

# Classification of Cells Based on Mobile Network Context Information

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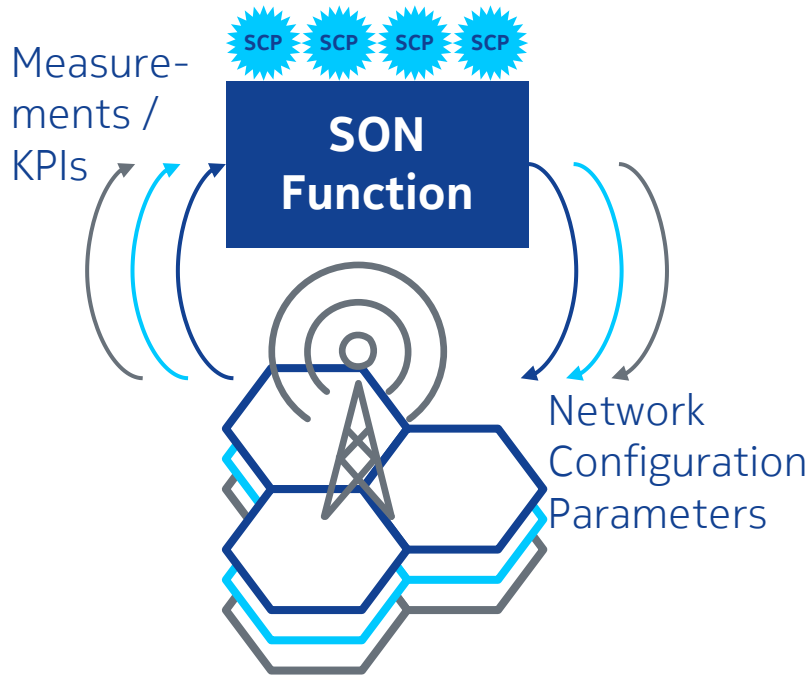
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# Motivation

