

The Multipurpose IP Phone Architecture for Home Service

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Abstract—The Megaco/H.248 protocol is highly flexible for mass deployment of services in a cost-effective manner than NCS protocol based on MGCP currently deployed over Cable network. Currently, Cable network subscribers need various services such as video service or healthcare service ,except voice service. This paper represents the architecture for Multipurpose IP Phone that includes the concepts of new termination and context and new call scenario for various services.

Keywords—Megaco, H.248, Healthcare.

1. Introduction

In recent years the growth of a worldwide IP-based data network, coupled with the rapid growth in the number of households that have online access, have resulted in an environment that allows service providers to offer integrated voice and data services over a common broadband cable access network and IP transport backbone. While the initial application of Voice over IP (VoIP) technology was for toll bypass services (particularly high-cost international toll service) the technology is now sufficiently mature that it is feasible to offer IP-based voice communication services similar to those offered by telecommunications carriers on the Public Switched Telephone Network (PSTN). Under broadband cable network, PacketCable architecture[5], based on DOCSIS standardization, defines a communication services architecture that overlays the two-way data-ready broadband cable access network.

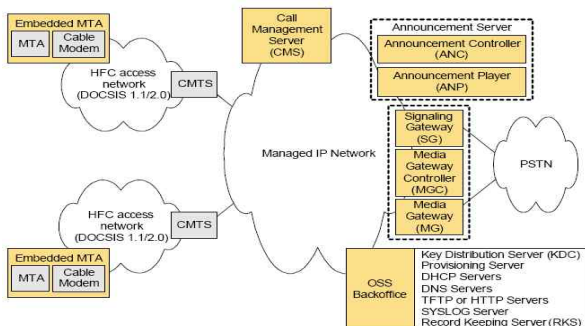


Figure 1. PacketCable Reference Architecture

In PacketCable network, An MTA is a PacketCable client device that contains a subscriber-side interface to the subscriber's CPE(e.g., telephone) and a network-side signaling interface to call control elements in the network. MTAs reside at the customer site and are connected to other PacketCable network elements via the HFC access network (DOCSIS). They are required to support the Network-based Call Signaling (NCS) protocol[6]. The NCS protocol is made based on Media Gateway Control Protocol[1]. The MGCP has some disadvantages. The Standardization of MGCP is a closed approach that does not reflect true industry consensus and, therefore, has limited potential for multi-vendor interoperability. Its connection model is Inefficient for conferences and other complex connection scenarios. Its package mechanism is difficult to extend monolithic design. The Megaco/H.248 protocol is the protocol that solves all advantages of MGCP. It developed jointly by both IETF[3] and ITU[2] open standards bodies. It is highly flexible for mass deployment of services in a cost-effective manner, as well as support and evolution of cable networks.

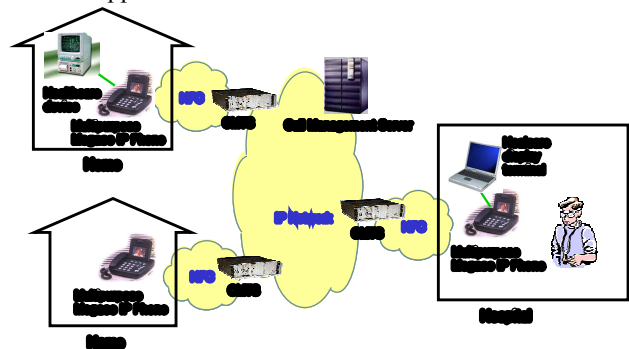


Figure 2. The deployment of Multipurpose Megaco IP Phone in Cable Network

Currently, Subscribers need various home services except voice service. The various services can be video or healthcare service. We are developing Multipurpose IP Phone using Megaco/H.248 protocol. This paper presents Megaco/H.248 model for voice and video ,beside, healthcare services, in IP domain of Cable network. Fig. 2 represents the deployment of Multipurpose Megaco IP Phone in Cable Network(PacketCable network). The Multipurpose Megaco IP Phone play a role of Multimedia Terminal Adapter(MTA)

