SON Management Based on Weighted Objectives and Combined SON Function Models

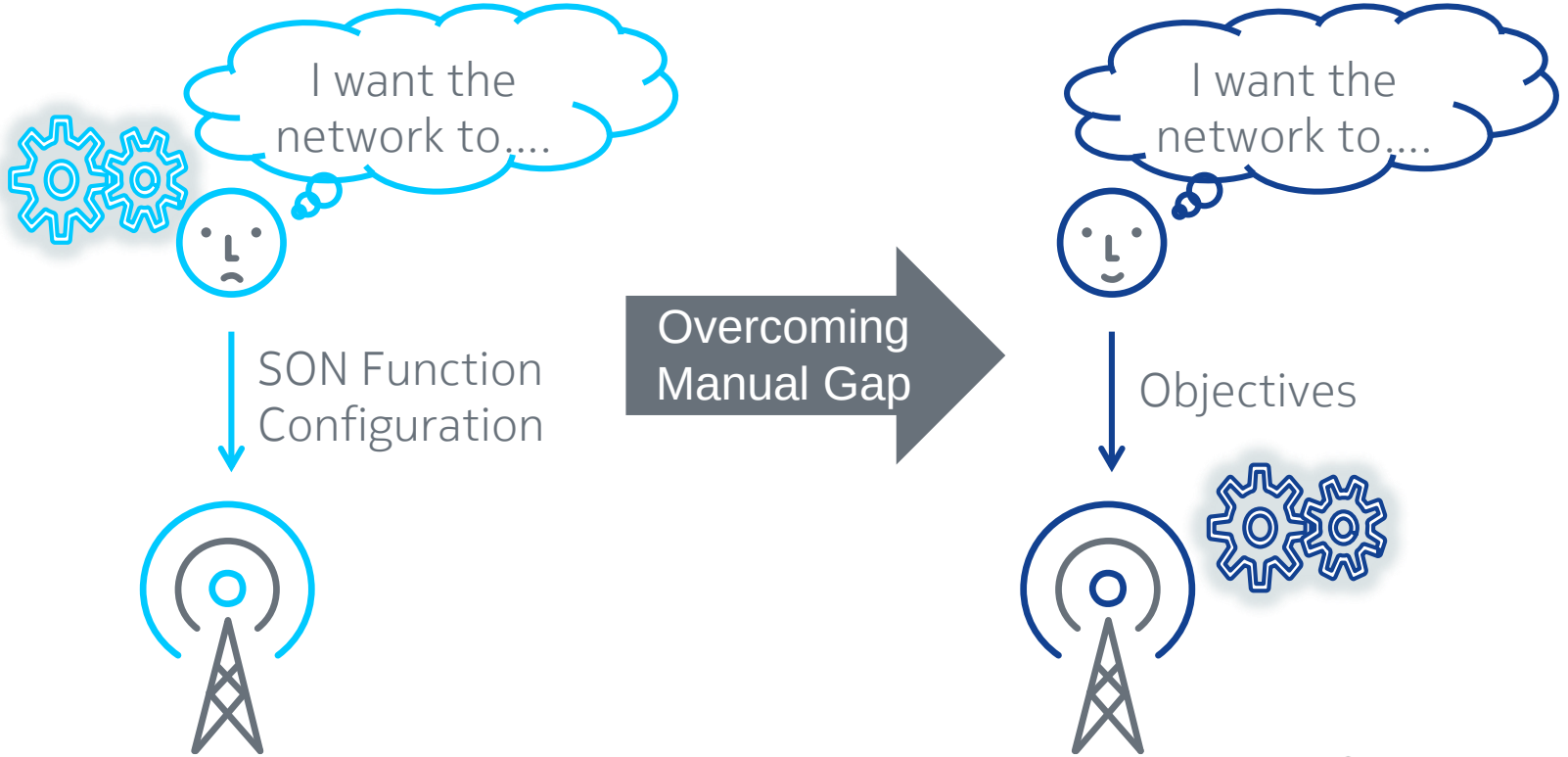
Christoph Frenzel, Simon Lohmüller, Lars Christoph Schmelz