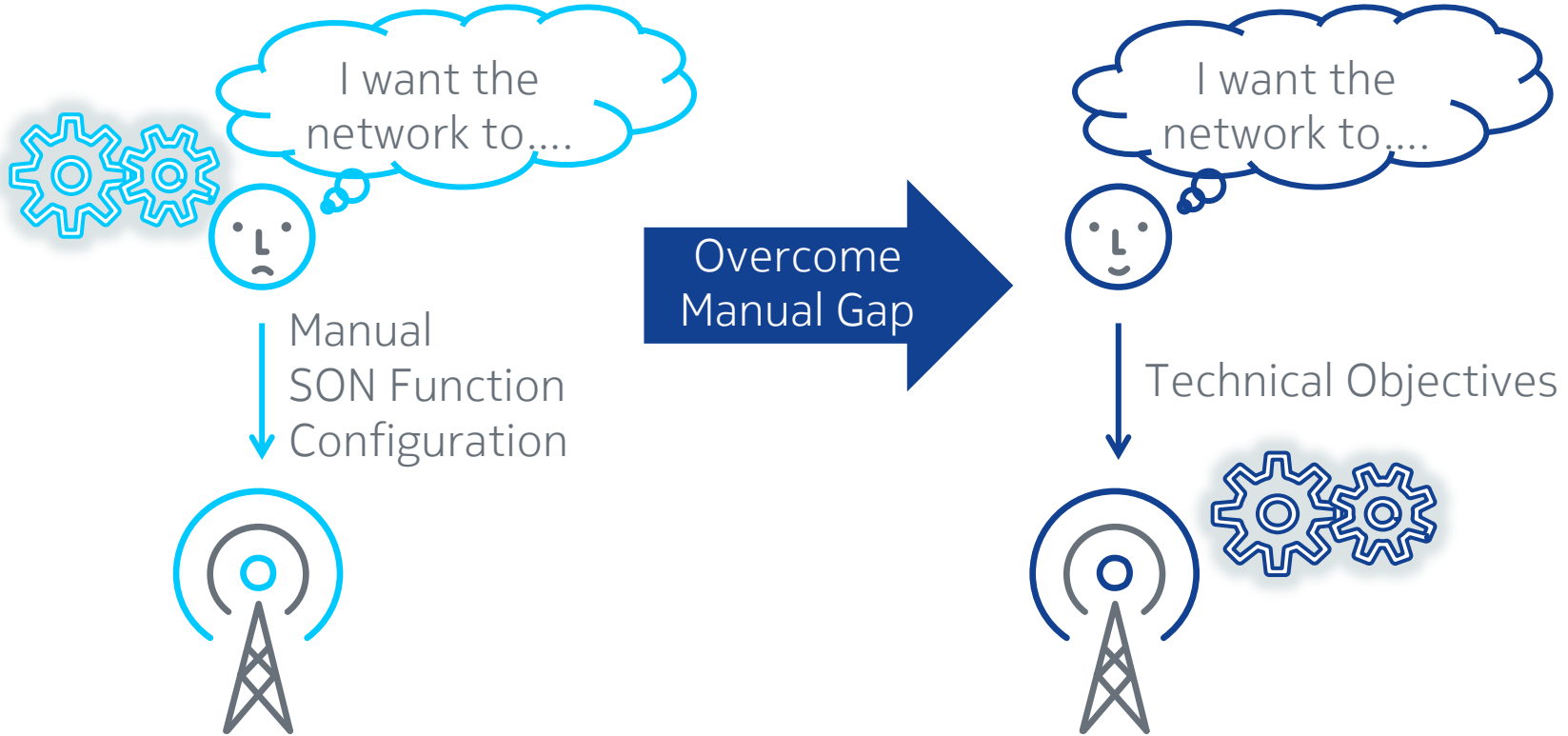
## SON Function Configuration



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

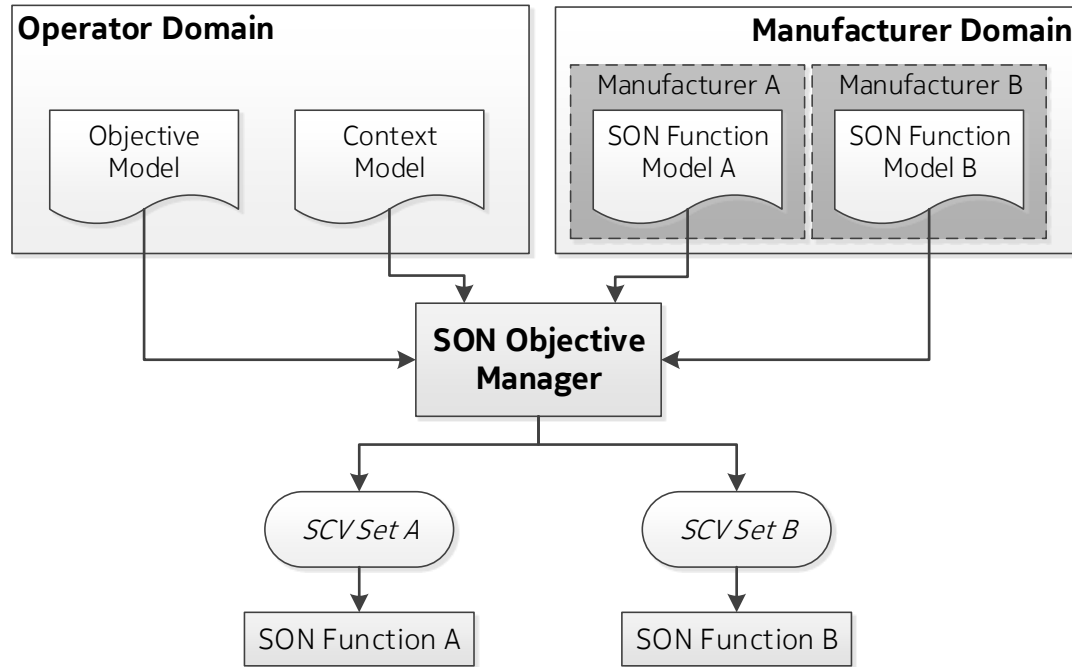
# Motivation

## SON Management



# Basics

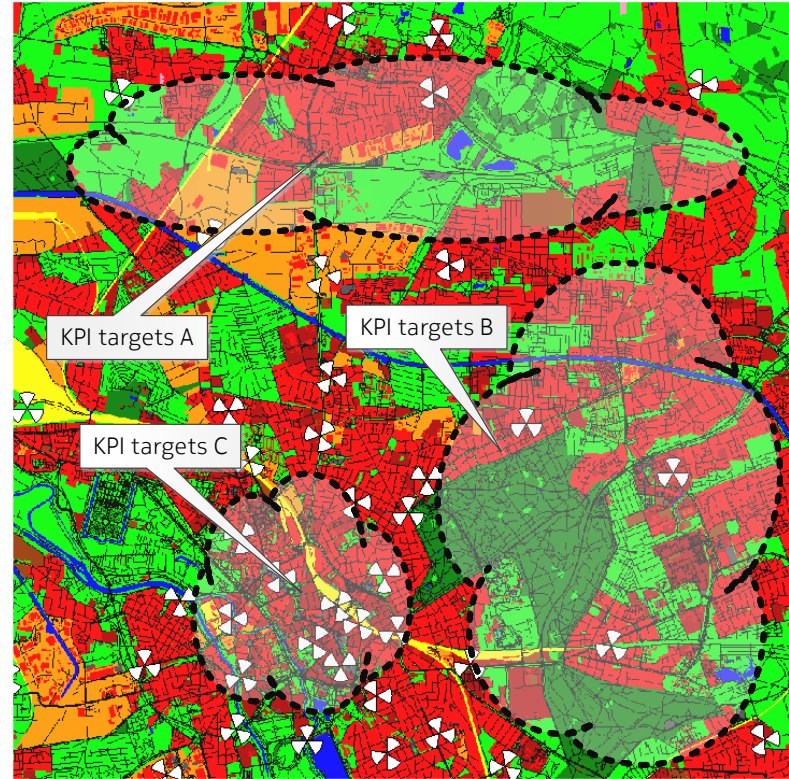
## SON Objective Manager



# Problem Description

## KPI Target Definition