Implementation of Dynamic Customer Product Information for a Network Router Product

Master's Thesis in Computer System Engineering

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Preface

This study has been carried out by Saghi Lotfi, student at Network Computer Engineering at Halmstad University, Sweden. The work has been performed at PDU Packet Core System Management section at Ericsson AB at Lindholmen, Göteborg, Sweden, under the supervision of Mats Slunga. Bertil Svensson, Professor of Computer Systems Engineering, has been the supervisor at Halmstad University. Examiner for this thesis is adjunct Urban Bilstrup at Halmstad University.

Firstly, I would like to thank Prof. Bertil Svensson, for his great help, support and comments on the work.

I would like to thank both Bengt Strömberg and Mats Slunga for their collaboration, support, and feedback.

Hereby I would also like to thank everybody involved in this thesis, especially my parents, Irma Kharshiladze and my sisters for their help and support during this project.

Saghi Lotfi

Halmstad University, October 2011
Abstract

When a telecommunication company delivers a product to a customer, three main pieces are included: software, hardware and Customer Product Information (CPI). The CPI can be thought of as the “user manual” for the product.

The CPI is important to most companies. It is important not only that the final product really corresponds to the needs of the customer, but also that the customer in an easy manner can learn how to install, configure and subsequently use the product. To provide this information to the customer, a correct content and a good information structure of the CPI is crucial. To ensure this, the studied company has developed a “Customer Product Information Life Cycle Process” to enhance the understanding of the customer needs in terms of documentation and training material about the product and comply with customer needs.

Part of this thesis consists of a study which makes an evaluation of the development parts of the CPI process. This is done in order to find a method and tool to be able to improve the structure, content and usability of the CPI used in a product called Gateway GPRS support Node (GGSN). The conclusions from the study are implemented with a Content Management System (CMS). One important aim is to use a wiki-type tool where the customer can make local adaptation to the delivered CPI and add information about their own network, configurations and handling; in this way they will be able to make the CPI structure more user-friendly and used more efficiently by the customer’s staff.

As part of this thesis, a test was carried out to suggest a new model to improve the current CPI model used at the company. The test was based on a methodology, tool-independent CMS called Drupal. Drupal was used to create test documents in the GGSN-MPG CPI environment. The quality of the CPI made with the Drupal tool was examined after the change. The results clearly demonstrate that a new portal platform, based on a Drupal-like tool achieves a far more flexible structure and would greatly improve the CPI capabilities. It is preferable to use a Drupal-like portal platform rather than a website when implementing a new CPI structure.
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Terminology

3GPP 3rd Generation Partnership Project
ALEX Active Library Explorer
AS Assignment Specification
BS Billing System
BSC Base Station Controller
CAL store Central ALEX Library
CDM Collaborative Document Management
CPIX Customer Product Information on Extranet
CSM Corporate Style Manual
CGF Charging Gateway Function
CMF Content Management Framework
CMS Content Management System
CR Change Requests
CS Circuit-Switched
DNS Domain Name System
DWAXE Docware for external and Ericsson products
FOA First Office Application
FOSI Formatting Output Specification Instance
GGSN Gateway GPRS Support Node
GGSN-MPG GGSN Mobile Packet Gateway
GPRS General Packet Radio Service
GRE Generic Routing Encapsulation
GSM Global System for Mobile communications
GSN GPRS Support Nodes
HTML HyperText Markup Language
IP Internet Protocol
MMS Multimedia Messaging Service
MBMS Multimedia Broadcast and Multicast Service
MS Mobile stations
MT Mobile terminal
O&M Operation and Maintenance
OCS Online Charging System
OSPF Open Shortest Path First
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>PCRF</td>
<td>Policy and Charging Rules Function</td>
</tr>
<tr>
<td>PDF</td>
<td>Portable Document Format</td>
</tr>
<tr>
<td>PD</td>
<td>Product Decisions</td>
</tr>
<tr>
<td>PDN</td>
<td>Packet Data Network</td>
</tr>
<tr>
<td>PDP</td>
<td>Packet Data Protocol</td>
</tr>
<tr>
<td>PCL</td>
<td>Plan and Control PLC</td>
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<tr>
<td>PLC</td>
<td>Product Life Cycle</td>
</tr>
<tr>
<td>PS</td>
<td>Packet Switching</td>
</tr>
<tr>
<td>PSTN</td>
<td>Public Switched Telephone Network</td>
</tr>
<tr>
<td>PVC</td>
<td>Permanent Virtual Circuit</td>
</tr>
<tr>
<td>QA</td>
<td>Quality Assurance</td>
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<tr>
<td>QoS</td>
<td>Quality of Service</td>
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<tr>
<td>RBS</td>
<td>Radio Base Station</td>
</tr>
<tr>
<td>SACC</td>
<td>Service Aware Charging and Control</td>
</tr>
<tr>
<td>SAU</td>
<td>Simultaneously Attached Users</td>
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<tr>
<td>SGML</td>
<td>SGML Document Interchange Format</td>
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<tr>
<td>SGSN</td>
<td>Serving GPRS Support Node</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
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<tr>
<td>TE</td>
<td>Terminal Equipment</td>
</tr>
<tr>
<td>TR</td>
<td>Trouble Reports</td>
</tr>
<tr>
<td>TTM</td>
<td>Time To Market</td>
</tr>
<tr>
<td>UDP</td>
<td>User Datagram Protocol</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual Local Area Network</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
</tr>
<tr>
<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
</tr>
<tr>
<td>XML</td>
<td>eXtensible Markup Language</td>
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1 Introduction

Customer Product Information (CPI) is the technical information needed to handle a product throughout its entire product life cycles. The CPI for a telecom product is, together with the hardware and software, an integral part of the system. For example, CPI is used in the early phases of system information. The CPI must be well structured, and it must be presented in such a way that the user can find the information easily. There are several reasons for improving the usability of CPI in all network environments. One reason is that the CPI is a unidirectional information channel for the company’s internal, customer and partner usage. Other reasons are that in the current form, it can be difficult to find information since the search functions are very basic, and that there is no way for the customer to modify or enhance the CPI.

In this thesis, different problem areas of CPI based on GPRS network architectures are discussed and two important nodes, SGSN and GGSN, are studied more in depth. Also, four popular Content Management Systems (CMS) are compared. One of these, Drupal has been studied and implemented in the PDU packet core department at Ericsson AB.

Drupal is used as a wiki-type tool for handling and managing customer product information which here mainly focuses on CPI structure for the Gateway GPRS Support Node (GGSN).

The study resulted in designing a web portal based on a CMS that mostly utilizes the Drupal software, and these methods are well suited to fulfill the requirements where the database must not be changed and customers shall be able to add their own information. Drupal has an incremental process where non-technical staff can iteratively discuss problems and understand what has to be done.

1.1 Motivation

The Gateway GPRS Support Node (GGSN) is lacking a modern and flexible CPI. Today there is no way of adding customer specific information to the CPI library in the existing tool in the GPRS network node. In order to enhance the customer perception in this area it is necessary to investigate how to improve CPI in network environment.

The quality of the GGSN-MPG CPI needs to be improved by making it flexible and easy to use. Providing a GGSN-MPG CPI is most important because the customers have own network on different kinds of nodes and they need information on how to set up and configure their nodes. Also they need to compile this information to visualize the steps needed to successfully integrate and maintain the nodes in a network, so finding a more flexible structure of network documentation and adaptation is motivated.

The most important task in this research is to provide and find the best solution to improve the CPI and provide an efficient flow of data in the CPI documentation process. Also, the task is to implement a new wiki-type tool which offers more flexible structure, adaptation and ease of use for customers.

1.2 Problem Studied and Questions to Answer

Rapid growth of new generations of mobile systems and high market demands push the company to consider in their CPI network model in order to accelerate their development processes and fulfilling tougher Time To Market (TTM) requirements. Thus, the current customer product model should be improved and modernized with a more flexible CPI, ease of use and provide a better value to the customer. The main problems within the development
of documents will be detected and alternative models proposed. The primary questions that need to be answered are:

- How is the CPI documentation organized and managed today?
- How does the staff use the current model of CPI?
- Does the CPI model which is currently used have the potential of becoming more flexible?

The users of the GGSN product usually have their own system for logging work orders, work descriptions and specific network setup documentation in their own database/system. The CPI is delivered to the customers as an ALEX (Active Library Explorer) library. There is a need to deliver the CPI in an alternative way with a more efficient informational structure where the customers easily can integrate their own specific information into the CPI.

An area where the information currently is spread over several different documents is the network deployment documentation. This makes it hard for the customer to find the full work flow for this activity. There is a need to collect and display this documentation as a compiled work flow description.

This thesis focuses on the specific customer product information and aims to find an answer to the questions:

- How do we find and suggest a better and more efficient information structure for customer product information?
- Is there a suitable way to present a modularized version of the existing CPI with the possibility for customer feedback, or even creating a community with customers and the company personnel?

The model proposed in this thesis will definitely improve the flexibility and usability of the CPI, and it will improve network integrity and deployment by detecting and recovering the problems and consequently decrease trouble reports.

1.3 Approach Chosen to Solve the Problem and Answer Questions

This is the chosen approach for this study:

- Try to modularize the existing CPI documents
- Make a market survey and see if there is a suitable tool to present a modularized version of the CPI with at least the possibility for the customers to adapt the CPI and preferably also provide feedback.
- If a suitable tool can be found, make a proof of concept demonstration using the tool and parts of the existing CPI as input.

1.4 Thesis Goals and Expected Results

The main purpose of this study is to improve the structure of the customer product information process at the Ericsson GGSN unit by investigating new tools.

Furthermore, this document will suggest and investigate what tools or software or what organizational models could make the dynamic CPI.
The research goes through the investigation of the current model used current way of working, identifying underlying problems, making a list of improvements and investigating these approaches from different points of view both in theory and practice.

The main goals are:

- Suggest a solution for optimizing CPI
- Suggest a Dynamic CPI solution
- Implement a prototype or demonstration based on content management system by using the chosen tool

1.5 Thesis Methodology

This research is based on collecting both empirical and theoretical data. Besides the literature reviews, an attempt has been made to collect information from interviews with experienced managers and employees working both inside and outside Ericsson.

Literature reviews and study of internal documents were an important part of the study in order to get an overview of the basic concepts of the CPI life-cycle, CPI library description and Active ALEX Liberty model and issues regarding CPI life-cycle management.

Internal interviews were done in order to identify the main problem areas in the current CPI life-cycle model, which is currently used at Ericsson. Understanding the underlying problems helps to find a solution. The solution was based on selecting one out of four popular content management systems.

Suggestion for Improvements

To further improve the empirical study, results should be gathered from interviews with users and people with a good market view (product managers, marketing personnel, support etc). An attempt has been made to summarize the findings and present solutions based on considering Fault Slip Through (FST)\(^1\) and trouble reports from companies or consultants. The investigation will be followed and suggestions based on the prototype will be presented as well. As mentioned before these suggestions for improvements are considered as a new strategy to achieve a useful CPI.

Findings from inside the company revealed that there is a potential for improvement in interaction and cooperation between system managers and technical writers. As we know, customer product information gives the customer a perception of the quality performance of the products that a company delivers.

1.6 Scope and Limitations

Due to confidentiality issues it was not allowed to provide the readers with all the information from inside Ericsson, so the scope was limited to discuss issues within the following boundaries.

