
Design Document

Online Charging System (OCS)

Version 1.0

Objective

Document Scope

The information provided in this document specifies the design details of Online Charging System (OCS) . For complete scope of OCS, please see the Project Proposal.

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1. References & Abbreviations

References

Following is the reference document list, which is related to the information present in this document:

- [1] 3GPP TS 32.240 V8.4.0: "Charging management; Charging architecture and principles".
- [2] 3GPP TS 32.296 V8.2.0: "Charging management; Online Charging System (OCS): Applications and interfaces"
- [3] 3GPP TS 32.299 V8.4.0: "Charging management; Diameter charging applications".
- [4] 3GPP TR 32.815 v6.1.0: "Charging management; Online Charging System (OCS) architecture study"
- [5] IETF RFC 3588: "Diameter Base Protocol".

Abbreviations

Following are the abbreviations that have been used in the document:

IMS	IP-Multimedia Subsystem
NE	Network Element
API	Application Programming interface
OCS	Online Charging System
AMPS	Asynchronous Middleware for Protocol Servers
CTF	Charging Trigger Function
RF	Rating Function
ABMF	Account Balance Management Function

2. Introduction

Online charging is a process where charging information for network resource usage is collected concurrently with that resource usage in the same fashion as in offline charging. However, authorization for the network resource usage must be obtained by the network prior to the actual resource usage to occur. This authorization is granted by the Online Charging System upon request from the network. When receiving a network resource usage request, the network assembles the relevant charging information and generates a charging event towards the OCS in real-time. The OCS then returns an appropriate resource usage authorization. The resource usage authorization may be limited in its scope (e.g. volume of data or duration); therefore the authorization may have to be renewed from time to time as long as the user's network resource usage persists.

In IMS, the Charging Trigger Function (CTF) inside various network elements interacts with the Online Charging System through the Diameter Ro Interface, through Diameter Messages.

In conclusion, online charging is a mechanism where charging information can affect, in real-time, the service rendered and therefore a direct interaction of the charging mechanism with the control of network resource usage is required.

3. OCS Architecture

The Online Charging System (OCS) is written using the AMPS framework, which is an Asynchronous Event Based framework that provides two major facilities to us as application writers:

- Hides the implementation details of Operating System specific API, thus making any code written on top of AMPS to be portable across various operating systems.
- Provides extensive support for asynchronous and event driven programming paradigm specifically tailored for writing protocol servers for networking and telecommunication domains.

AMPS framework is implemented as a shared library, and lies at the bottom of the architecture. The diameter base protocol stack has been implemented as a shared library, and lies on top of AMPS. The communication between Diameter Base Protocol stack and AMPS is through direct function calls and through callback functions.

OCS itself is implemented as an AMPS module, which we can call the application's main module.. Please refer to figure 1 for a visual display of the broad term OCS Architecture.

