

Classification of Cells Based on Mobile Network Context Information

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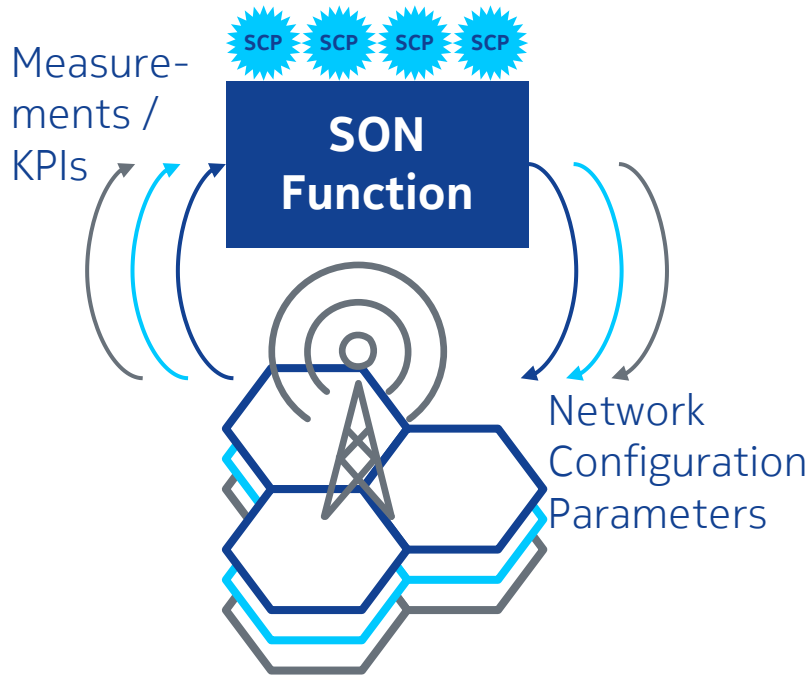
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Motivation