Scope

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\(^1\) FST is used in Ericsson to analyze Trouble reports, to suggest improvements for free frequently occurring problems.
Discussions about the current model of the CPI and CPI life-cycle at Ericsson compose the main parts of the research. In this study some stages of customer product information and problem areas of CPI are investigated.

These stages are:

- **Pre-study**: Possible solutions in order to find and suggest a new, better and more efficient information structure
  
  Ways to improve the structure of customer product information to investigate a new possible wiki-type tool where customer and other users also can make their own local adaptation

- **Execution**: Implementation of a new tool based on Drupal to create a new flexible structure model of CPI

- **Realization**: How to start Integration and Verification (feedback via comment) from the beginning (Move current model to new model)

**Limitations**

The last part of this thesis is a demo, showing what can be done with the suggested tool. Also, a sample implementation is made of a part of the GGSN_MPG ALEX database section and how to handle that using the tool. How to increase motivation among employees and how to apply concurrent engineering within the execution phase are not parts of the discussion in this study.
2 Background

Ericsson, founded in 1876, is a leading company in the telecommunication business which provides global telecom services, communication networks, equipment, and multimedia solutions. Several current products are work is based on the 3rd Generation Partnership Project (3GPP), which has given them the possibility to be among the few companies that can offer end-to-end solution for all common mobile communication standards. Over 1,000 networks in more than 180 countries use Ericsson equipment. Furthermore, more than 40% of all mobile calls pass through Ericsson’s communication systems (In the year, 2011). The Ericsson Packet Core Solution provides the reliability, scalability, capacity, functionality and performance needed.

GGSN is one of the main elements of the General Packet Radio Service (GPRS) packet core network, which acts as an interface between the Mobile Station (MS) and the Packet Data Network (PDN) towards internet or corporate network. This thesis work is carried out at the PDU Packet Core System Management section at Ericsson Company in Gothenburg, Sweden.

The GGSN is one product included in a broader Packet Core solution. Packet Core also includes several other products such as SGSN/MME, HLR, PCRF, Multi-mediation, and so on. Each product that is delivered to Ericsson’s customers includes: software, hardware and Customer Product Information (CPI). The CPI can be thought of as the “user manual” or an instruction for a product. The CPI documentation must be a well-structured document to describe the role of the product in the overall Packet Core environment, therefore these documents must describe in a meaningful way how the product should be configured, integrated, and monitored as part of the overall solution. The rest of this chapter will describe the CPI, more details about GPRS network and GGSN functionality is found in appendix B.

2.1 What is CPI?

CPI is the technical information needed in order to handle products throughout their life cycle.

Generic Requirements on CPI are described by the Product Information Discipline centrally within Ericsson. These requirements are compiled to ensure consistent CPI of good quality and a common look and feel. and are common for all Ericsson products. The main goal of these kinds of requirements is to have a common structure and visual appearance, common numbering and naming and rule also common administration, an aligned CPI supply. This is also valid for all Ericsson products.

An efficient CPI plays the most important role for customer satisfaction and supporting company’s products.

2.2 Customer Product Information (CPI)

The CPI today presents the customer documentation as a number of html and PDF files, delivered in a library called Active Library Explorer (ALEX) [13]. The customer product information should cover the correct information in a specific structure, which includes all information about specific nodes in a way that is easily understood by the reader. Since the product is quite general it can be configured in many ways, which means that the customers are interested in different parts of the documentation; description of both Hardware and Software, Upgrades, Operation and Maintenance, Planning and Installation, Configuration Management, Interfaces Management, Performance Management, Alarm Handling, Logging and Tracing, Troubleshooting, Emergency handling procedure and more. The GGSN-MPG
interacts with many other servers (called nodes) in the network. The customers often have nodes with different configurations and behaviours, therefore need to have documents to setup GGSN, other nodes and different interfaces.

2.3 CPI Library Description

The CPI library description is defined as a tool in the GGSN environment, which presents the customer documentation as a number of different files, delivered in a library called Active Library EXplorer (ALEX).

2.4 CPI Library Categorize

Categorizing of the documents in CPI library includes:

- Descriptive documents provide descriptions of the GGSN from different aspects.
- Operational documents provide instructions on operating and maintaining the GGSN.
- Reference documents provide additional in-depth information on miscellaneous product topics.

![Figure 1: CPI Library Category](image)

As be seen in the Figure 1, the CPI Library for GGSN, in active Library Explorer (ALEX) browser is grouped in the following main folders:

- Safety and Environment
- Library Overview
- Product Overview
- Planning
- Installation
- Initial Configuration
- Operation and Maintenance
- Emergency
- Interface
The CPI contains information which enables the customer to operate and maintain the GGSN product.

2.5 Library Overview

The Library Overview folder includes the CPI library description and a document that outlines the changes to the CPI library between releases, as well as specifies reasons for the new CPI revision.

It also contains the product Readers' Guide, which gives instructions on how to approach the product documentation. In this study the product is referring to GGSN-MPG.

2.6 Product Overview

The Product Overview folder consists of several separate subfolders, and the structure of the subfolders resembles the structure of the GGSN Technical Product Description Overview. It is recommended to start with this document when looking for information on the general functionality of the GGSN.

2.7 CPI Overview

Technical information is very important for the customer to handle the product throughout all stages of the product life cycle contained in the CPI. All preliminary and released CPI is stored online in CPI Store and is made available to customers on extranet.

Figure 2, shows the general overview of CPI, the first level shows the CPI requirements, after that it describes the methods of CPI process and instructions and recommendations on how to produce CPI usability and activities that must be performed to support an efficient and consistent way. In this part it also describes the CPI work flow. In the end it shows four related tools which are used to produce and publish the CPIs.

2.8 CPI Requirements

The major generic requirements for the CPI are:

- Ensure that all CPI are be created in consistent way.
• User friendly help for creating and publishing CPI in compliance with CPI requirements

• Helping users to manage all tools that are related to CPI and ensure that those work together in correct way.

There are two types of CPI requirements:

• Generic Requirements on CPI described by the Product Information Discipline centrally within Ericsson. These requirements are compiled to ensure consistent CPI of good quality and a common look and feel. These are common for all products. The main goal of these kinds of requirements is to get a common structure and visual appearance, common numbering and naming and rule also common administration, an aligned CPI supply.

• Product Specific CPI requirements [2] described by product and system management for each product area. These requirements are specific to a product or a product area.

2.9 CPI Methods

These methods are giving instructions and recommendations on how to produce CPI with the available tools, and it is necessary to think about adaptation in certain cases for recommended and suggested application of methods for the individual CPI development projects.

Major proposals of CPI methods are shown below:

• User friendly help for creating and publishing CPI in compliance with CPI requirements

• Helping users manage all tools that are related to CPI and ensure that those work together in a correct way.

• The CPI must be created in a consistent way.

CPI process outline

The aim of the CPI process is to describe instructions and recommendations on how to produce CPI usability and activities that must be performed to support an efficient and consistent CPI.

Four activities are identified for CPI methods and each applies to a specific part of the CPI Development:

1. **Analysis**: analyze the requirements and the information that shall be incorporated into the CPI. How will the product be sold and used? What are the requirements on the reader? Are new documents needed or can you update existing documents?

2. **Design**: involves information used during the production of the documents.

3. **Packaging**: produce the actual CPI according to requirements and guidelines. This work is done in close cooperative with system managers, designers, and so on.

4. **Supply**: How to deliver the CPI product to CPI consumers.

Customer feedback and usage statistics gives a base for future improvements.
All supporting methods are needed to increase the quality and usability of the CPI product for getting high quality assurance of the documentation.

2.10 CPI Workflows Overview

The procedure to describe the process from start of a CPI project till the completed CPI is published and the project is closed.

![CPI Development Work Flow](image)

The CPI development process with the related instructions and templates is depicted in Figure 3, as you can see the result of each activity is an output for the next activity to proceed correctly.

When an assignment for CPI development is received, the project’s first delivery is usually to a first customer trail First Office Application (FOA), when the first released CPI product is delivered to a FOA customer, the customer started to test, during the FOA the new product release is installed, thoroughly tested and introduced in a line network. When this is successful and any problems are corrected, a General Availability (GA) decision is taken and product can be delivered to other customers.

**CPI Design:**

The activity involves writing and updating CPI documents, including review, test and verification.

**Role Description:** Mentions the roles that are assigned in the CPI workflow

**Product Manager:** The CPI product manager is responsible for high level requirements on CPI.

**CPI System Manager:** The CPI System Manager is overall responsible for the product’s CPI. The role has a cross-functional and an end-to-end view concerning all CPI at a product unit and is not directly involved in the activities in a specific CPI project.

Main tasks are to manage the product CPI concept and roadmap.

- Ensure continuous improvement of the CPI through detailed analysis of the CPI and Setting requirements on the development projects.
• Analyze main requirements and ensure consistency of requirements for the product’s CPI.

• Evaluate and initiate new requirements.

• Support the project (both in CPI and in system project).

• Develop and maintain local methods and guidelines.

• Contribute in investigation for product management.

• Drive the work to create and maintain templates for the CPI.

• Drive and arrange customer visits and feedback.

• Arrange quality audits of the CPI.

**CPI Project Manager:** Is the project manager for the CPI from start to end.

Some major tasks are:

• Responsibility for analyzing the Assignment Specification (AS) at the start of the project

• Writing the CPI project Implementation Proposal (IP) and Project Specification (PS)

• Coordinate and support Configuration Management (CM)

• Participating in review meetings and analyzing Trouble Reports (TRs) and Change Requests (CRs)

• Creating the Product Revision Information (PRI) describing the changes in the CPI release.

• Creating a final report at the end of the project.

**Technical Writer (TW):** Is the person who writes CPI. TW works as bridge or interface between those who develop the product and those who will use it:

• TW must have good knowledge of the Corporate Style Manual (CSM) that is intended to be an online resource for writers of CPI.

• They have to know the target groups of the CPI and have an understanding of its application.

• Good knowledge of tools and training in order to write user-manuals.

**Main Task:** They have to be able to gather and analyze technical information from system managers and designers to write CPI that follows the requirements for CPI to manage structure, conciseness, style, clarity and terminology in cooperation with the technical Editor. Furthermore they need to cooperate with designers to verify that the CPI is technically correct, also collaborate with developers and product specialists to design user interfaces.
After that they must participate in per reviews and technical inspection. After Technical Inspection, FOA [3], Verification, tests are done, it’s the time for updating the CPI and making the final delivery.

Technical Editor: Editors are responsible for proof reading works to ensure proper grammar and syntax, and for confirming the veracity of the information presented. The main tasks are to communicate the style and language standards within the project and support the technical writers during the process of development such as document title, document structure, style, language, word use, readability and irretrievability index, table of contents, comprehensibility and completeness. Also they are responsible for performing editorial reviews of documents.

2.11 CPI Related Tools

There are four related tools which are used to produce and publish CPI.

1.1.1 Tagtool

Tagtool[4] is set of tools, for supporting the creation, editing and sorting of documentation in eXtensible Mark-up Language (XML) and Standard Generalized Mark-up Language (SGML) formats.

1.1.2 DWAXE

DWAXE [5] is a web-based system used to create document libraries, help sets, packages and containers that are used by internal and external customers. The CPI can also include 3rd party product documentation.