in Cable network and makes a subscriber communicate with the other subscriber as voice and video service. Also, It has healthcare services capability. A subscriber may be patient residing in home, or may want to take health investigation remotely from doctor in hospital. The Multipurpose Megaco IP phone has camera and display panel for video phone service, and has a connectivity with healthcare peripherals for healthcare services. This healthcare peripherals perform only measurements such as temperature, respiration, blood pressure, electro cardiogram and urine measurement to name a few. These devices are connected to the Multipurpose Megaco IP phone over the RS-232/USB or Wireless Interfaces such as Bluetooth. When a subscriber connects with a doctor in hospital by the Multipurpose Megaco IP phone, the subscriber can use healthcare device, and the healthcare measurements is sent to a doctor in the remote hospital for consultation. As a result, the Multipurpose Megaco IP phone facilitates connectivity and apprises the subscriber of the measurement result and enables the doctor to take appropriate action based on measurement.

2. The Architecture of Multipurpose IP Phone for Home Service

2.1 The Megaco protocol framework of Multipurpose IP Phone

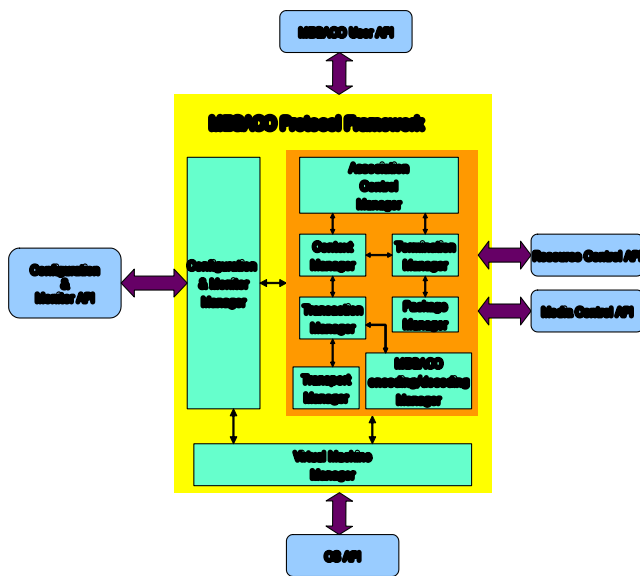


Figure 3. The Megaco protocol framework

Fig 3. represents the Megaco protocol framework. MEGACO protocol consists of total nine blocks – association control manager, configuration/monitoring manager, context manager, termination manager, package manager, transaction manager, MEGACO

encoding/decoding manager, transport manager, and virtual machine manager. Operation manager receives operating command to operator's configuration and monitor in MEGACO slave protocol, analyzes the received operating command, notifies the analyzed operating command to internal function block. Also, it output the processing result of the operating command to external MMC command processing module. Association Control manager controls "association", which is logical session between MGC and MG, and performs Megaco state machine. The Megaco state machine is classified of 5 states – INIT, RESTART, ASSOCIATION, HANDOVER, SHUTDOWN. Context manager analyzes MEGACO command which MGC wants to be processed and performs actions related to MEGACO command – Add, Modify, Subtract, Audit, AuditCapabilities, etc. Termination manager performs the allocation, modification, and deletion of termination which context processing block wants to be processed. Also, it performs the handling of descriptor – the element which control terminations. Transaction manager performs the processing of request, response, and pending of transaction. Package manager performs the processing of the defined package to support various kind of MG. MEGACO encoder and decoder manager performs function to encode and decode MEGACO message in according with the syntax based on text[4]. And we designs interface to easily integrate encoder and decoder based binary with the block. Transport manager performs the function to send or receive MEGACO message to MEGACO Master Protocol(MGC) in the use of Transport layer (UDP). Virtual machine manager provides the function for MEGACO protocol to operate as a process. It includes task memory, and debug management.

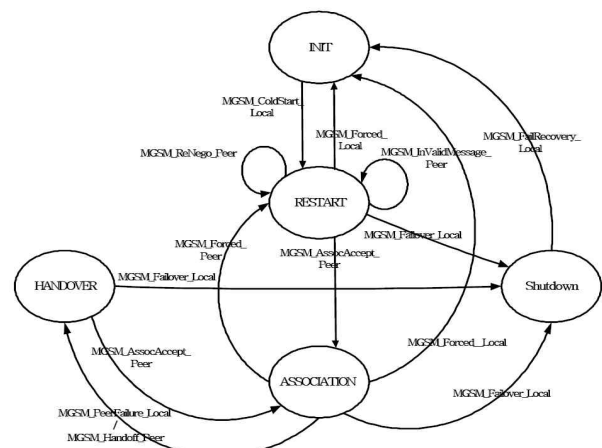


Figure 4. The State Machine for Megaco protocol

Fig 4. represents the association control state machine of Megaco protocol. It includes states, happening events, and actions processed in according to events. The states of association control state machine consist of five states. They

are classified to INIT, RESTART, ASSOCIATION, HANDOVER, and SHUTDOWN. The following ones include definition of each states, events happened in each states, executing actions in according to events, and next states by the actions.