University of Augsburg, Germany
Nokia, Munich, Germany

IWSON 2014, Barcelona, Spain, 26 August 2014

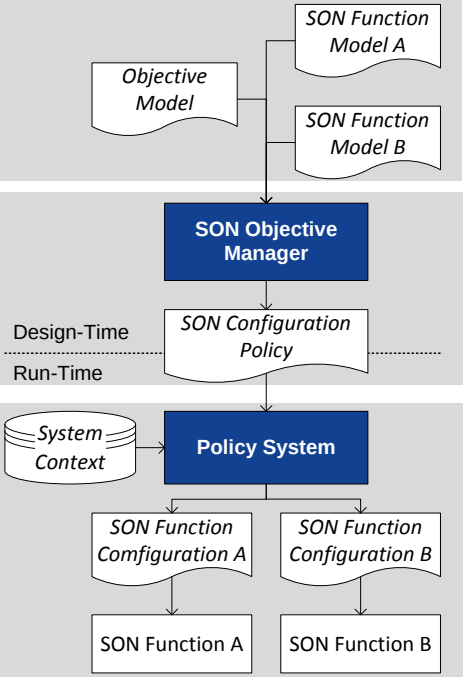
Motivation

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

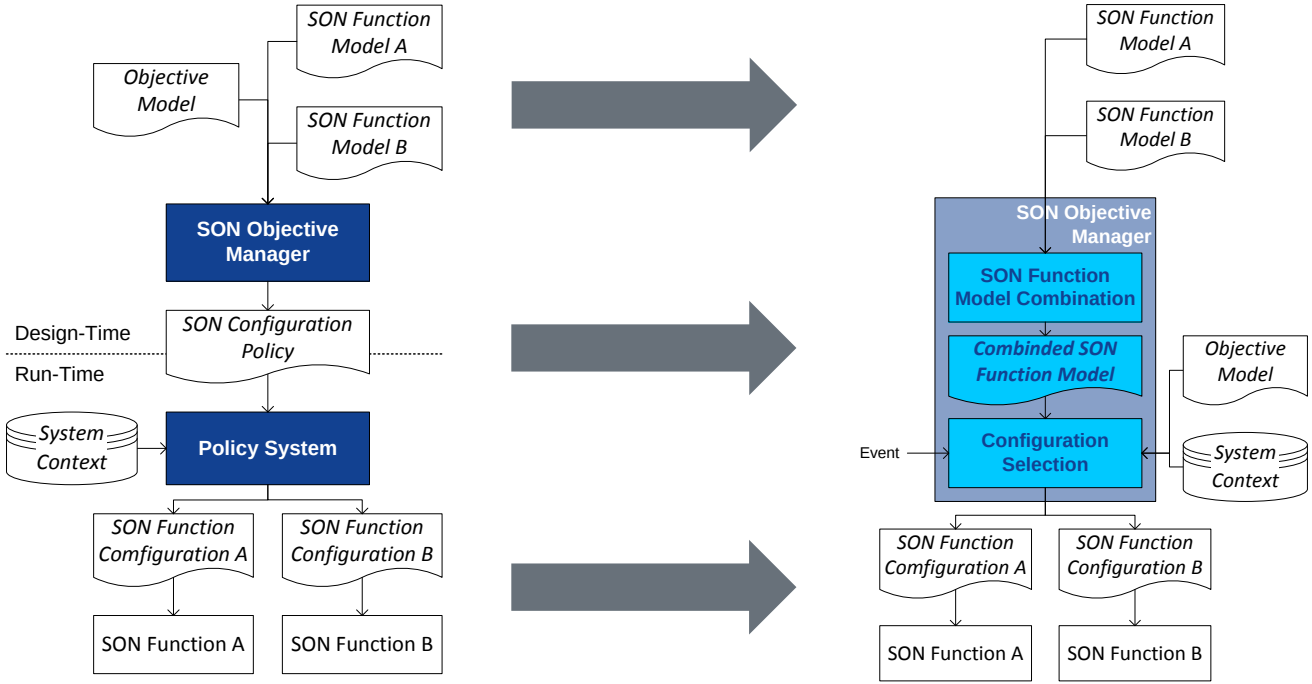
Limited expressivity → **Set-based semantics of models**
- Allows more predicates
- Well-defined model combination and utilization