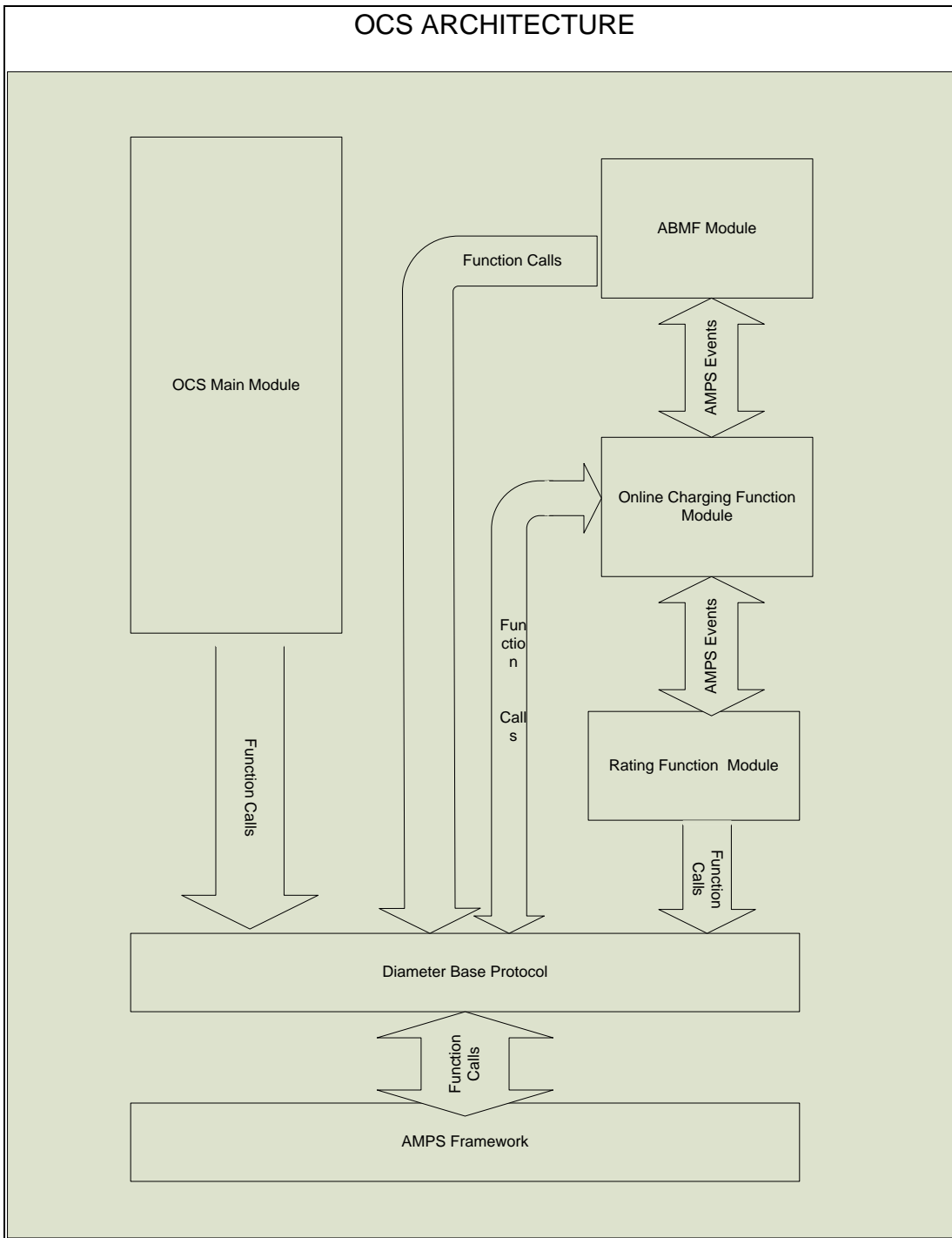


Figure 1 – OCS Architecture

4. Components of OCS Architecture

Each component of the OCS architecture, , as illustrated above, is described in detail in the following section.

4.1 Asynchronous Middleware for Protocol Server (AMPS)

Asynchronous Middleware for Protocol Servers (AMPS) is an open source server development platform supporting event driven, asynchronous programming paradigm. AMPS is ideally suited for development of high performance application protocol servers in telecommunications and networking domains.

AMPS, with its asynchronous, event-driven programming model and fully abstracted OS dependent layer provides the end-user with following features:

- High performance.
- Supports multi – Operating system environment.
- Requires substantially lesser time to develop and market

AMPS is a powerful middleware to implement protocol servers. Due to these features, AMPS was selected as the underlying middleware framework to be used in the design and development of HSS. AMPS exist in the form of a shared library to be linked with the main application that is to be developed.

4.1. Diameter Base Protocol Stack

The Diameter Base Protocol Stack is a complete implementation of IETF RFC 3588 specifications, utilizing the AMPS framework. This stack is used as a shared library that needs to be loaded and configured by its clients. The OCS will function as a client of the Diameter Base Protocol Stack.