1.1.3 CPIX

Customer Product Information on Extranet (CPIX) [6] is the application behind CPI Extranet, CPI Store and CAL Store, which are Ericsson repositories for Customer Product Information. The CPI Extranet installation serves Ericsson customers and partners and is part of the eBusiness portal. CPI Store serves internal users with released product information, while CAL Store typically contains preliminary and non-released information strictly intended for Ericsson internal use only. An external partner company may, however, be granted access to a specific folder on CAL Store.

1.1.4 Active Library Explorer

A central component of CPIX is Active Library Explorer (ALEX), which implements the browser and search functionality. The CPI illustrated in the Active Library Explorer (ALEX) window and can be accessed from a standard web browser.

Active Library Explorer is designed to handle electronic documentation in such a way that the same document library can be used both on web-servers, on a Local Area Network (LAN) file server, and on portable PCs. Active Library Explorer supports several document formats which include HTML, PDF, Excel. [7]

All preliminary and released CPI is stored online in CPI Store and is made available to customers on Extranet.
2.12 Current Model of Using CPI in Ericsson

ALEX Library Explorer [9] is used to display the CPI and can be accessed from a standard web browser, see Figure 4.

2.13 ALEX Browser View

Active Library EXplorer (ALEX) as the web-based interface and the delivery formats of the CPI Active Library Explorer (ALEX) provides a means for a user to browse Ericsson document libraries with a standard www browser. The Active Library Explorer is intended both for Ericsson internal and for customer use.

Active Library Explorer (ALEX) is a principle that could be used for describing the current document management status at Ericsson. ALEX with regards to management of highly complex CPI in the Active Library Explorer (ALEX) browser is grouped on the following main folders. It includes a description of the logical structure, a technical content of the CPI Library, and explains how to use ALEX to view CPI.

![ALEX Browser View](image)

**Figure 4: ALEX Browser View**

ALEX window shows Subfolders and the documents in the document frame are displayed simply by checking the + symbol to the left of the folder.

As you can see in the Figure 4, the Alex window is divided into three frames which are the toolbar frame, the tree frame, and the document frame. At the top of the browser you can see the toolbar frame, to the left is the frame used for navigation and the subfolders or documents are shown in the document frame.

Two ways exist to find a document:

- Using the search function in the toolbar frame
- Using the hierarchical library structure in the tree frame by navigating in the library

**Generic CPI structure:**

**Searching:** Search document box on the toolbar frame is used by entering the search parameters. There are four different types of searches that will work on the documents.
• Searching command or block name
• Searching of the text body
• Searching based on the title
• Numbering searching

The CPI should cover the correct information in a specific structure, which includes all information about specific nodes in a way that is easily understood by the reader. Since the product is quite general, it can be configured in many ways, which means that the customers are interested in different parts of the documentation; description of both Hardware and Software, Upgrades, Operation and Maintenance, Planning and Installation, Configuration Management, Interfaces Management, Performance Management, Alarm Handling, Logging and Tracing, Troubleshooting, Emergency handling procedure and more.

As all the information does not apply in specific products, the readers first must familiarize themselves with the product that they are working with and understand which document parts apply to their product.

These documents or instruction manuals require that persons performing work on Ericsson products have the necessary education, training, and competence.

2.14 Customer Perspective

The CPI should cover and describe all tasks and contain sufficient information; it is important that this information is relevant, clear, and concise.

One of the problems that our customers are faced with is an increasing amount of text where customers need to find the correct information for the specific product they use.

Large part of the trouble reports that are received concerns missing information inside the CPI and it is a good reason for using checklists during reviews. During a review, we can understand what is wrong in a text but, by using checklist and answering these questions, we hope they will help to identify what is missing in the document and not just what is wrong in a text.

Now the risk of confusion on the customer side is at a high level, and it can directly cause errors in their network. If we find a method to get a modular structure, then we will be able to decrease the number of problems during configuration and setup.

The advantages of modular information are as follow:

- Easier to understand
- Easier to update
- Reuse of information
- Easier to present the information in different ways (documents, apps, database for inclusion in a customer's existing O&M system)

Here is suggestion about how to improve the text inside the development team.
2.15 Usability of CPI

The usability of CPI means how general concept of CPI usability is interpreted relating to the CPI and providing methods that result in usable CPI.

A CPI can have different purposes depending on who is using the CPI, the usability of the CPI is never better than the usability of the product that it describes, but at this time Ericsson has good products of top level quality, however sometimes the customers are not satisfied with that product because they are not satisfied with the fragmentation of the data in the CPI.

Usability Strategies: The purposes for effective and usable CPI are shown below:

CPI should be accurate and complete.

- Specific information deals with specific topics.

- CPI is illustrated and delivered in the most effective way, such as ALEX, online help.

Readers can rely on the CPI [8] without having to ask a colleague or call a help desk.

Quality Assurance: Quality Assurance (QA) strategies for customer product information to be used throughout the development cycle to ensure that released CPI is correct, consistent, complete and valid.

Satisfaction:

Reaching effectiveness of CPI is related to:

- Consider the information regarding effectiveness and efficiency.

- Not distracting the reader from the task.

- Providing clear navigation techniques.

2.16 Integration between Business and Technology

The usability and quality of the CPI is only one (and at least up to recently, sometimes small) base for business decisions, and although it is not always considered by new customers, a good CPI is definitely appreciated by the customer and will be a good selling point for future business. CPI may historically not have had top priority focus. However, during the last two or three years Ericsson has noted an increased cost within various parts of the service organization. To mitigate this increase it was decided to investigate costs for CPI. Therefore, focus on CPI process, methods and tools, quality and so on, has increased and even if it may not be a primary part for business decision from a customer point of view, Ericsson is relying more and more on a good, high quality and accurate CPI. The focus on CPI has dramatically increased over the last couple of years.
3 Problem Analysis

Today’s customer markets are changing so quickly and companies that want to survive in the global market competition must adapt themselves to the rapid growth of market requests. While network speeds are increasing, new technologies force companies to think about fast delivery of services and products to their customers. These cause new releases of the CPI to be presented very fast to the market and replace the previous ones.

In all networks some aspects like integration and deployment should be considered. In most cases managing and handling of network products by using a good instruction and good interaction between customers and companies can help avoid problems.

A customer needs to have a good website interface to get easy access to CPI to be able to configure and maintain their networks, CPI is used to relay the correct information on how to setup and detect errors in the network and what should be done to correct them. If customers get errors or are faced with confusing information based on Ericsson CPI they will make mistakes configuring interfaces and routers and it will place their local network in critical situations.

Another problem also appear when product interacts with many other servers (called nodes) in the network, and the customers have different kind of nodes with different configurations and behaviors, and have a need to document the handling of both the GGSN-MPG and other nodes or interfaces according to their local needs.

Therefore, Ericsson needs a powerful online storage or database (web portal) that can cover all information described above, to give access to their customers and help them make and implement their network on a high level. This documentation should be functional and easy to use with simple and straightforward instructions. In this section I will only give a brief coverage of the problem as a background for further analysis. The focus is on content management system solution and achieving a more user-friendly and flexible handling of CPI.

3.1 Creating Dynamic CPI is Divided into Three Different Activities

More specifically, the subject proposed by Ericsson can be divided into different activities that can contribute to the objective achievement.

To understand the Industrial context:

This was achieved by studying internal documents, several interviews, attending the CPI responsible group. The result of this is learning how to manage the requirements in a more detailed manner. It is very important to understand each level of product, system, customer requirement and tools in order to release the interface between the customers’ requests, customer’s interactions and the technical requirements.

To improve customer product information process:

In order to achieve this, the first step is to analyse and learn ALEX library description, analyse the CPI process and the existing tools, furthermore, participate at a conception of a database and the website that is defined as interface between customer request management tool and customer request engineering.

To create and ensure customer feedback process:

This was achieved by studying available documents. The result was summarised and four popular Content Management Systems (CMSs) was compared. By investigating how to
manage the requirements in a more detailed manner by selecting one of them, in this case Drupal.

Drupal is a free open source platform and content management system that allows an individual to make a community for users. Drupal content management features let you create and manage your site easily for different goals. It works as a toolkit with many powerful capabilities and is extremely flexible. Furthermore, it has rules and a large variety of options for new user accounts and user permissions. In addition, it can be modified in a variety of ways. [13]

### 3.2 Basic Problems

There are a couple of problems to address how the CPI is delivered through web browser:

- **Add function:** add/link new information into the current CPI
- **Integrity:** can the information be manipulated in any way?
- **Structure flexibility:** can the large document be broken down into smaller parts?

Add function is solved with posted command where the customer can add/link in their own information.

Integrity is solved by adding feedback and comments on the CPI.

Structure flexibility is solved by adding advanced search function to the portal and separating the large document to the small parts that will make a CPI easy to read.

### 3.3 Mapping System with UML

Each use case focuses on describing how to achieve a goal or a task that we need to test.

There are three actors work in this system, the first actor is defined as Customer, second one is defined as a person responsible for the CPI with the ability to work and interact with customer. Third one is defined as an administrator who is the site-Admin of the system.

**Textual Descriptions of Use Cases**

Name of the use cases is a solution specific name that is related to a goal. The use case’s table representation illustrates the requirements necessary to achieve the goal.

**3.3.1 Use Case Diagram**

A use Case diagram provides a graphical behavior of the activity by the system in terms of actors, goals, and the interaction between use cases. It shows what system functions are performed by which actors.
Figure 5, shows the use case diagram specifying the behaviour of a Development CPI tool system. Each actor outside of the box represents an external object interacting with the system. System functionalities are defined as use cases inside the system. Typical goals of customers for online interaction are to browse a catalogue, add feedback (their own specific information) to the specific CPI, view their comments, review the feedback and get the answer, etc. as you can see in Figure 5, use case names are chosen to exactly express these objectives.

3.3.2 Use Case Scenarios

Scenario” Create Comment”

The customer will post a comment. The customer will write it on the form that includes title, description, body of comment, attachments file (text files, pictures or TRs) could be added into the CPI.

Participating actor: Customer

Entry conditions: Customer is logged into the CPI tool.

Exit conditions: Customer has received a message “comment has been saved” from the system that the selected transaction is complete, or if not complete, a message displayed “failed”.

1. The customer starts the Create comment task. (Writing feedback)
2. Creates a new Comment with a system assigned sequence number.
3. Open the comment-creation view using the new comment and displaying it to the Customer.
4. Enter a title and description and body of comment.
5. Activate the Add New command.
6. Inform the create comment task that the Add New command has been activated.
7. Create a title using the CPI number.
8. Attached the newly created files to the comment.
9. The customer activates the Save command.
10. Inform the Create comment task that the Save commands has been activated.
11. The Create comment task saves the comment.

Exceptions:
If in step 2, when the system fails to verify Customer’s access rights (customer’s password is different than provided), the system suggests “Try again”

Scenario of “Evaluated Feedback”
The E-user will read the recent feedback. The E-user will review it by details, furthermore, the user will be able to reply to the comment on the form, including title, description and Body of the comment; this will also relay from the system.

Participating actor: E-user.

Entry conditions: E-User is logged into the CPI tool.
Exit conditions: E-user has sent a message from the system that the selected transaction is complete, or if not complete, a message expressing failed.

E-user starts to review the feedback task.

Create a reply comment with a system assigned sequence number.

Open the new comment-creation view using the new comment (as reply) and displaying it to the E-user.