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

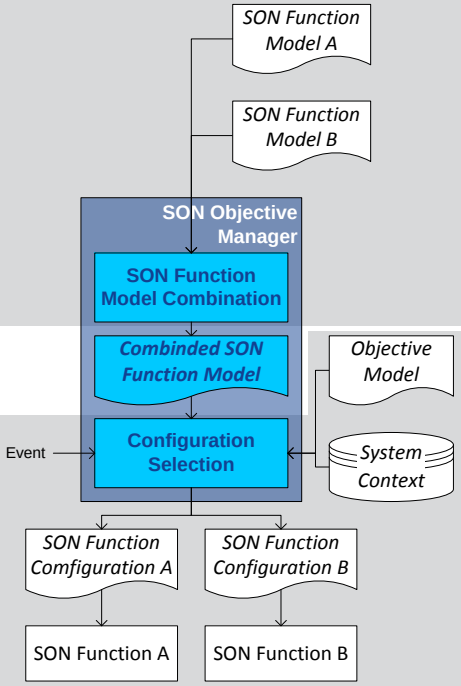
Functional overview of a new approach for the SON Objective Manager

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

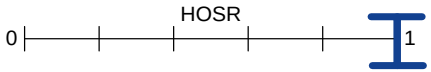
Network performance prediction for combined SON function configurations

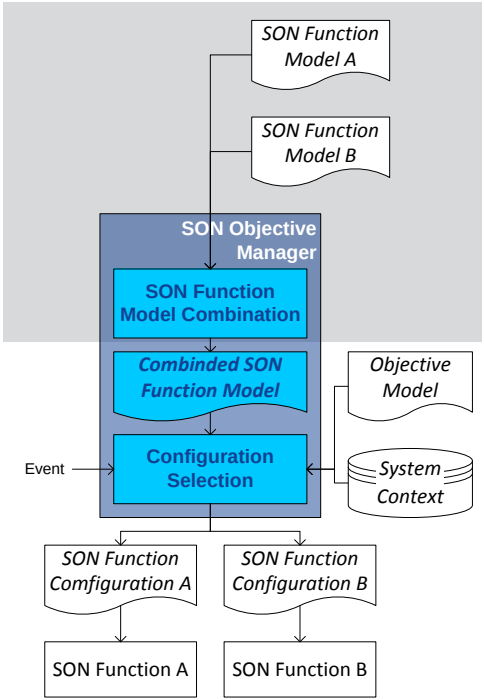
SON function model

- 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.,

DCR ≤ 0.2

HOSR ↑





Solution: SON Function Model Combination

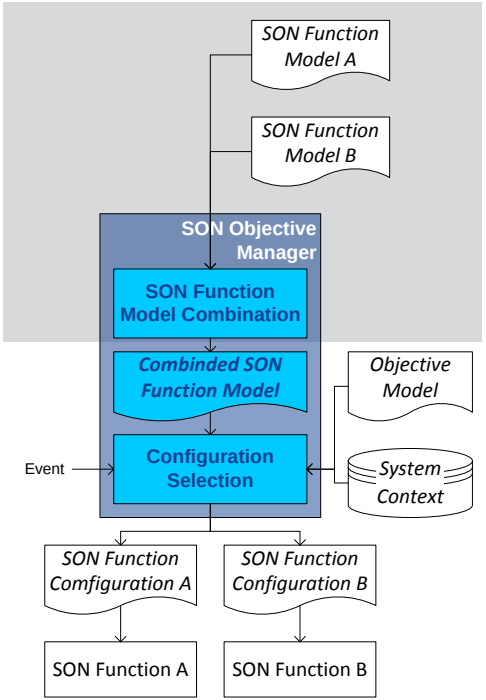
Network performance prediction for combined SON function configurations