4.2. OCS Main Module

The OCS Main module is an AMPS application that performs following tasks,

- Loading its own configuration file and implementing the configuration dictated by the configuration file.
- Initializing and configuring the AMPS framework.
- Initializing and configuring the Diameter Base Protocol Stack.
- Initializing and loading each AMPS module required by HSS, i.e. ABMF module, Rating Function Module, and the Online Charging Function module.
- Passing control over to AMPS framework for the event based logic to take over control and drive subsequent code execution.

The OCS main module therefore makes direct function call into AMPS and Diameter Stack.

4.3. Online Charging Function Module

Online Charging Function Module is an AMPS Module. As part of its initialization, it registers its Application ID with the Diameter Stack and its Message Processor function callback that it implements. Whenever a message for local processing arrives from the network that is destined for OCS, the Diameter stack calls this message processing function within the Online Charging Function Module. From that point onwards, the control shifts to this module's message processor function. The message processor function then implements the required application logic to process the message that has been passed to it.

In actual usage, Diameter Credit Control Request messages sent by Network Elements over Ro Interface will be received by the Online Charging Module's message processor function. As part of processing these messages, this module will need to interact with the Rating Function Module, as well as with the ABMF module. The Rating Function Module, and the ABMF Module provide some service on behalf of this module, and send the results of the service back to the Online Charging Function Module. The communication of the Online Charging Function Module with the Rating Function module as well as the ABMF module and vice versa, is done through AMPS event passing across modules.

The Online Charging Function Module provides support for session based as well as event based online charging.

4.4. Rating Function Module

Rating function module is an AMPS module that provides services to the Online Charging Function module. It communicates to and from the Online Charging Function module using AMPS events.

The purpose of the Rating Function module is to perform both monetary and non-monetary unit determination, and this functionality is defined as rating. It provides the following functionalities:

- Rating for network- and external services and applications (session, service, event) before and after service delivery;
- Cross-product and cross-channel discounts, benefits and allowances.

The Rating Function module handles the following three types of rating instances,

- Rating of volume
- Rating of time

- Rating of events

Upon receipt of a rate request (price or tariff request) from the Online Charging Function Module - sent using the relevant AMPS event - , the Rating Function Module does the following,

- Evaluates the request.
- Determines the applicable price or tariff model and returns it to the Online Charging Function Module using AMPS Events.

4.5. ABMF Module

The Account Balance Management Function (ABMF) module is the location of the subscriber's account balance within the OCS. This ABMF module provides service for the Online Charging Function Module. The communication between the ABMF Module and the Online Charging Function Module happens through the exchange of AMPS events.

The ABMF module provides mechanisms so that the Online Charging Function Module can query and update the subscribers' account and counters status as per requirement and functionality demanded by the Online Charging Function Module.

5. Typical control and Data Flow in OCS

A Typical control and data flow sequence is given below for better architectural understanding:

1. OCS Main module reads its configuration XML file. It then loads and initializes AMPS, Diameter Base protocol shared library and required AMPS modules, i.e. Online Charging function module, Rating Function Module, and ABMF module. It transfers control to the AMPS scheduler.
2. As part of its initialization, Online Charging Function Module registers a callback function with the Base protocol library against its Application ID.
3. A raw Credit Control Request diameter message is received by Diameter base protocol library. The library converts it into structured format. Then the library passes this structured message to the Online Charging Function Module by calling its callback function. The callback function is found by doing a lookup against the Application ID in diameter message, in a library maintained mapping data structure.
4. The Online Charging Function's message processor function processes the Credit Control Request Message and implements the application logic. As part of the implementation of the logic, it needs to query and send information to/from the Rating Function Module and the ABMF Module. This communication is done through the exchange of AMPS Events.
5. The Online Charging Function generates a Credit Control Answer message and sends it to

the peer from whom the original request was received.