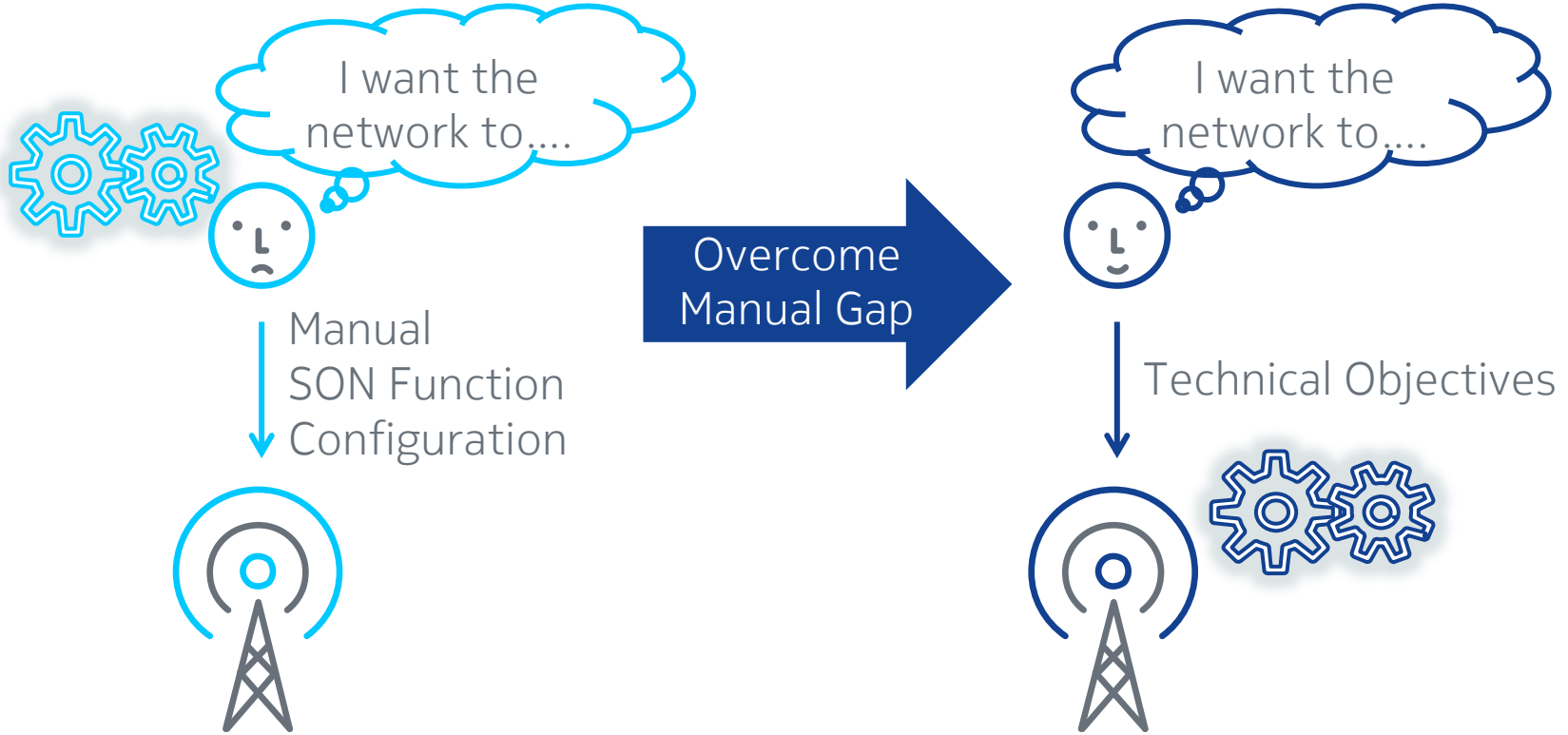
SON Function Configuration



SON Function behaviour (impact on KPI values) can be influenced through SON Function Configuration Parameters (SCPs) by adjusting SCP Values (SCVs)

