



AUSTRALIAN SYSTEMS
ENGINEERING WORKSHOP
ADELAIDE | 1-2 NOVEMBER 2018



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Model-Based Systems Engineering Analysis for Communications Networks

Introduction

- SESA Telecommunications Working Group
 - Since November 2017
 - See the displayed Quad Chart

To improve telecommunications services by developing a body of knowledge that advances Systems Engineering of telecommunications solutions

- Developed model for Mobile Communications Network
 - Purposely not on current technology, but somewhat realistic example
 - Initially small model to demonstrate some specific areas of interest
 - Looking to develop further as a product of the working group
 - Aims to provide a sandpit for other Working Group ideas and products

Problem Scope & Challenge

- **Greenfield** rollout of a new **GSM mobile** communications network
 - Scoped to cover basic GSM mobile services only (calls and SMS) rather than more modern mobile networks for data
- What questions would you want to answer as part of the design of such a network?
 - Questions needed for **input** to the design
 - Questions that you would want the design to **answer**

Initial Network Design Requirements

ACME Telecommunications Company

High-Level Requirements for GSM Mobile Telecommunications System

The ACME telecommunications company has conducted market research for the initial roll-out of a new mobile phone service for the Springfield area. This market research has resulted in the following top-level design needs for the initial mobile system deployment:

Development of a new mobile telecommunications network meeting the following parameters:

- a. Second generation GSM mobile network
- b. Providing full coverage of the Springfield local area, which has a uniform population density over its **2000 km²** area.
- c. For sufficient coverage, a maximum cell radius of **10km**.
- d. Providing a Grade of Service (GoS) with a **2%** probability of call block.
- e. Utilising **7.5MHz** of spectrum bandwidth with sectored frequency reuse in a **3/9 plan** (cluster size of 3 cells with 9 frequency sets)
- f. Utilising two channels per sector for signalling.
- g. Each mobile base station site will be set up in a **3-sector formation**, providing services for 3 cells in a single site.

Consulting the ACME Telecommunications spectrum use and "Erlang B" table of capacity, this will provide 30 channels per cell, and the 2% Grade of Service results in **21.9 Erlang** of capacity per cell. A derating factor of **2** is used to account for the mobile distribution of customers in Springfield.

The expected initial customer demand in Springfield for this network is:

- a. **25,000 customers** to be served (2% of Springfield's population of 1.25 million)
- b. Average usage is **120 call minutes** per customer per month
- c. **20%** of the calls are made in the busy hour (weekdays only, of which there are 22 per month)

- Walkthrough / demonstration:
 - Modelling of basic Architecture and Behaviour
 - Managing Constraint Requirements
 - Identifying, connecting and managing system parameters
 - Creating Constraint Definitions
 - Communicating constraints via diagrams (Constraint Block Diagram and Parametric Diagram)
 - Using the Matlab Constraint Solver from GENESYS to solve constraint equations
 - Further uses: “what if...?”, impact of requirement change

Demonstration

Further Design Questions?

- **Greenfield** rollout of a new **GSM mobile** communications network
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- What further design-related questions can you think of that could be integrated in this model?

Summary

- Parameters from Requirements
 - *Building richness of model*
- Constraint Definitions
 - *Defines design interactions between model elements*
- Constraint BDD and Parametric Diagrams
 - *Communicate design constraint interactions*
- Analytical solution exploration and resulting changes in system design
 - *Simple, repeatable impact analysis of requirement changes*

Telecommunications Working Group



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Charter

Purpose

To improve telecommunications services by developing a body of knowledge that advances Systems Engineering of telecommunications solutions.

Goals

- To demonstrate how systems engineering practices can improve the development and management of telecommunications systems.
- To increase the practice of systems engineering in the telecommunications industry and on telecommunications projects.

Scope

- Supporting telecommunications systems solutions not only in the telecommunications services industry, but also other industries that rely heavily on telecommunications systems, such as government, defence and transportation.
- Align to the SESA Mission to share, promote and advance the best of Systems Engineering for the benefit of organisations and community.

2018 Outcomes

Established weekly working group meetings:

- Identified potential working group participants from SESA and elsewhere.
- Solicited working group interest by email to the SESA membership.
- Identified technical societies, professional bodies and open source development groups closely related to telecommunications systems engineering.

Presence at SETE 2018

Telecommunications stream at ASEW 2018

Discussion of Telecommunications current issues:

- Dynamic Spectrum License Management
- Network Flexibility Concerns

Collect existing MBSE model samples that relate to telecommunications

Draft Guide to Application of Systems Engineering to Large Communications Network Systems

Planned Work

Formalise Working Group:

- Establish an INCOSE industry telecommunications working group and presence at INCOSE IW 2019
- Formalise Working Group Charter

Publish Guide to the Application of Systems Engineering to Large Communications Network Systems

Publish sample MBSE models / broad architecture models that can be used for telecommunications problems

Arrange telecommunications speaker in the SESA National Speakers Program

Prepare 2019 Calendar Year plan prior to INCOSE IW

Outreach:

- Continue to seek out telecommunications engineering executives domestically or internationally to champion this working group.
- Engage Australian telecommunications researchers and academics to raise awareness of the role of systems engineering in the telecommunications industry.
- Shepherd telecommunications student submissions to SETE / IS / IW.
- Setup periodic collaboration meetings with groups closely related to telecommunications.
- Enlist telecommunications companies to be SESA/INCOSE sponsors (or over time, members of a corporate advisory board).
- Presentation / Advertising of INCOSE systems engineering body of knowledge in telecommunications companies and bodies.
- Arrange for accreditation of CSEPs in the telecommunications industry.

Further Questions? Interest in Telecommunications WG?



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