in the Mobile Network

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

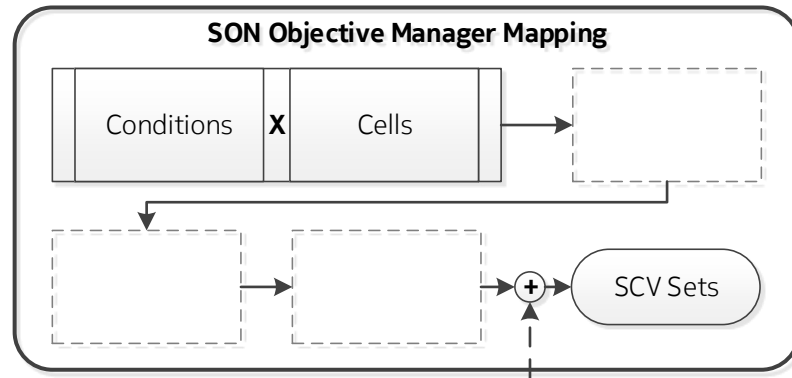


# Problem Description

## 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				

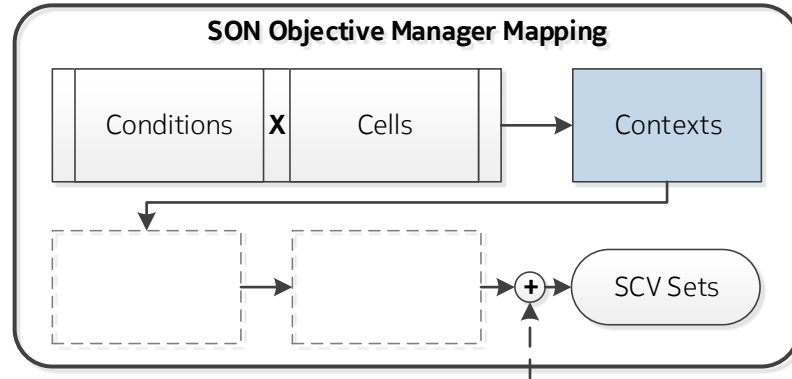
**Problem:** n-dimensional context space with possibly infinite context attributes