1. Enter a title and description and body of comment.
2. Activate the reply command.
3. E-user checks the comment and adds the correct technical information.
4. Inform the reply comment task that the Add New command has been activated.
5. E-user activates the Save command.
6. Inform the reply comment task that the Save commands has been activated.
7. Create comment task saves the comment.
8. The system sends a notification.

Exceptions:
If in step2, when the E-user clears the feedback to verify Customer’s comment not relevant to the existing CPI, the message appears.

Scenario of “Browse Catalogue”
The customer browses through the complete list of CPIs that are available in ALEX data base and can search and display a sub-folder of these documents, and display product information details of each CPI. The user can then select CPIs to post a comment for his request/question.

Participating actor: Customer.

Entry conditions: Customer is logged into the CPI tool.
Exit conditions: Customer has fond a CPI from the system that the selected transaction is complete, or if not complete, a message expressing failed.
1. The system displays all CPIs releases available. It displays for each CPI a unique identifier, its title and the unique number of documents.

2. The customer enters and submits a search text of CPIs.

3. The system displays a filtered list of CPIs that only show entries that have the search keyword as a substring in the field.

4. The customer selects one CPI to read its details.

The system (tool) displays the details of information of the CPIs. It displays the unique identifier, the number of the documents, target groups, proposing this type of publication.

**Scenario verify “user name and password”**

Participating actor: Customer, E-user, Administrator.

Objective: In the main page in login section users have to give values for the user-name, password and then presses on sign-in button to login and cancel.

Entry conditions: All users of the system have their specific information

Exit conditions: Users have received a message “successfully sign in” from the system that the selected transaction is complete, or if not complete, a message expressing failed.

The user starts to the sign in task.

1. System has a specific region for login.

2. Write a user name and password with a system assigned and sequence number.

3. System verifies the user and password boxes.

4. Enter a user name and password.

5. Activate the log in button.


Exceptions:

If in step 3, when the system fails to verify Customer’s access rights (customer user name or password is different that provided), the system suggest” Try again”.

2. An analysis value of username.

2. A Maximum equal to 16 characters.

2. b Minimum equal to 6 characters. (More than max. and less than min. is not allowed)

Valid type to be entered is A-Z or a-z 0-9.

**3.3.3 Use Case Tables**

In this system there are 14 use cases applicable. All use case tables can be seen in the Appendix A.

**3.4 Using a Content Management System to improve the CPI**

The question is “what is the suitable solution to use the current CPI at Ericsson, without changing all the structure of current documents, and how can it be made it easier to use?”

To answer the question which kind of wiki tool could to solve the basic problems that are mentioned above, Content Management System would be a good solution. A content
management system (CMS) [10] is used as a solution to help business/enterprise manage and add content of any format. It is a good strategy to evaluate CPIs. CMS provides a complete website solution which can be used to create a new tool to work as web-based interface and the delivery format of the CPI.

What is Content Management System, and why do I need one?

Content management system is used to provide a collection of procedures and manage work flow in collaboration environment. The procedures are designed to allow for a large number of people to contribute and share data in a collaborative environment. It provides control access to data by defining user groups and assigned the groups a specific role; furthermore, it is used to reduce repetitive duplicate data input and also improves the ease of report writing as well as communication between users.

Three commonly definitions seen for CMS are the following:

“A software application is used for the collaborative creation, storage, and management of content in many formats.”[23]

“An engine that brings your website to life by allowing you to create and edit content with interactive functionality” [24]

“A software tool that enables groups of (centralized) technical and (de-centralized) non technical staff to store, created, edit, manage and publish a variety of digital content types”[25]

Data can be anything in CMS such as: documents, movies, pictures, scientific data, etc. CMSs are often used to store, control, revise, and publish documentation. CMSs serve as repositories, increases the version level of new updates to an already existing file. Version control is one of the main benefits of CMS.

3.5 What CMS is Suitable?

Today, there are several content management systems available on the market, choosing the right CMS can be demanding for a developer. It can be difficult to decide which solution is the best. It depends on needs, expectations and situation. All available systems work well as long as long the site is less than several hundred pages. In this study four popular content management systems have been investigated to find the best solution and method to optimize the information structure for CPI. A new webpage based on the Drupal model is such a solution.

Short description of above mentioned four CMS follows below in next part:

3.5.1 Word Press

Wordpress [11] [12] is an open source Content Management System and a great choice mainly because it’s straightforward; the arrangement of the Web site is very simple. It is easy to install, update, maintain and understand, it includes many predefined graphic themes, adapting themes and there are multiple add-on modules available. But, its scale does not support complex web sites or if we would like our posts or pages to appear in many different places based on automatic roles. In such cases, it’s not a good choice for us. It does not support content-based permissions.

Advantages:

- The Word press platform has been programmed in PHP
• A popular tool for bloggers
• Easy to learn and understand
• Easy and fast setup
• Lots of template and plugins are available

Simple requirements of the hosting server

Disadvantages:
• Database queries may require a lot of resources
• No support of content-based permissions

3.5.2 Joomla

Joomla[11] [12] is a free and open source content management system which enables us to build web sites and powerful online applications. It’s useful in various scenarios and applications. The setup and installation procedure is relatively straightforward.

A system based on Joomla includes three parts:
• Sections
• Categories
• Articles

Extra functionalities can be provided by add-on modules. Joomla’s Add-on modules support a wide variety of functionalities. In the case of requiring many different internal content authors, Joomla is not the best choice. Joomla supports more complex site structures than Word Press but Drupal or Plone are more flexible than Joomla.

• User friendly interface
• Joomla is used in social networking and educational contexts
• More powerful and robust than Wordpres
• Deep level of navigation and categorization
• Joomla is programmed in PHP and My SQL

3.5.2.1 Plone

Plone[11][12] is a more powerful CMS and is more suitable for organizations with very complex systems. It offers more flexibility and control and supports complicated workflows. Update of text and graphics is easier for non–technical administrators. Plone is better in features than its three other rivals in most areas. But adding existing graphic themes and add in modules, creating custom themes and setup of the web site structure is more complex than other systems. Plone is written in Python, it may be harder to find someone to extend the system through custom code.

• More powerful than Joomla and Word Press
• Suitable for very complex systems
• Supports complicated workflows
• Updating text and images are easy for non-technical staff
• The platform has been programmed in Python
• Its setup and configuration is very complex
• Generally more complex than the other three systems

Disadvantages:
• It’s relatively harder to find someone to extend the system using custom code
• Creating custom themes and site structure setup is more complex than with the others.

3.5.3 Drupal
Drupal [15] is one of several content management systems that are available in the market today which gives the possibility to build everything from a single website to multiple websites, for example an internet forum or community website. Furthermore it can also be used as content management framework or web application framework. It is very powerful and unique it is not just an advanced content management system. It provides more advanced features, workflows, consistent. In addition, it can give to developer to have highly flexible and scalable core architected. By using some of the more than 7000 add-on modules available, it makes it possible to use Drupal as a suitable tool for well-structured CPI.

Drupal as a content management system is used in building search friendly websites including features such as:

• Storing of content in a database
• Keeping website design separate from content
• Updating content easily
• Making it highly scalable.

3.5.3.1 Why Drupal?
Main reasons why the Drupal is better than the other open-source systems:

• Joomla – Out of the box is not search engine friendly compared to Drupal
• Plone – Its being programmed in Python and certain server requirements makes it less easy to extend in comparison to Drupal.
• Wordrpess – its being programmed in PHP as well as Drupal but it is not a good solution for the website more than hundred pages.
If you need a more heavy-duty website and if you plan to extend the structure of your website in the future, you should consider using Drupal.

Is good to know that several important websites have used Drupal to organize and manage their content. The list of High Profile Websites run on Drupal’s CMS platform is as follows: [17]

- The White House
- Amnesty International
- US Foreign Affairs
- Yahoo Research
- NASA
- Greenpeace UK

3.5.3.2 What is Drupal?

Drupal [13] is managed through the programming interface which is useable for developers; no programming skill is required for building a basic website.

As mentioned before, Drupal is a free open source platform and content management system that allows an individual to make a community for users. Drupal content management features let you create and manage your site easily. It works as a toolkit with many powerful capabilities and is very flexible. Furthermore, it has rules and great varieties of options for new user accounts and user permissions. In addition it can be modified in a variety of ways.

General Concepts: Drupal tries to arrange some conflicting goals by providing users with the tools that they need to make and build their content management solution, while supplying some powerful pre-build components and modules to help them to get started. Hence, it can be described both as a content management system (CMS) [14] and a content management framework (CMF) [14], by covering both in one system.

Drupal is made with building blocks in the form of contributed modules and skilled developers can create a suitable website which could be used for your needs, whether it is a new site, an online store, a social network, a blog, a wiki or something else altogether. In fact, it is a useful system that allows administration of your site, organize and display content, manage routine tasks. The framework of Drupal is open source that means the source code is available to use for anyone who has interest in working with it.

It can be easily used for managing in all other aspects that you need for your website from adding content and images to updating a product catalogue; In addition it can be used for credit card payment processing or taking online reservations.

Drupal is based on the PHP programming language that is known for its usefulness in producing web sites. It can work with Windows, Mac OS X, Linux and many other operating systems. It also requires a database to store content and settings. A distributed module can be used to build a more scalable website.

Drupal Core: Drupal core and several contributed modules work together and you are able to build your site with more flexibility and simplicity. Furthermore, its behavior model models
most content types as variations of the same concepts, all components are stored in the same way such as a static pages, blog posts or new items.

A site navigating structure is created individually by editing menus, list of content (view) and blocks or site content that have already been linked to different site sections.

To extend the core functionality you can use modules. In order to enable a module, one needs to select the checkbox and click the save configuration button. The permission to use the module is activated as soon as the module is enabled.

More than 7000 modules are available for extending your website. By default Drupal includes the core modules, themes, localization, auto-update notification and database abstraction.

List of core modules that are available in Drupal core can be seen in figure 6.

<table>
<thead>
<tr>
<th>Enabled</th>
<th>Name</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aggregator</td>
<td>6.9</td>
<td>Aggregates syndicated content (RSS, RDF, and Atom feeds).</td>
</tr>
<tr>
<td>✔️</td>
<td>Blog</td>
<td>6.9</td>
<td>Enables keeping easily and regularly updated user web pages or blogs.</td>
</tr>
<tr>
<td></td>
<td>Blog API</td>
<td>6.9</td>
<td>Allows users to post content using applications that support XML-RPC blog APIs.</td>
</tr>
<tr>
<td></td>
<td>Book</td>
<td>6.9</td>
<td>Allows users to structure site pages in a hierarchy or outline.</td>
</tr>
<tr>
<td>✔️</td>
<td>Color</td>
<td>6.9</td>
<td>Allows the user to change the color scheme of certain themes.</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>6.9</td>
<td>Allows users to comment on and discuss published content.</td>
</tr>
<tr>
<td></td>
<td>Required by: Forum (disabled), Tracker (disabled)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contact</td>
<td>6.9</td>
<td>Enables the use of both personal and site-wide contact forms.</td>
</tr>
<tr>
<td></td>
<td>Content translation</td>
<td>6.9</td>
<td>Allows content to be translated into different languages. Depends on: Locale (disabled)</td>
</tr>
</tbody>
</table>

![Figure 6: Drupal Default Core Module](image)

A site navigating structure is created individually by editing menus, list of content (view) and blocks or site content that have already linked to different site sections.