Typical Control And Data Flow in OCS

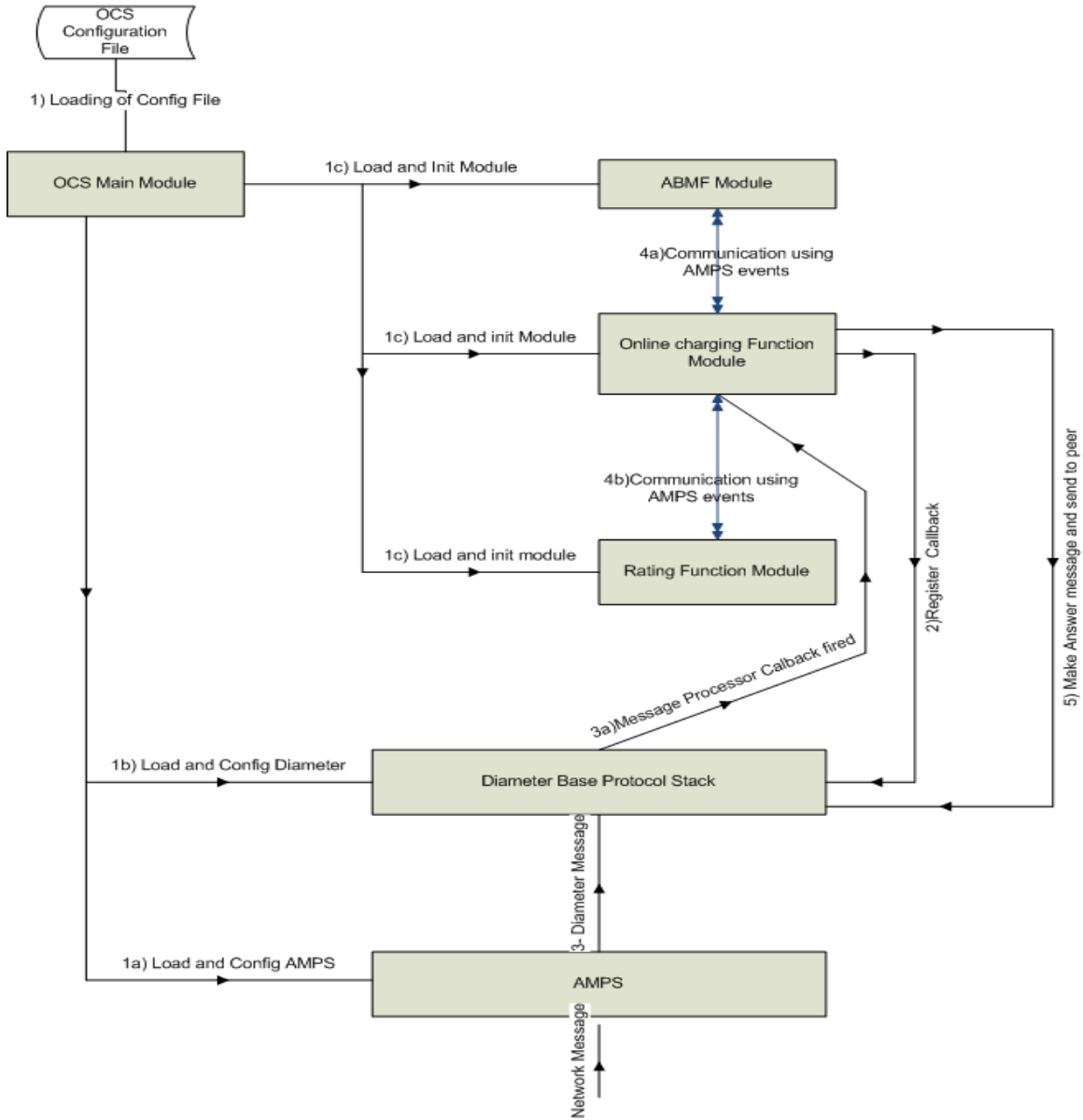


Fig: Online Charging System Control Flow Diagram