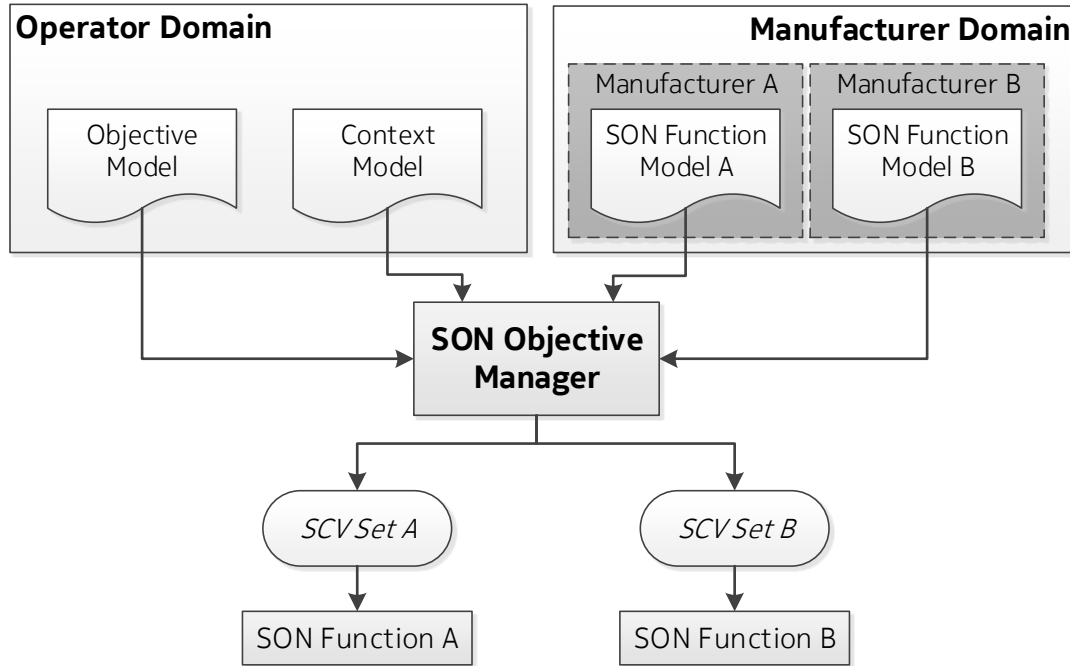
Motivation

SON Management



Basics

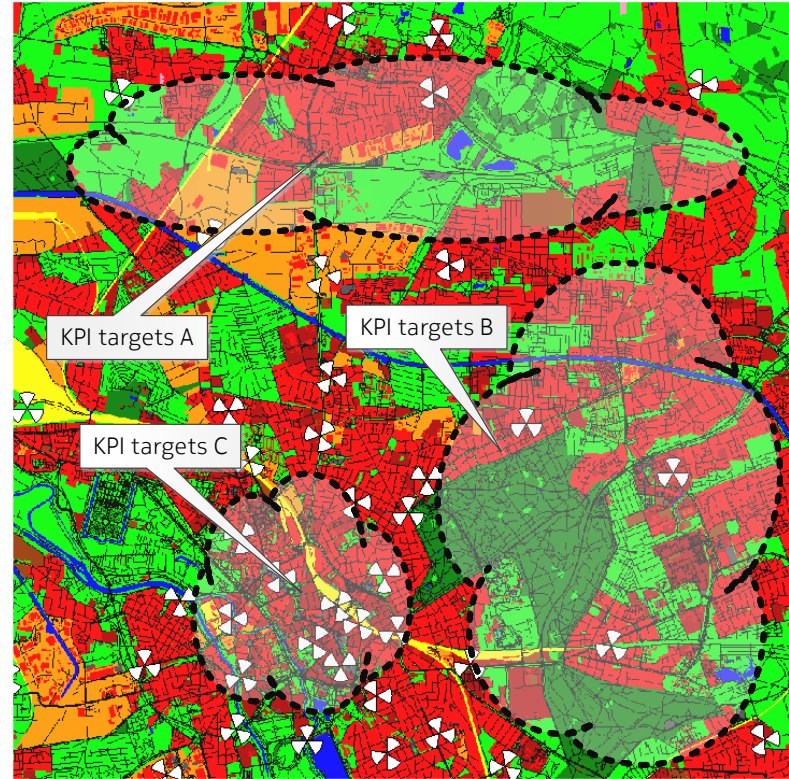
SON Objective Manager



Problem Description

KPI Target Definition in the Mobile Network

- Different KPI targets for different areas in the network
- KPI targets may change over time

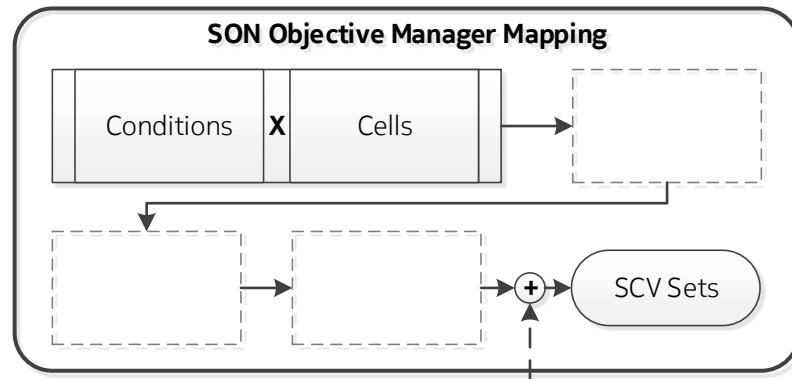


Problem Description

Goal for SON Objective Manager

Goal

- Find suitable SCV Sets...
 - for the SON Functions implemented at each cell
 - for every condition the cell may be in



Problem: Impossible to select suitable SCV Sets for each individual cell manually

Problem Description

Context – Context Space

Context

- Abstract description of a cell's properties and capabilities as well as the environment and situation it operates in

Context Space

- All possible context combinations that may exist
- One dimension for each context parameter

- **Cell Type** $\in \{Pico, Micro, Macro\}$
- **Cell Technology** $\in \{LTE-1800, LTE-2600, UMTS-2100, GSM-900\}$
- ...