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



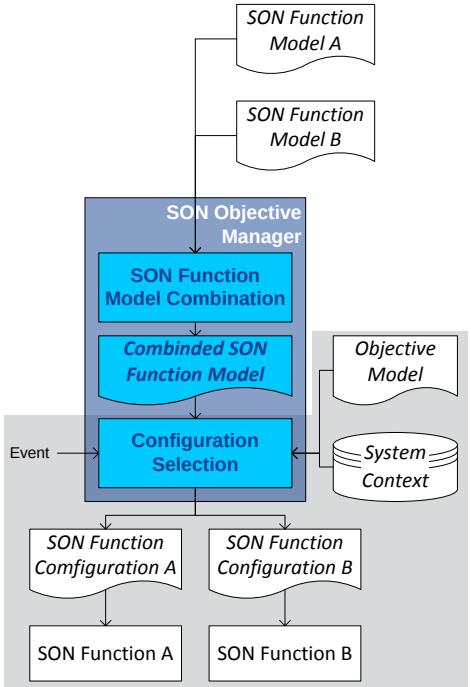
Solution: Configuration Selection

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 ≤ 0.02 WITH 0.5
```



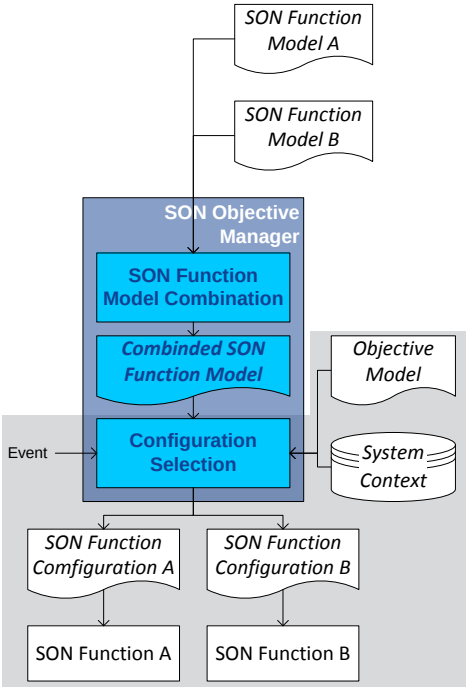
Solution: Configuration Selection

Calculation of utility of combined SON function configurations for actual objectives

Utility of combined SON function configuration models

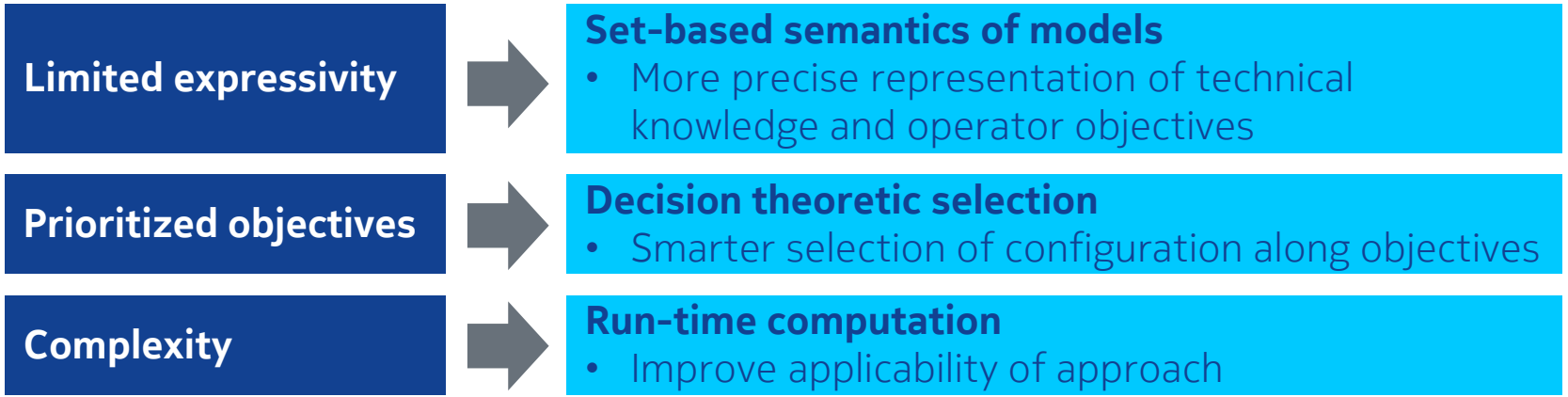
- Iteratively performed for each and every cell
  1. Collect the applicable objectives for the current cell context
  2. Calculate the utility for each combined SON function configuration
     - Utility = sum of weights of satisfied objectives
     - An objective is satisfied if the entire effect of 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



NOKIA

Universität Augsburg University