To extend the core functionality you can use modules. In order to enable a module, one needs to select the checkbox and click the save configuration button. The permission to use the module is activated as soon as the module is enabled. More than 7000 modules are available for extending your website. By default Drupal includes the core modules, themes, localization, auto-update notification and database abstraction.

### 3.5.3.3 Drupal Characteristics

On one hand, Drupal is a free and open source content management system and the perfect choice for large enterprise websites with high traffic, written in PHP and use database to store contents. On the other hand it is a community collaboration tool and is appreciated the dynamic nature that it provides. Websites based on the Drupal framework are able to change very fast by modifying modules.

The major advantages of using Drupal are:
• Ease of use for creating, editing and modifying content.

• Maintenance and operation without technical web knowledge can be done.

• Easy way to manage your text, audio and video files.

• Simple generation of navigation structures.

• Easy to add Web 2.0 features.
4 Implementation in Detail

This chapter will introduce the implementation of Drupal, Also implementation of a new tool based on Drupal.

4.1 Requirements for Software and Hardware

Older versions of Drupal can run on any computing platform that supports both a web server capable of running PHP 4.4+ and capable to run a database to store content and settings.

The latest Drupal 7 is released also and requires PHP 5.2 or higher.

Software Requirement:

In this thesis the following setup and recommendation is given:

- Operating system can be used Linux, FreeBSD, MS Windows
  
  Recommended window vista

- Web server - Apache or IIS, Lighttpd and nginx
  
  Recommended Apache

- Database server - My sql, postgreSQL, SQLite or Microsoft SQL server
  
  Using My SQL server

- Programming language - PHP 4.4+
  
  A php version 6 supported our website

- Recommendation: WAMP, XAMPP (Window, Apache, MySQL, PHP/Python) for security purposes, ease of installation.

Hardware Requirement:

Minimum base installation requires at least 3MB of disk space, but if many contributed modules and contributed themes are used, the actual disk space for the installation should be 40 MB or more.

The next section will introduce the Drupal as a tool and give a summary of common configuration and installation.

4.2 Common configuration for Drupal based website

File required for installation:

1. XAMPP
2. Drupal

And those are available in

www.apachefriends.org/en/xampp-windows.html
http://www.drupal.org

After downloading these two files the steps for installation are following as below:

**Extract XAMPP files and setup XAMPP:** Before explanation, configuration, and testing of each requirement, it is necessary to explain the common configuration of all website that use Drupal. To provide the flexible structure of customer product information, XAMP is installed on the network and used as a bundle of (Working windows, Apache, My SQL, PHP/python) and many other utilities, it is only used for a local test server which is available on your computer for security purposes and ease of installation. After XAMPP is installed I manage Drupal database in MY SQL and set the password for My SQL.

Running Apache and My SQL on XAMPP Services:

![Figure 7: Control Panel Application of XAMPP](image)

It was needed to run XAMPP Control Panel Application to start Apache and MY SQL as you can see in Figure 7.

It has to create a Drupal database in My SQL for storing all the Ericsson information and then set a password for My SQL is a next step.

Extract Drupal files and enter the database and server settings

**Install Drupal site and start to configure:** Test of XAMPP installation was performed by opening web browser and type http://localhost or http://127.0.0.1 in the address bar. The pre-build XAMPP page appears.

The new database ‘Drupal’ was created by clicking ‘Php MyAdmin’ on XAMPP page,

Extract Drupal files to c:\xampp\htdocs folder was completed by renaming extracted folder to ‘drupal’

**Setting Drupal:** In this step ‘drupal’ folder must be open; defult.settings.php file must be copy to the same folder and rename it to settings.php.

Result of the last step is an input for next step which means opening settings.php with WordPad and enter db_url and base_url:

1. Open the settings.php and enter $db_url and $base_url
2. Setting \$db_url='mysql://root:admin@localhost/drupal' \n3. Then scroll down and set \$base_url='http://localhost/drupal' \n
Now time is for installing own website:

Step 1: Open web browser and enter http://localhost/drupal/install:php in the address bar

![Figure 8: Setting Language](image)

Step2: Drupal default installation will be check required setting.

Step3: Set up database, enter it and URL setting and click ‘save and continue’ button.

![Figure 9: Installation](image)

Enter database name, database username, database password
Figure 10: Database Configuration

Step 4: Drupal will install the site.

Figure 11: Installation

If the installation procedure was successful then we got the notification as you can see in figure.

Figure 12: Installation Complete

New platform based on Drupal is following by the link below

http://localhost/drupal
4.3 Detail Description of implementation

The demo is designed in order to start the test function. Software parts are also created in order to integrate with prototype and getting ready for verification. The Preliminary designs is based on Ericsson’s requirements, require models are added to the default core Drual.. It shows that it is possible to import the current CPI library information on new model which means that new model is able to support and cover all characteristics and customer requirements and also can be followed by rules and principles that the Ericsson’s CPI has.

Configuration:

For designing the web site you have to follow four steps

**Installation:** the first step is installing the software by setting up the database and creating necessary users, setup Apache by setting up domain and root. Furthermore, we need to configure the file which matches the domain name path, then set up a working directory and set the web server permissions and add a cron job.

**Select theme:** I used the Ubercart theme [16] for my website that is an extending open source e-commerce shopping cart with the ability to work like a fully integrated store with Drupal.

**Add modules:** consist of two parts: using and enabling a core module which is defined by default and optional modules that are useful and fulfill our requirements.

**Build block:** It provides a drag-and-drop interface for assigning a block to a specific region. By building blocks you can control the boxes that are displayed around the main content. By clicking configure next, each block can be configured with the specific title and visibility setting.
List of the modules which are used for providing new model (Figure 14):

**Book Module:** Book module is one of several modules supported by Drupal which gives the possibility to allow users to structure site pages in a hierarchy or outline. So it is useful to get the tree structure of Ericsson documentation. In addition to this for creating the hierarchical node in Drupal, Node hierarchy module is needed. Furthermore, for viewing tree structure of the documents the Node Hierarchy Views Embed module. By adding it we allow node children to be embedded in to the node to get better views.

**Administration menu:** it is used for providing a dropdown menu to most administrative task and other common task. These means can have a differ dependent on use permissions.

**Content:** that allows definition of new content types. Requirements for content modules include, Content type, content permission, date, image field, field group, node references, number,

**Text:** which defines simple test field types depend on content.

**Aggregator content:** involve RSS, RDF.

**Blog:** enable regularly updated user web pages or blogs.

**Blog API:** using application that allows users to post content by XML-PRC format.

**Comment:** allows users to discuss and add comment on published content.

**Database logging:** takes logs and records including events from the system database.

**Menu:** for customizing the site navigation menu.
**Search:** enables the site-wide keyword searching.

Making a structure of Drupal

Organizing the information architecture on tools is following by issues:

1. Content types
2. Navigation menus
3. Blocks
4. Taxonomies
5. Views
6. Panels

**Configuration of New tool:**

Drupal provides useability by generating new structure categories that simulates the dynamic behavior of ALEX folders. The new tools allow differentiated access for customers. It puts emphasis on creating a web portal, with multiple subfolders, having unique pages for each folder. Also, in each part it is possible to add comments in each section. It includes an advanced search function that lets you search by the name of the product or all kind of search that you need based on Google web search.

The new tool provides a flexible structure, which make the access easier for the user. Investigating the new tool shows the following:

1. Importing part of Alex library on a tool where customer specific information can be added or linked in.
2. The customer’s information that is added can be of different kinds of file: from small notes to complete document or other files (video, and so on).
3. Possibility to collect feedback from different sources for a specific document.
4. Different view of the document was created which use customer documents as source and ALEX as add-on info or vice versa.
5. Activating the advanced search function.
6. Separating the large document into small chapters for easy browsing.

**Content types of Drupal used to build a prototype website:**

Admin->content->types->List (Administer>content management>content type>list)

Each time you create a post (page or, story, etc) a content type is being used to hold and store forms for the items of your entries. When you save a post that you enter, you have created a node using a content type. It means all posts that exist on your site are instances of a content type.
Standard Drupal core content types include two pre-configured default content types with different default configured behaviors.

Page: is a simple method for creating and displaying information such as” About us “section for a website similar in form or story. In this section users are not allowed to put comments

Story: is an ideal for creating and displaying content informs or engages website visitors. The entry information is automatically featured on the site’s initial home page.

Drupal core has four different optional content types:

One of the optional Drupal core content types is used for handling and managing the information in Ericsson environments that is called Book page.

Book Page: can be defined as a page of content, it could be useful for organizing information into a collection of relevant entries with a link to adjacent pages that is displayed automatically.

As the document structure for each product include a collection of information that are related to each other, a hierarchal structure provide a simple navigation and might be helpful for archiving a flexible structure for CPI, for organizing and reviewing structured content.

Create a new content type is called Ericsson document:

By creating a different “custom content types” the website management becomes easier and more user friendly. I created a new content type for each CPI documents as a new content type that was created with its individual permissions.

Each item of content in my website is a node (all of the customer product information that we have in ALEX can be defined as an individual node). A node can be one of a number of content types.

Drupal content has a flexible feature which can be used to create and define our own content types. So by using this feature to create a specific content type which is called “Ericsson document type” is created.

For using a specific content type, content Construction Kit (CCK) module must be added to our website and adding the custom field to custom content types is used to create a web interface.

Content Construction Kit (CCK) module and content type field is used to create the Ericsson documentation structure.

Book module:

Creating a new book page the following 3 steps needed:

Step1- creating a node is needed for the website
Step 2- Book flowing outline section
Step 3- selecting a new book

Adding a page as child page list:
Adding a child page is possible by using a standard book module to add a child page, by clicking “add child page link” book page can be added as a child.

**Comment module:**

First step is enabling a comment module, by adding this module our users can post comments to discuss a forum topic, a log post, a book page, etc. The administrator can specify the default comment settings for each content type.

When the configuration is finished we can specify whether our users or customers can make comments

**Configure comment settings for a content type:**

The feedback can be defined as a comment; for enabling a comment tab we can go to Admin /build/modules/list in a part that includes core Drupal standard modules and then enable a comment module.

Four permission options are available for comment module and by setting up roles and assign them to the users they can be configured as follows:

- Access comments—it means we can give an access to our users to be able to see them.
- Administrator comments—it means that deleting and editing comments is allowed.
- Post comment without approval—it means that they will be published as soon as it saved, if this access is not allowed, the comments will be in queue waiting for administrator approval.

Our Ericsson document (CPIs) is presented as a kind of content type in the new website. For viewing the comments that were published on the website:

- Admin/content/types/list

By clicking on the content type, the comment setting subsection section is available. By using the setting read/write check-box allows for setting the users permissions.

The CPI is imported to the data base and adds to the tool by using Book module, therefore, View setting is used to present the CPI where the customers can add their own local information. This local information can be stored, presented and modified in simple way while accessing the official documentation. A benefit of new tool is the CPI content can be broken down to smaller chapters. The customer’s specific information will be tracked to the correct place in the document as a comment or a feedback even when upgraded. The customer’s information can be anything from one-line comments to separate files (documents, pictures and so on).

It is important that the original information must not be changed, therefore, all customer’s information must be additional information. By using specific modules during configuration enables the separation of large documents into short chapters. By linking it is possible to refer to other chapters, which allows all relevant information can presented and to be available in a simple way.
5 Test or Analysis of Solution

By importing the part of CPI of the product (here is GGSN_MPG) to the new database and testing the new model based on Drupal, we can say that the functionalities like search, is performed much faster, than the current version. Also adding comments directly to the CPI without changing the content, allow for a shorter response time is solving the problem associated with performance of the product. We will now, analyze the new tool by using two functions.