Available Technology

	LTE-1800	LTE-2600	UMTS-2100	GSM-900
Macro				
Micro				
Pico				

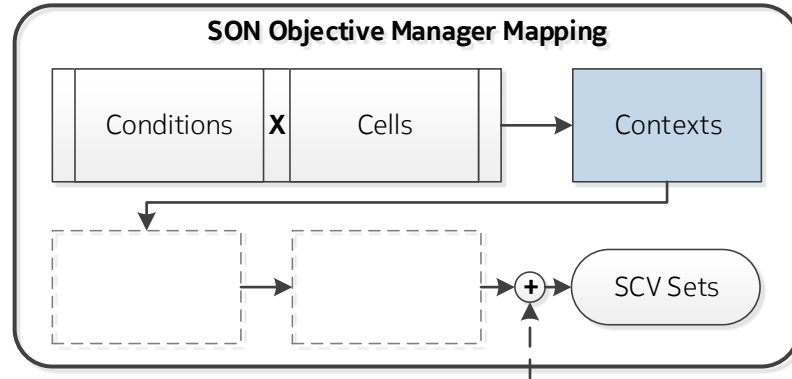
Problem: n-dimensional context space with possibly infinite context attributes

Concept

Introduction of Context Attributes

First Reduction

- Introduction of context attributes
 - SCV Set selection based on description of cell's context



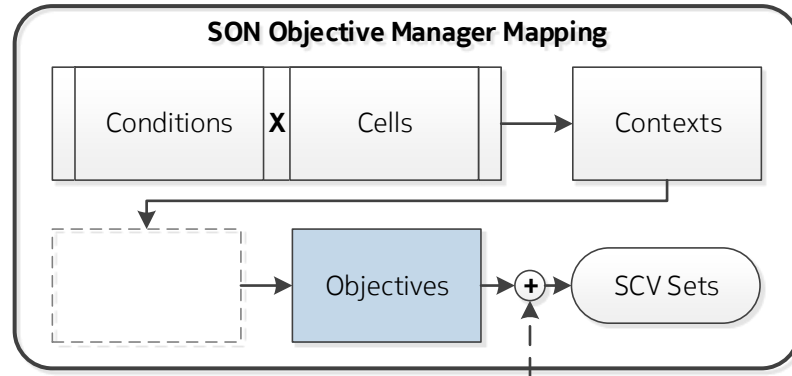
Assumption: Cells in the same context (i.e., operating in the same situation and environment) can be handled in a similar way

Concept

Introduction of Objectives

Objectives

- Depend on the cell's context
- Formulated by the network operator



Problem: Impossible to define objectives for each individual cell context manually

Assumption: Cells in equal context have equal objectives

Concept

Context Space – Context Classes

Context Space

- all possible context combinations that may exist
- one dimension for each context parameter

		Available Technology			
		LTE-1800	LTE-2600	UMTS-2100	GSM-900
Cell Type	Macro				
	Micro				
	Pico				



Context Classes

- Combination of context attributes
- Each cell class represents certain cells in the network

		Available Technology			
		LTE-1800	LTE-2600	UMTS-2100	GSM-900
Cell Type	Macro			B	
	Micro	A			
	Pico			C	

Problem: n-dimensional context space with possibly infinite context attributes

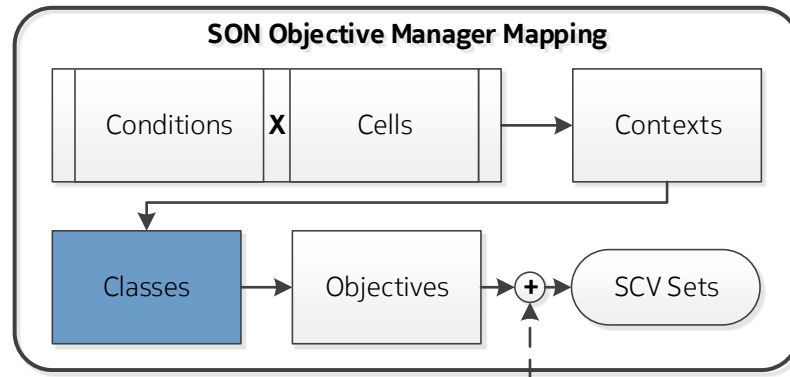
Solution: Partitioning of context into context classes

Concept

Reduction to Cell Classes

Classes

- Reduce the amount of objectives \rightarrow one objective per cell class
- Reduce the complexity of the context space \rightarrow partitioning into cell classes