# 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

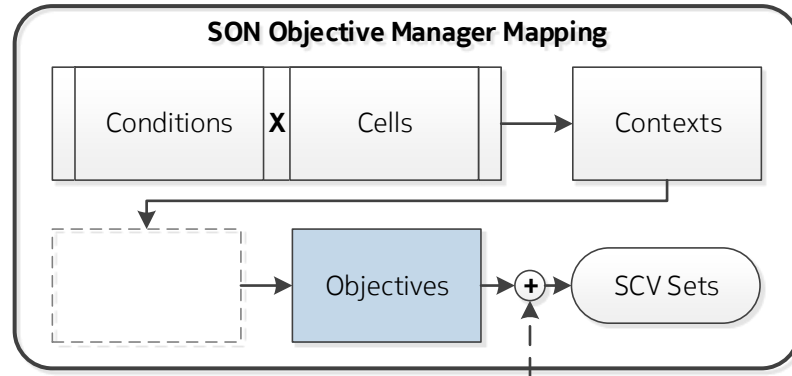


# Concept

## 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>B</b>	
	Micro	<b>A</b>			
	Pico			<b>C</b>	

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

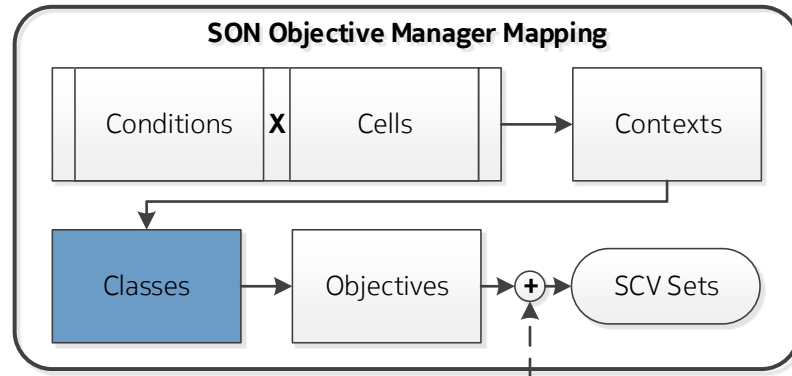
**Solution:** Partitioning of context into context classes

# 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

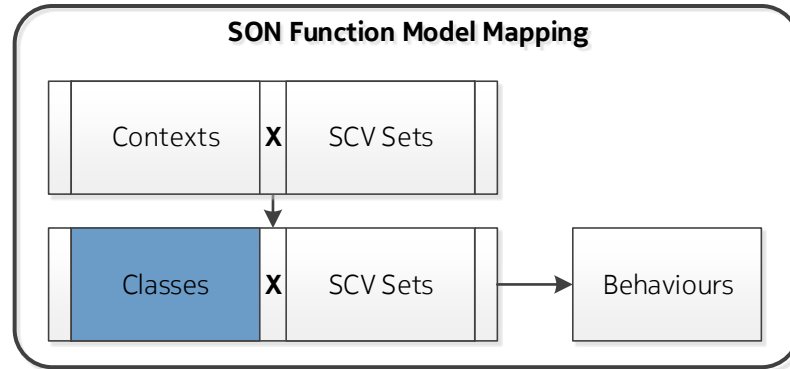


# Concept

## SON Function Model Mapping

### SON Function Model (SFM)

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



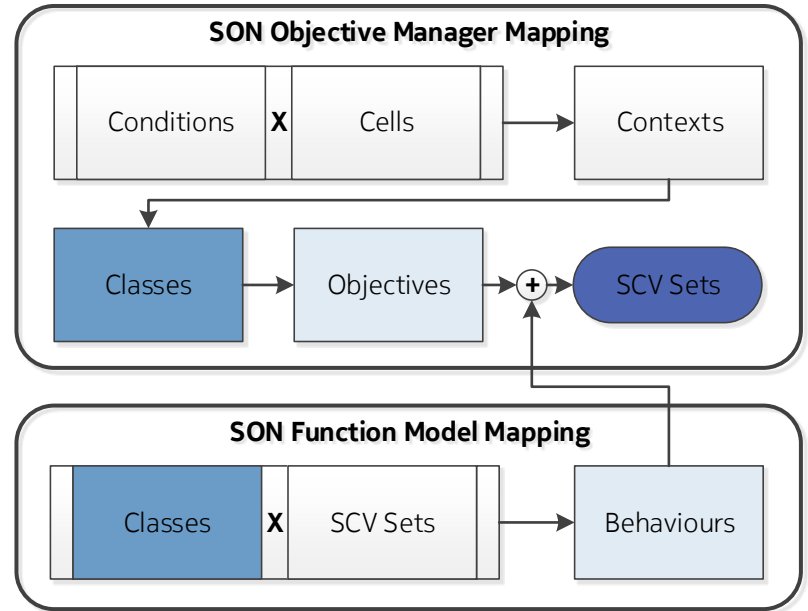
**Assumption:** Behaviour depends on cell context and the environment → context dependent effects in the SFM

# 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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