5.1 Feedback channel via comments in current model vs. new model

The tool that was created provide a feedback channel via comments, the user can input the comment and post whatever information they require as a result the user is able to provide a feedback to the CPI producer

Since there is no way of providing feedback in the current CPI, the user previously had two alternatives:

1: Create an official Trouble Report if there is an error. This involves administration (and cost) both for the customer and the producer, so it is only used for severe errors when the cost can be justified.

2: Try to find an alternative way of providing feedback (mostly for minor errors or improvement suggestions), but since there is no official channel this has to be made using local Ericsson representatives or locating a person working with the CPI, so in reality there is very little feedback coming this way.

Solving these problems by using the new model of the CPI with the tool

1: They can write their ideas and add their text files, audio, videos, etc, by this way the cost and administration decreases for both the customer and Ericsson

2: This is the good way for minor errors to be fixed and is useful for saving time both for customers and the company; it could be an interface channel for achieving more interaction and cooperation.

The user adds customer specific information to the CPI

- Using the current CPI (It shows in Figure 15)

There is no support for adding information in the CPI today, so many users have the CPI imported into their own tools, or copy and rewrite the information and thereby create their own version of the CPI.

- Using the new tool (It shows in Figure 16)

By using new tool users can add/link their own information and these methods are well suited to Ericsson requirements where the Ericsson database must not be changed and Ericsson customers shall be able to add their own information such as text, audio, video and etc.
5.2 Search function in current model vs. new model

The website contains a search function field with an advanced search function. It is able to search all letters as lower-case letters, and upper-case letters and is also able to find the sentences or title that the user is looking for.

The user searches for information on how to configure the alarm level for available IP addresses (It shows in Figure 17).

As you can see in Figure 17, the user enters the search words “ip address alarm level configuration”. Since the search engine locates the string “ip” in words like “description”, the relevant document (APN Configuration for GGSN-MPG) is presented as the third hit in the list, preceded by the irrelevant documents “Alarm and Event Description” and “Alarm and
Event Interface Description”. Since the user is using new to the CPI he/she will at least first read the “Alarm and Event Description” (where there is no information on the subject) before finding the right document. When the relevant document is found the user has to scroll down (or step through all occurrences of the individual search words) to find the correct chapter information. (It shows in Figure 18).

![Figure 17: Search Function Result in Current Model](image1)

![Figure 18: Search Function result in New Model](image2)

**Result of implementation:**

The website was built based on Drupal. Drupal has features to support a communicating website. All content has been imported to a MY SQL database. The dynamic CPI on the website for customer’s interaction is available.

Due to confidentiality reasons, full Website configuration will not be shown here. The following test has been implemented with Drupal software 6.19
Drupal provides modular functionality by generating a website that simulates the dynamic behavior of customer product information as you can see in Figure 19.

Figure 19 shows the summary of the implementation. I have tested the new tools with more capacities that would be useful for customers where they get the access to database and add their own specific information and they will be able to use an advanced search function to find the information or document in an easy way.

Using Drupal has a lot of advantages (features and capabilities are available in Drupal.org) for managing and handling your wiki website. This will provide a scalable website. The flexible structure, ease of use, simple search function, language translation of documents, and simple access to the CPI means that all customers could be satisfied.

5.3 Dynamic CPI

An example of dynamic CPI is when customer’s accesses a website, and they are predefined as part of a user-group, the website content will be tailored to their specific needs and interest areas, and they can also add comments and their own specific information to the CPI.

The ability of Drupal has been evaluated during this test, in which the modules enable the user to add information. This response includes a page with a header line to put a title and the frame box to put the text (that is the user’s comments).

Document View:

Document view enables:

- Searching document
- Advanced searching
- Save document to local disk
- Command tab
- Printing friendly

The left sidebar is similar to Active Library Explorer (ALEX) showing Library or document dependent on which tab is selected:
- Library tab
- Document Tab

The main frame contains the list of information or folders selected in the left panel.

As you can see in Figure 20, by clicking the library tab, the library tree structure in the left panel is displayed. The tree contains folders and subfolders with documents related to a specific subject. The new view of separate pages enables division of one document into several parts with the link to the next section. The content of chapters is displayed in a new page for easy work flow.

Figure 20: New Model of CPI Content
6 Examples of Implementations of new tool based on Drupal

In this chapter, the results of the prototype of my model based on Drupal are presented. It is implemented with a database connection.

Using CPI this way is more useful than before; making it more acceptable for the customer. The CPI becomes more structured and customers are able to post a comment wherever they want, it leads to user satisfactions.

I will show the look and feel in the new tool through screen shots from the prototype. I tested the feedback process and customer product information structure which is functioning.

Figure 21, shows the advanced search options to enables site-wide keyword searching. Search module with Google analytics characteristics is used for obtaining advance search to help the customers finding more options.

The advanced search function enables the ability to search with the options: (figure 21) containing any of words, containing the phrase, containing noun of the word will provide and allow user’s access advanced search function with a lot more flexibility.

Figure 21: Advanced Search Form
Figure 22, displays an Example of search function by using new tool.

Figure 22: Example of Search Result

Figures 23-24 illustrate the CPI product which include the Mandatory Data as an example that is show this part separated to small chapter include a “Read more” blue link to expanded the detail relevant information related.

Figure 23: New View of Large Document

As you can see in Figure 23, by clicking on the “Read more” link the content is expanded and is shown the details information. You can see the result in Figure 24.
2 Mandatory Data

The log and data described in this section must always be included in the CSR.

Use the checklist presented in Table 1 when writing the CSR. A more detailed description of each line is presented after the checklist. Some parts are not applicable to certain types of requests, for example documentation faults or consoltations, but all parts apply to software and hardware faults. Fill out as many as possible for the specific case.

Table 1 Checklist when Writing CSR

<table>
<thead>
<tr>
<th>FACTS</th>
<th>GGSN-MPG release:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HW platform:</td>
</tr>
<tr>
<td>RECENT CHANGES</td>
<td>SW changes:</td>
</tr>
<tr>
<td>CASE DESCRIPTION</td>
<td>HW changes:</td>
</tr>
<tr>
<td></td>
<td>OBM procedures:</td>
</tr>
<tr>
<td>MEASURES</td>
<td>Environment:</td>
</tr>
<tr>
<td>ATACHMENTS</td>
<td>Date and time:</td>
</tr>
<tr>
<td>Type of attachments:</td>
<td></td>
</tr>
</tbody>
</table>

Figure 24: Detailed View of Large Document

Figure 25: Add New Comment with Attachment
Figure 25 shows a CPI with the ”Add new comment” option, it will provide and allow users to add their specific information to our CPI with a lot more flexibility.

Figure 26, displays the Reply form of existing comment, with a PDF attachment at the top that is created by user1, it contains subject, comment, and the preview button to show the content.
2.1 Workflow

The workflow for collecting troubleshooting data to the CSR is as follows:

1. Collect the general mandatory data that is needed for any problem experienced. For more information, see Section 3.
2. Collect specific data based on the problem type. For more information, see Section 4.

Figure 27: Example of Feedback

Figure 27, displays the feedback via comment and how they look and feel with new tool. The two comments shown as an Example are RADIUS and L2TP/LNS.
7 Conclusions and Suggestions to Future Work

Since the CPI is the main source of information base tool for integrating products in a network, an efficient CPI will generate fewer problems with network deployments and configurations. It leads to a more stable network, decreased number of trouble reports, improved network performance, which leads to a satisfied customer!

This thesis proves that Drupal can be used as a base to create a new customer interface for accessing CPI. By using existing add-on modules and by creating specific modules, the CPI documents can be modularized. This achieves good scalability and provides a high flexibility in the presentation. There is a great potential for re-using information which is currently duplicated in several documents, thereby increasing the productivity as well as presenting different information to different users. This allows customer adaptation of the CPI and it also provides an optional feedback channel where the customer can add information submitted to the CPI producer.

To prove that this thesis shows the way forward, it should be mentioned that the PDU PC discipline has very recently created a new vision roadmap that now covers the ideas presented and demonstrated in this thesis.

7.1 Suggestions for Further Research

More research must be done to see how the methods can be implemented in Ericsson’s projects for customer product information.

The company is planning to include support for an improved CPI structure in GGSN-MPG environments. The aim is to obtain easier access to all information for configuration and maintenance of the products GGSN-MPG, SGSN, MME, eNodeB, PDN, PCRF, S-GW and PDN-GW improving the usability of the customer product information for products.

The suggested future work, in the context of this thesis, is to perform a future assessment where the proposed functionalities are implemented. Another important future task is to assess the tool and its performance with the entire database that Ericsson has and expand the tools in other parts of the CPI libraries as well as uploading the tool on a server and testing it in real networks.

Other areas to explore for the company could be the use of other/new types of media for handling and documenting of CPI. Also other/new means of distribution should be investigated. E.g. video is an area where other companies are looking, whereas Ericsson has not at present explored these areas.

The complete business case for CPI should be further investigated. PDU PC has started to do this which is positive; however, a broader view should be taken. This may be a catalyst into more research on detailed level.
References

[1] MATS SLUNGA, NDO GGSN-MPG, EAB/FBA/GS
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   mats.slunga@ericsson.com
   www.ericsson.com

   Regarding to internal Ericsson document please contact blow:
   Accesses to reference number from [2] to [9]

   For access to ref number [2] please refer to reference [1]

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## 8 Appendix

### 8.1 Appendix A

**Unified Modeling Language (UML)**

Modeling is described a system at a high level and used for requirements and specification. Unified Modeling Language (UML) is a standard graphical and consistent language, for specifying, visualizing constructing and documenting the artifacts of software system.

UML diagrams are defined as Use Case diagram, Sequence Diagram and Collaboration diagram. Use Case diagram is used for describing a set of user scenarios; furthermore, they are working as a contract between end user and software developer for capturing user requirements.

General concepts with the use cases are:

- Actors can be defined as users that may interact with the subject.
- Use cases –the term use case” refer to a use case type
- Subject is the system under consideration to which the use cases apply

**Use Case Modeling**

Looking for the actors can be covered by following question?

- Who use the system?
- Who gets information from this system?
- Who provides information to the system?

**List of Use Case Tables Description**

<table>
<thead>
<tr>
<th>Table 1: Login Use Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UC1</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Actors</strong></td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
</tr>
</tbody>
</table>
| **Process follow** | 1. The system displays prompt for the customer, user name and pass, the LOGIN button is displayed as well (refer to screen LOGIN  
2. Customer enters the **Username**  
3. Customer enters the **Password**  
4. Customer presses the **LOGIN button**  
5. the system locates the customer’s customer object  
6. the system verifies the customer’s access right  
7. the system displays the overview of GGSN_MP CPIs  
If in step5, the EricssonCustomer’s customer object cannot be located the system displays the **Access to the Web site is blocked by your** |

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administrator. Please notify your system administrator. Made http request for GET / HTTP/1.1 to internal.ericsson.com:80” and terminate use case.

If in step 6, the system fails to verify Customer’s access rights (customer. password is different that provided), the system displays the “Unknown User “terminate the use case.