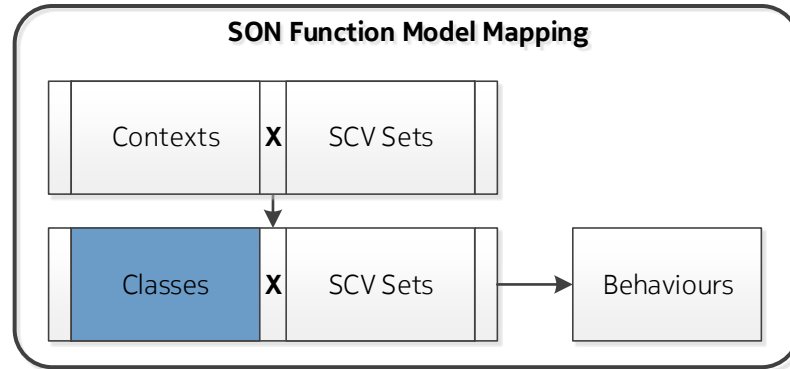


Concept

SON Function Model Mapping

SON Function Model (SFM)

- Predicts the expected network behaviour in terms of KPIs for a specific SCV Set



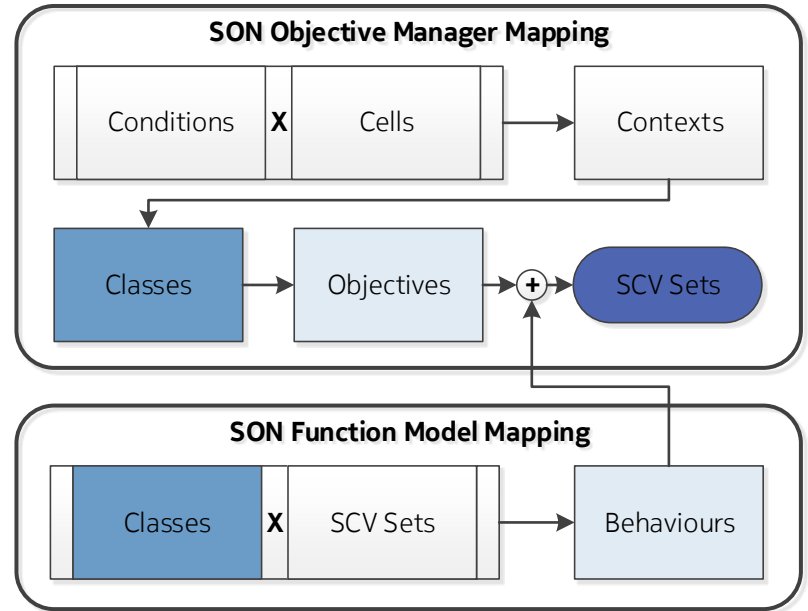
Assumption: Behaviour depends on cell context and the environment → context dependent effects in the SFM

Concept

Combined Transformation Process

SON Objective Manager

- Combines both mapping processes in order to reduce complexity
- Determines the appropriate objective for a cell under a given condition based on cell class definition
- Behaviour prediction in the SFM enables selection of SCV Sets that are in line with the given objectives



Implementation

Context Attribute Identification Techniques

Expert Knowledge

- Basic set of context attributes can be provided manually by the operator

Problems

- Hard to classify thousands of cells in the network
- Cell's context may change over time



Automation

- Determine context attributes of a cell with regards to the type of land it covers
 - E.g., urban vs. rural, high-speed mobility vs. normal mobility
- Use so-called „land use maps“ (or „clutter maps“) and „pixel maps“

Example

- Large parts of cell's footprint consists of the land use classes „low-density area“ and „forest“ → Cell will be classified as „**rural**“

Implementation

Detection of Faults in the Assignment

Problem

- Introducing an automated mechanism raises questions about
 - How can results be verified?
 - How may faults be detected?



Solution

- Fault detection by analysing the similarity of the behaviour of cells belonging to the same context class
 - Statistical outlier detection
 - Classification methods

Conclusion and Future Work

Conclusion

- A mechanism to classify cells based on network context information has been introduced → complexity in the management of the network can be significantly reduced
- Applications for Context and Classes in the management of a SON have been introduced
- Methods to classify cells and detect incorrectly classified cells have been explained

Future Work

- Apply self-learning techniques (e.g., to deal with wrong cell class assignment)
- Ultimate goal: Facilitate the adjustment of cells and the SON Function running on that cell individually so that they best fulfil given operator objectives

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