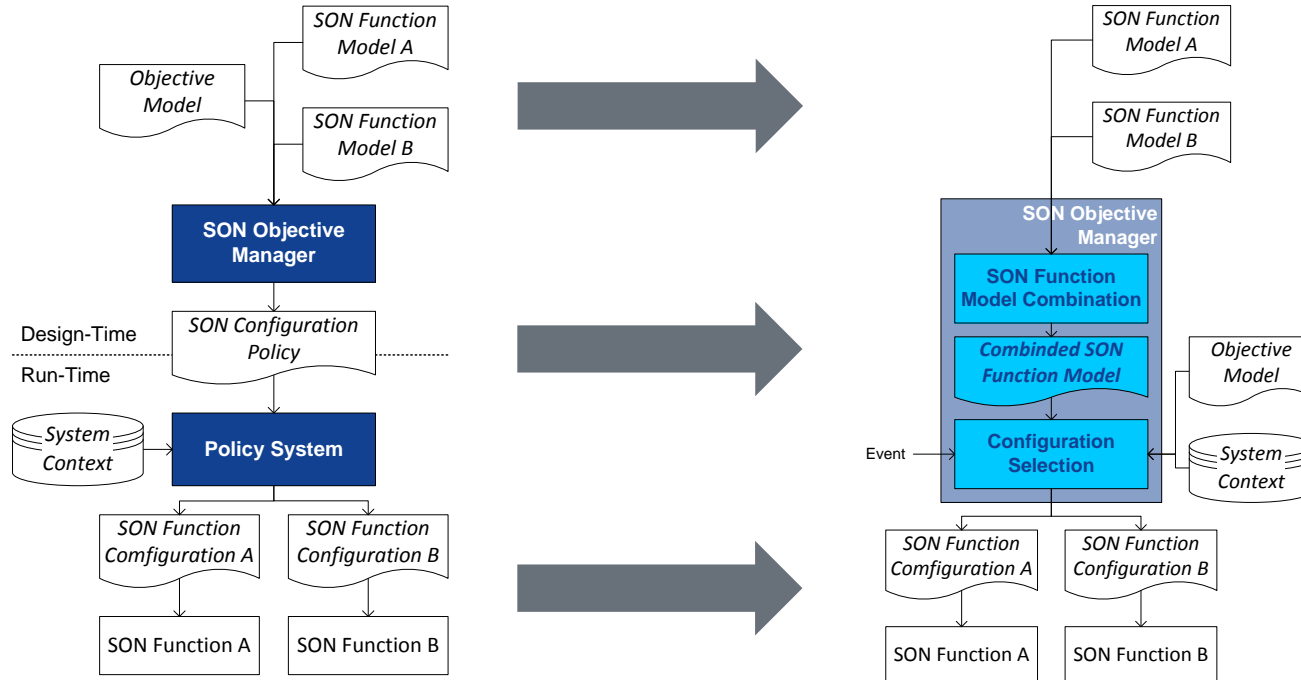


Run-time computation

- Solely considers the actual current network cell context for the configuration

Solution: Overview

Functional overview of a new approach for the SON Objective Manager



Solution: Overview

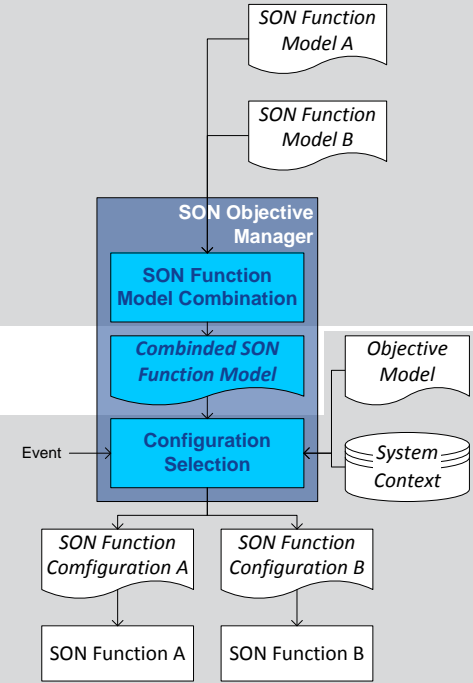
Functional overview of a new approach for the SON Objective Manager

SON function model combination

- Predict the network performance for all combinations of SON function configurations

Configuration selection

- Get applicable objectives for context
- Calculate the utility of combined SON function configurations
- Deploy best combined configuration