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-conditions</td>
<td>None</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>The Customer object is available for other use cases as the same Ericsson Customer</td>
</tr>
</tbody>
</table>

Table 2: Browse CPI Use Case

<table>
<thead>
<tr>
<th>UC2</th>
<th>Browse CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This use case detail the BrowseCPI steps of a website, the customer browses through the complete list of GGSN_MPG releases products, can search and displays a sub-folder of this list, and displays product details of each releases. The customer can select products to be adding comment.</td>
</tr>
<tr>
<td>Actors</td>
<td>Customers,</td>
</tr>
<tr>
<td>Assumptions</td>
<td>All required resources are known and identified to the search function</td>
</tr>
<tr>
<td>Process follow</td>
<td>1. the system displays all GGSN_MPG products available, 2. Customer enters and submit a search text to filter the displayed list of relevant information of his own request 3. the system displays a filtered list of GGSN-MPG CPI product that only show entries that have the search keyword as a substring in the title field 4. The customer selects one to review its details. 5. The system displays the details of the GGSN-MPG CPIs. It displays the unique number, title.</td>
</tr>
<tr>
<td>Alternative Flows</td>
<td><strong>Attach file to the CPI</strong>  After step 3, the customer can attach new file. The system displays the file attachments part with ATTACH Button. The use case end or resume in step4.  <strong>ADD Comment to the CPI</strong>  After step5, the customer selects the displayed CPI to post a comment on it System has no CPI to search, The system adds the comment to the CPI. The use case resume in step 3.</td>
</tr>
</tbody>
</table>
After step 5, the customer requests to preview the whole page again. The system displays **SAVE** button. The use case end.

<table>
<thead>
<tr>
<th>Pre-conditions</th>
<th>Customer logged in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-conditions</td>
<td>Comment list displayed</td>
</tr>
<tr>
<td></td>
<td>Comment details displayed</td>
</tr>
</tbody>
</table>

**Table 3: Search Use Case**

<table>
<thead>
<tr>
<th>UC3</th>
<th>Search</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>This use case details the Search a Website, it is important to get right access to other functionality for a keyword</td>
</tr>
<tr>
<td><strong>Actors</strong></td>
<td>Customers, E-User</td>
</tr>
</tbody>
</table>
| **Process follow** | 1. the website displays prompt for the customer, **SEARCH** button is displayed as well (refer to screen Search)  
2. Customer enters the **keyword**  
3. Customer presses the **SEARCH** button  
4. The system presents a set of search results and sponsored CPI products, all of which include name, short description and unique number of product  
5. the result are shown |
| **Alternative Flows** | If in step 3, System has no CPI to search, then the user is redirected back to the search screen at step 1 |
| **Triggers** | The Customer elects to use the CPIs |
| **Pre-conditions** | User has correct user authentication and a valid search term |
| **Post-conditions** | The Customer has found their result and to other use cases to get |

**Table 4: Add Use Case**

<table>
<thead>
<tr>
<th>UC4</th>
<th>Add</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>This use case details the Add steps of a comment, when customer calls to order, system verify customer information, create a new file, add items to the CPI</td>
</tr>
<tr>
<td><strong>Actors</strong></td>
<td>Customer</td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
<td>All required resources are known and identified to the search function</td>
</tr>
</tbody>
</table>
| **Process follow** | 1. The system verifies the customer’s access right  
2. The customer selects the displayed CPI to post a comment on |
3. System initiates the creation of a new comment and displays ADD button
4. Customer presses the ADD button
5. The system adds the comment to the CPI.
6. The new comment added to the CPI
7. The system displays preview of the comment
8. Customer presses the save button
9. The system displays the “The request has been saved“, terminate the use case.

Pre-conditions  Customer must be existed, CPIs Catalog, inventory item must be existed for request items.

Post-conditions  Comment items must be created.
The request must be related (associated) to the CPI

<table>
<thead>
<tr>
<th>Table 5: Attachment files Use Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC5</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Actors</td>
</tr>
</tbody>
</table>
| Alternative Flows | 1. The system verifies the customer’s access right  
2. The customer selects the displayed CPI to post a comment on it.  
3. System initiates the creation of file attachments and displays **choose file** button  
4. Customer presses the **ATTACHEMENTS** button  
5. The system attaches the file to the comment.  
6. The new attached to the comment  
7. The system displays preview of the comment  
8. Customer presses the save button  
9. The system displays the “The request has been saved“,  
10. Terminate the use case. |

| Alternative Flows | If in step12, the customer chosen file is not involved the existent type of files and more than the maximum limit, the system displays the “file |
can not uploaded”, use case

<table>
<thead>
<tr>
<th>Limitation</th>
<th>The maximum upload size is 1 MB. Only files with the following extensions may be uploaded: jpg jpeg gif png txt doc xls pdf ppt pps odt ods odp.</th>
</tr>
</thead>
</table>
| Pre-conditions | customer is logged in,  
At least one CPI is selected |
| Post-conditions | Files are attached. |

**Table 6: Remove Use Case**

<table>
<thead>
<tr>
<th>UC6</th>
<th>Remove</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This use case details the Remove steps of a comment, comment is removed from a CPI</td>
</tr>
<tr>
<td>Actors</td>
<td>Customer</td>
</tr>
</tbody>
</table>
| Process follow | 3. The system verifies the customer’s access right.  
4. The customer selects the displayed CPI to post a comment on it. |
| Extension | None |
| Pre-conditions | Customer must be existed, CPIs Catalog, inventory item must be existed for request items. |
| Post-conditions | Comment is deleted. |

**Table 7: Print Use Case**

<table>
<thead>
<tr>
<th>UC7</th>
<th>Print</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The Customer has searched a CPI and wants to print it.</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user, System</td>
</tr>
</tbody>
</table>
| Process follow | 1. The customer searched a CPI  
2. The system displays CPI catalog  
3. customer select the document  
4. the system displays PRINT button  
5. customer select print options  
6. The customer presses OK button on print Dialog window.  
7. Print dialog window disappears.  
8. the system displays ADD button  
9. The application displays “printing...” in the status bar.  
10. the application sends the print job to the printer |
11. The use case terminated.
If in step 4, the customer clicks cancel button on the print Dialog window. Print process is stopped.
If in step 7, A printer error occurs. Then Application displays “print Error” message.

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-conditions</td>
<td>customer is logged in,</td>
</tr>
<tr>
<td></td>
<td>customer has searched one or more CPI</td>
</tr>
<tr>
<td></td>
<td>User has access to printer</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>The CPIs documentations are printed successfully</td>
</tr>
</tbody>
</table>

Table 8: Recent Notification Use Case

<table>
<thead>
<tr>
<th>UC8</th>
<th>Recent Notification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The E-User can resend a message to the selected Customer</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user</td>
</tr>
<tr>
<td>Process follow</td>
<td>1. The E-user select the “Message “ view</td>
</tr>
<tr>
<td></td>
<td>2. The E-user selects a received message</td>
</tr>
<tr>
<td></td>
<td>3. System displays MODIFY button</td>
</tr>
<tr>
<td></td>
<td>4. E-user presses the MODIFY button</td>
</tr>
<tr>
<td></td>
<td>5. The system adds a new comment to the exist CPI.</td>
</tr>
<tr>
<td></td>
<td>6. The new comment added to the CPI</td>
</tr>
<tr>
<td></td>
<td>7. The system displays preview of the comment</td>
</tr>
<tr>
<td></td>
<td>8. E-user presses the save button</td>
</tr>
<tr>
<td></td>
<td>9. The system displays the “The Message has been saved“and terminates the use case.</td>
</tr>
<tr>
<td></td>
<td>If in step 4, the E-user detected the comment is not related to the CPI, it can be removed, the system displays the “are you sure to delete the comment”, the system displays save changes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-conditions</td>
<td>E-user is logged in, at least one CPI is selected</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>The message has been sent to the customer</td>
</tr>
</tbody>
</table>
### Table 9: Send Notification Use Case

<table>
<thead>
<tr>
<th>UC9</th>
<th>Send Notification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The E-User send a reply message to the Customer</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user</td>
</tr>
</tbody>
</table>
| Process follow | 1. The E-user select the “Message “ view  
2. The E-user selects a received message  
3. System displays MODIFY button  
4. E-user presses the MODIFY button  
5. The system adds a new comment to the exist CPI.  
6. The new comment added to the CPI  
7. The system displays preview of the comment  
8. E-user presses the save button  
9. The system displays the “The Message has been saved“and terminates the use case. |
| Extension | None |
| Pre-conditions | E-user is logged in, at least one CPI is selected |
| Post-conditions | The message has been sent to the customer |

If in step4, the E-user detected the comment is not related to the CPI, it can be removed , the system displays the “are you sure to delete the comment”, the system displays save changes.

### Table 10: Clear Comment Use Case

<table>
<thead>
<tr>
<th>UC10</th>
<th>Clear Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The system sends notification to selected E-User</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user, System</td>
</tr>
</tbody>
</table>
| Process follow | 1. The system select the “recent comment list “  
2. The system displays the “REVIEW button”  
3. E-user presses the review button  
4. the system displays Delete button  
5. The system remove the selected comment to the exist CPI. |
| Extension | None |
| Pre-conditions | E-user is logged in, at least one CPI is selected |
| Post-conditions | The message has been sent to the customer |

If in step4, the E-user detected the comment is not related to the CPI, it can be removed , the system displays the “are you sure to delete the comment”.
comment”, the system displays save changes

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-conditions</td>
<td>E-user is logged in, at least one CPI is selected</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>The irrelevant comment is deleted.</td>
</tr>
</tbody>
</table>

Table 11: Approve

<table>
<thead>
<tr>
<th>UC11</th>
<th>Approve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The comment has displayed on the selected CPI.</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user,</td>
</tr>
</tbody>
</table>
| Process follow | 1. The E-user received a notification  
2. The system displays recent comment/post  
3. E-user review the comment  
4. the system displays ADD button  
5. E-user Reply the comment  
6. the system displays SAVE button  
7. the comment will be appear |
| Extension | None |
| Pre-conditions | customer is logged in,  
customer has searched one or more CPI  
User has access to printer |
| Post-conditions | The CPI comment is showed in the page. |

Table 12: Approve

<table>
<thead>
<tr>
<th>UC12</th>
<th>Update Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The new version of the CPI has updated in the system.</td>
</tr>
<tr>
<td>Actors</td>
<td>E-user,</td>
</tr>
</tbody>
</table>
| Process follow | 1. The E-user received a notification  
2. The system displays recent comment/post  
3. E-user review the comment  
4. the system displays ADD button  
5. E-user Reply the comment |
6. the system displays **SAVE** button
7. the comment will be appear

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
</table>
| Pre-conditions | customer is logged in,  
customer has searched one or more CPI  
User has access to printer |
| Post-conditions | The new version of content is displayed. |

### Table 13: Approve

<table>
<thead>
<tr>
<th>UC13</th>
<th>Manage user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This use case details the Manage user steps are, how a administrator creates and later maintains information related to user profiles</td>
</tr>
<tr>
<td>Actors</td>
<td>Admin</td>
</tr>
<tr>
<td>Assumptions</td>
<td>All required resources are known and identified to the search function</td>
</tr>
</tbody>
</table>
| Process follow | 1. The system displays list of users,  
2. Admin selects the **user profile**  
3. Admin presses the **CRATE** button  
4. the system send a notification to the user  
5. the system ADD the user to the database |

   If in step3, the user’s conditions cannot be confirmed the system displays the **“role of the user unknown”** and terminate use case.

<table>
<thead>
<tr>
<th>Extension</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-conditions</td>
<td>User has role and permission to the system</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>The User profile are created successfully</td>
</tr>
</tbody>
</table>

### Table 14: Process User Request

<table>
<thead>
<tr>
<th>UC14</th>
<th>Process User Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This use case details the Process User Request, it is important to accept commands from the E-user to perform the customer request</td>
</tr>
<tr>
<td>Actors</td>
<td>Customers, E-User</td>
</tr>
<tr>
<td>Assumptions</td>
<td>All required resources are known and identified to the search function</td>
</tr>
<tr>
<td>Process follow</td>
<td>1. The system receives a start order from the customer.</td>
</tr>
<tr>
<td></td>
<td>2. the system send a data request message as a comment to the <strong>CPI</strong> database to obtain technical information</td>
</tr>
<tr>
<td></td>
<td>3. the system send a notification to the E-user to determine whether the comment has met the proper condition</td>
</tr>
<tr>
<td></td>
<td>4. The system sends a view result of request to allow the customer to view the result of approval</td>
</tr>
<tr>
<td></td>
<td>5. the result are shown</td>
</tr>
<tr>
<td></td>
<td>If in step3, System has no CPI to search, then the user is redirected back to the search screen at step 1</td>
</tr>
</tbody>
</table>

| Extension     | None |
| Pre-conditions| User has correct user authentication and a valid search term |
| Post-conditions| The Customer has found their result |
8.2 Appendix B

GPRS packet core network and elements

This appendix describes the GPRS packet core network and elements, with focus on Gateway GPRS Support Node, its interfaces and functionalities, GPRS tunneling protocol and a short overview of some functionality of GGSN in the packet core network.

General Packet Radio Service (GPRS) provides packet data services to the Global System for Mobile communications (GSM) and Wideband Code Division Multiple Access (WCDMA) Systems. It provides a basic solution for Internet Protocol (IP) communication between Mobile Stations (MSs) and the Internet, corporate Local Area Networks (LAN), or operators' service networks. The Ericsson GPRS solution complies with the Third Generation Partnership Project (3GPP). The Ericsson GPRS solution is integrated with the Circuit-Switched (CS) part of the Ericsson GSM and the WCDMA Systems.

Data connection over GPRS requires a mobile terminal (MT) with GPRS capabilities. Data applications (such as internet browsers) running on the Terminal Equipment (TE) can connect to Internet servers (such as HTTP hosts) over the GPRS network. Neither the TE nor the Internet Host is dependent on GPRS, but using the GPRS network, they can communicate over a mobile PS connection.

The solution of Ericsson GPRS includes a Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN).

GPRS Network Overview

This section gives an overview of the GPRS core network architecture and elements, with focuses on GGSN (Gateway GPRS support node) functionality and responsibilities. The GGSN is responsible for connecting mobile users to IP-based data networks (such as the Internet). The GGSN also provides added-value functionality, such as Charging (real-time and non-real-time) and Policy Control. Moreover, it will describe most important communication protocol that is used between two main elements of the core network, GPRS Support Node (GGSN) and Serving Support Node (SGSN) that is called GTP protocol Gateway.

GPRS Services

Services provided by GPRS include following:

- In the cellular network, efficient transport of data packets
- Handles distribution of radio resources
- Prepaid or postpaid of charging based on content as volume or session duration
- Fast setup and access time
- Using IP for connecting to other external Packet Data Network (PDNs)

GPRS Tunneling Protocol (GTP)

IP protocol of the GPRS network allows end users of GSM and WCDMA network to move from one place to another while they are connected to the internet at one location at the Gateway GPRS Support Node (GGSN). [21]
GPRS Network Elements

**Figure 17:** Logical View of GPRS Network Nodes includes both GSM and WCDMA systems [20]

Figure19, show all the elements that cover all different nodes in the GSM and WCDMA systems. I will focus more on one of the main elements and its functionality and responsibilities that called GGSN. Both GGSN and SGSN are part of the Packet Core which means that they are centrally stored by the operator. Typically a Swedish operator has only a few of those elements.

**SGSN**

The role of SGSN is handling mobility and it is responsible to keeping track of the subscriber’s location. When subscribers move from one geographic place to another, they may also move from one SGSN to another.

SGSN makes sure that the identity of the user is kept intact even when the user moves between different cellular areas.

**GGSN**

GGSN is one of the most fundamental nodes in GPRS network. Ericsson is a leading company in this area and produces and manages to increase number of GGSN nodes in the world. GGSN responsibility is inter-working between the GPRS networks and internet. The major functionality of GGSN node is to forward IP packets from the mobile networks on to the internet or other corporate internal network.
GGSN Responsibility in Packet Core Networks

GGSN provides an interface between the SGSN and Packet Data Networks (PDNs) in the GSM and WCDMA networks, such as the internet, corporate intranets, and private data network. GGSN is also responsible for charging the user; limit the user’s available bandwidth. The major functionality of GGSN node is to forward IP packets from the mobile networks on to the internet or other corporate internal network.

GGSN Responsibility

GGSN provides the connection between the Mobile Packet Core and Packet Data Networks (PDNs - internet, corporate intranets, private data network etc) in the GSM and WCDMA networks. GGSN also provides interfaces to external business-logic systems (Radius, PCRF, OCS etc.) managed by operators to enforce authorization, charging, and other commercial and legal policies. GGSN provides so-called service aware functionality. The possibility to recognize specific data services being accessed by individual users, and to apply charging and policy decisions for specific services in real-time.

Interfaces and Protocols

As seen in the figure 2 the GGSN communicates over lot of different interfaces and protocols. In this thesis I have focused on two of them:

Gi Network Interface

The GGSN communicates with the Internet Protocol (IP) networks over the Gi interface. The GGSN can have simultaneous connections to many different IP networks. At connection time, Mobile Stations (MSs) and Service GPRS Support Nodes (SGSNs) provide a key called APN with which the GGSN can select between the connected IP networks, known as APN networks. The APN network can be an Internet Service Provider (ISP) or a corporate network. The Gi interface supports both IP version 4 (IPv4) and IP version 6 (IPv6).

Services like authentication, accounting, and IP address allocation can be provided by the APNs (inbound services), by the outbound services network, or a mix of the two.
The Gi interface is also used for transport of Multimedia Broadcast and Multicast Service (MBMS) payload from a Broadcast Multicast-Service Centre (BM-SC) to the GGSN.

**Gi interface:** connects the GGSN to the service networks and Access Point Name (APN) networks and connects the GGSN to an ISP network or Corporate network APN network, it is used for transferring signal and payload. It can also connect the GGSN to the RADIUS server, where the user service (RADIUS) is used.

Gi Interface – is IP protocol used between GGSN and the APNs, allowing exchange of signaling and payload. It supports both IP version 6 (IPv6) and IP version 4 (IPv4). [19]

**GGSN Functionality**

GGSN use APR feature to divide traffic related to mobile station (MS) and one Access Point Name (APN) into several Virtual Private Network (VPNs). Routing traffic based on service classification and PDP context acts with GGSN by selecting the VPN.

**Session Management**

Session management functionality of GGSN establishes and handles the connection between Mobile station (MS) and Access Point Name (APN) network, through the Service GPRS support Node. It supports three main procedures that include PDP context activation, PDP context deactivation, and PDP context modification.

These procedures work with Internet Protocol (IP) addresses and Quality of Service (QOS) parameters. PDP contexts can establish the GPRS Tunneling protocol (GTP) and control them. GTP tunnel control allows the GGSN to get access from MS to provide Packet Data Network (PDN).

PDP context are created over GTP, and for each PDP context a GTP tunnel is created between SGSN and GGSN.

During PDP context activation the GGSN allocates and assigns a unique IP address to the PDP context. The PDP context remains active in the GGSN as long as the user is using data services. Newer model phone models (so called Smart phones) often use the ‘always-on’ paradigm, meaning that the PDP context remains active ‘all the time’ (though in reality it is normally deactivated if the phone is idle for longer periods of time, to conserve network resources).

![Figure 19: Logical View](image)

**Interconnection to External Networks**

Signal transfer performed by GGSN in the packet core network can create, modify and delete PDP context. Execution of signals, such as allocation of the IP addresses for UE configures the PDP context toward PDN. This kind of signaling occurs after PDP context creation.
Charging
Charging functionality describes the service aware charging methods for Global System for mobile communication (GAM) and Wide Code Division Multiple Access (WCDMA) which is available for service Aware Charging and Control (ASCC) in the Gateway GPRS Support node (GGSN) and it covers volume-based charging, time-based charging, event-based charging methods.

The target of service aware charging methods for network operation optimization is the personnel as well as system administrators. Basic knowledge of datacom and telecom in the GGSN is required.

Service Data Flow ID is assigned by two different methods:

- Packet Inspection and Service Classification
- Service Classification without packet Inspection

Packet inspection and traffic analysis of the user plane traffic are the essential functionalities in GGSN. The user plane traffic normally includes hypertext transfer protocol, wireless application protocol, multimedia messaging service, email and the streaming voice (media with session initiation protocol) and real-time streaming protocol.

According to the configuration method charging will be initiated and measured with Different services that can be charged using individually or a combination of all.

Quality of Service
There is no guarantee for delivering packets through the internet but we can say that Traffic on the internet is carried with best effort. It is possible some packets lose is caused by network congestion or over loaded equipment. One of the ways to solve this problem is increasing the bandwidth but the protocol that causes the congestion might eat up the extra bandwidth which leads to the problem according again.

Different services and protocols have different requirements and features one example which is not affected by jitter is ftp. Packets lose or delay although bandwidth limitation might have impacted on duration of downloading file but the final result will not be altered.

On the other hand conversational real time services are sensitive to the network behavior the conversation might sound choppy and changed when the voice packet have more than 150-200 ms delay. [23]

It is obvious that different user’s needs different quality so some customers prefer to pay more to get better services in order to get less failure in transition and connection. On the other hand when the customers prefer to pay less the Qos concept can be used to offer guarantee services for mobile subscribers.

Routing
GGSN IP routing function Tunneling is responsible to forwarding IP packets between the Service GPRS Support Node (SGSN) and the internet or corporate networks. The main activities involved in routing are determining the optional routing paths and transporting packets through the networks. On the other hand the GGSN supports IP routing over the Gn and Gi interfaces networks as well as the internal IP network. All communication between different networks is managed by the General Packet Radio Service (GPRS) application. It provides also security, load sharing, redundancy, and IP fragmentation.
Routing data traffic between the MT and external networks is basic GGSN functionality. GGSN routes ‘Uplink’ traffic (payload sent by the MT) to the internet by looking up the correct route configured for the external network that the user is connected to. The external network is represented by the APN key. The routing path for each APN is configured locally on GGSN.

GGSN routes ‘Downlink’ packets (packets sent to the MT) by looking up the correct GTP tunnel created for the PDP context when the PDP context was created, and by sending the payload on that GTP tunnel. To look up the GTP tunnel, GGSN uses the APN and the IP address to which the payload is sent.

**Security**

It targets security for network operators, network and service planners, as well as system engineers and administrators.

Security mechanism and function in the GGSN environment are designed by following:

- **Node security**: describes as integrity of the GGSN itself, such as authentication of management operations and prevention of Denial of Service (DoS) attacks

- **Network security**: describes security of functions which are available for protecting the integrity of the overall GPRS system and traffic to the MSs.