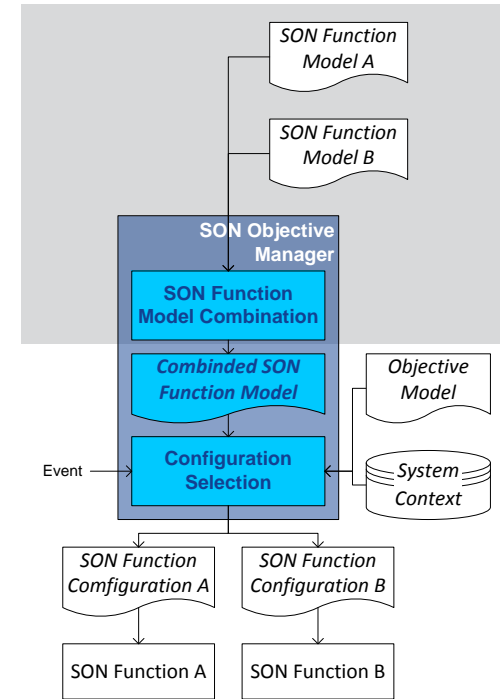
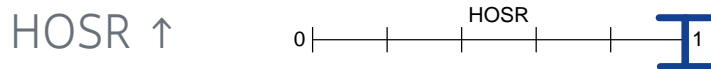


Solution: SON Function Model Combination

Network performance prediction for combined SON function configurations

SON function model

- Contains a set of configurations and their effects on each and every KPI for one SON function
 - An effect is the definition of KPI values that are possible
 - Set-based semantics: an effect is a subset of the set of all values of a KPI, e.g.,



Solution: SON Function Model Combination

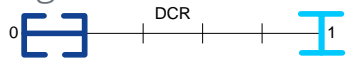
Network performance prediction for combined SON function configurations

SON function model combination

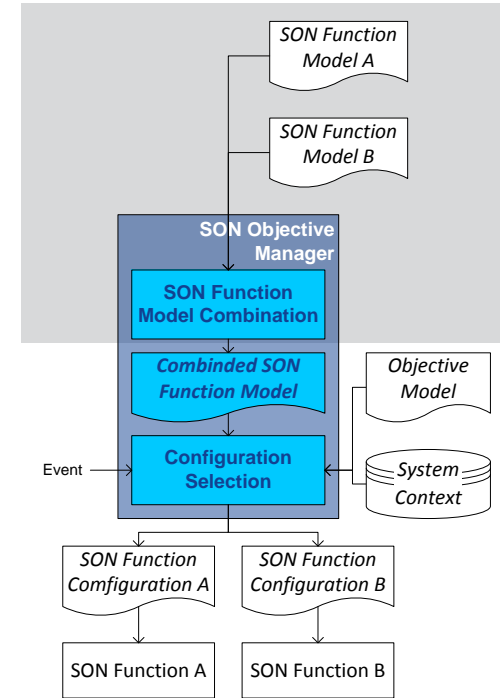
- Effect prediction for multiple SON functions with specific configurations
 - A KPI value is an effect of a combined SON function configuration if it is the effect of all configurations, i.e., intersection of the effects



- Conflicts between configurations can lead to undesired system behavior, e.g., oscillating network configuration
 - A pair of SON function configurations is in conflict if they do not agree on their effects, i.e., the effects do not overlap



- Recomputation required on changes of SON function models



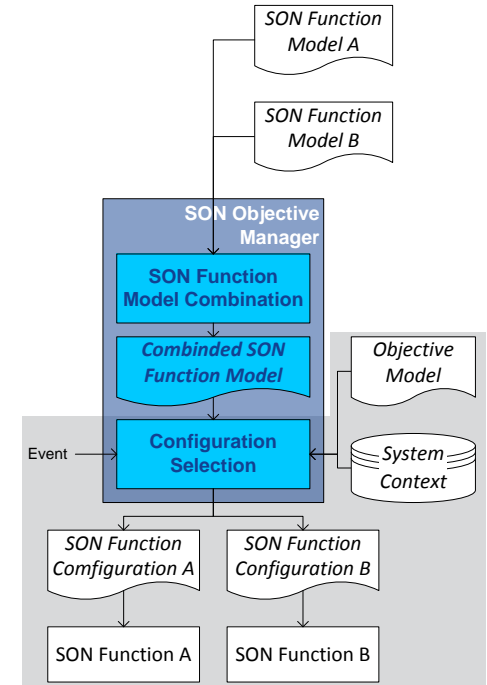
Solution: Configuration Selection

Calculation of utility of combined SON function configurations for actual objectives

Objective model

- An objective is a pair of a target for a KPI and a weight
- An target is the definition of a set of acceptable values for a KPI (semantics analogous to SON function model)
- A weight defines the importance of the satisfaction of the target, i.e., it allows a trade-off between objectives if not all can satisfied
- Objectives are context dependent, e.g., through rules

IF location=rural THEN dcr \leq 0.02 WITH 0.5

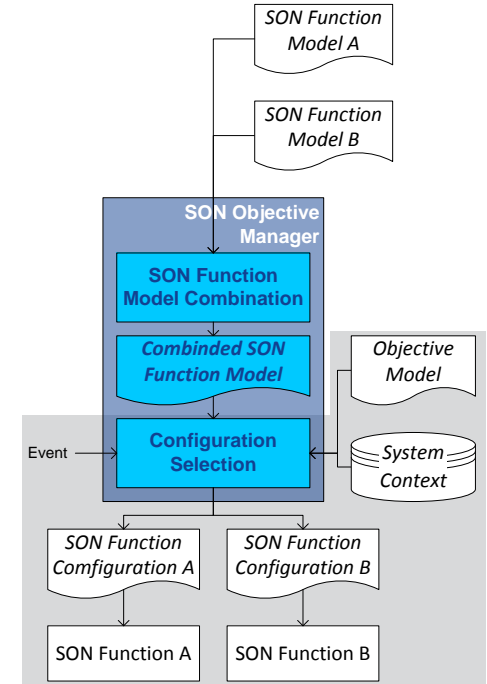


Solution: Configuration Selection

Calculation of utility of combined SON function configurations for actual objectives

Utility of combined SON function configuration models

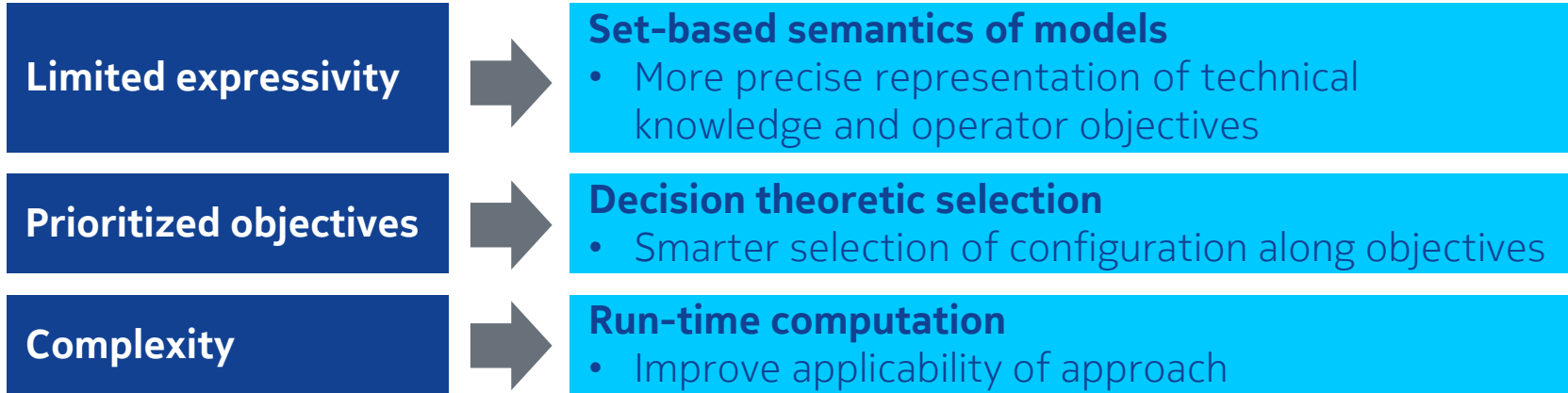
- Iteratively performed for each and every cell
 1. Collect the applicable objectives for the current cell context
 2. Calculate the utility for each combined SON function configuration
 - Utility = sum of weights of satisfied objectives
 - An objective is satisfied if the entire effect of the combined SON function configuration satisfies the objective target, i.e., the effect is a subset of the target
 3. Deploy the combined SON function configuration with the highest utility
- Execution triggered by events, e.g., timer or network changes



Conclusion

What the new approach achieves

- Managing a mobile network through objectives instead of network parameters
- Improving the previously introduced SON Objective Manager



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The screenshot displays the SEMAFOUR Operator Panel interface. The window title is "Operator Panel" and the SEMAFOUR logo is visible in the top right corner. The date and time "2014-09-23 09:01:28" are shown in the bottom right corner.

The interface is divided into several sections:

- Objectives:** Contains a "Classes" tab with configuration for two classes: **CLASS_001_NORMAL** and **CLASS_002_BUSY**. Each class has sliders for CDR, HOSR, UT, and CL, and dropdown menus for priority levels (HIGH, MEDIUM, LOW).
- SON Parameters:** Includes a "SCV Set" dropdown menu currently set to "MRO_7". Below it, a table lists parameters and their values:

Parameter	Value
Method	Window
Window	120
Events	-1
Policy	1, 05, 7
Hysteresis	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Time_to_trigger	0, 1, 2, 3, 4, 5, 6, 10, 12, 25, 51

The **Policy** section on the right shows a list of classes with their corresponding MIB and MRO values:

Class	MIB	MRO
CLASS_001_BUSY	MLB_41	MRO_7
CLASS_001_NORMAL	MLB_2	MRO_1
CLASS_002_BUSY	MLB_67	MRO_7
CLASS_002_NORMAL	MLB_67	MRO_7
CLASS_003_BUSY	MLB_67	MRO_7
CLASS_003_NORMAL	MLB_67	MRO_7
CLASS_004_BUSY	MLB_2	MRO_5
CLASS_004_NORMAL	MLB_67	MRO_7
CLASS_005_BUSY	MLB_67	MRO_7
CLASS_005_NORMAL	MLB_57	MRO_7
CLASS_009_BUSY	MLB_41	MRO_7
CLASS_009_NORMAL	MLB_67	MRO_7