The Megaco protocol that we designed and implemented have the features being the following ones.

- **Efficiency** : Memory management manages the re-usable memory units that the protocol uses without freeing them back to the operation system(OS). This reduces the possibility of fragmentation caused by the random memory allocation and memory releasing. Also, this reduces the overhead of system calls caused by them, and increases the performance of the protocol.
- **Portability** : Currently, our Megaco protocol only supports Linux. But, it has interface for supporting other OSs.
- **Extensible package mechanism** : has the data structures and interface to support to add easily data structure and execution of new package.
- **Testability** : It needs rapidly developing time for MG to support a new service in time to market. To help this, there is the mechanism which can user-friendly log and debug.

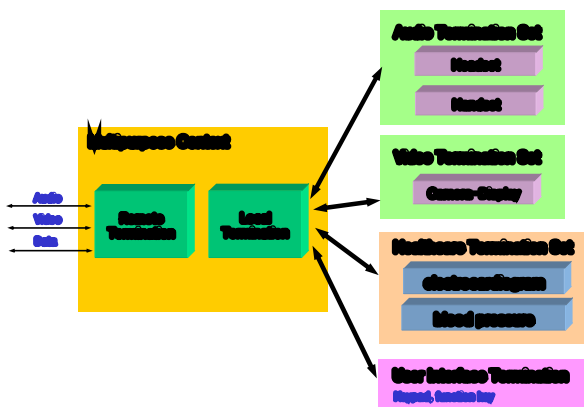


Figure 5. The Megaco/H.248 context/termination model for Multipurpose IP Phone

Fig 5. represents the Megaco/H.248 context / terminationmodel for Multipurpose IP Phone. In Megaco/H.248, A termination sources and/or sinks one or more streams. Audio termination set includes the input/output stream of headset or handset for audio/voice communication. Video termination set includes the input/output stream of camera-display for video communication. Healthcare termination set includes the healthcare measurements of healthcare device. A context is an association between a collection of terminations. The Multipurpose context associates local termination(a

subscriber) with remote termination(a doctor or the other subscriber). The local termination can be Audio termination, or(and) Video termination, or(and) Healthcare termination. Or(and), User interface termination.

2.2 The Service scenario between Multipurpose IP Phones

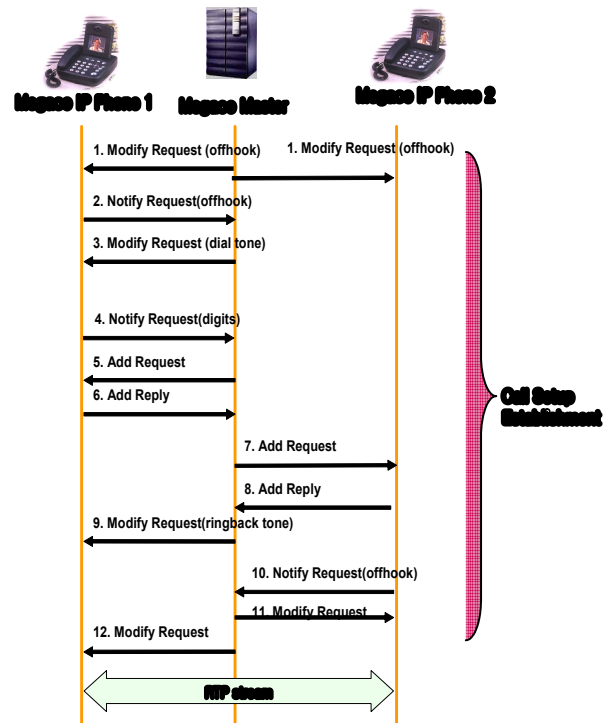


Figure 6. The Call Setup Establishment of Megaco protocol

Fig 5. represents the Call Setup Establishment of Megaco protocol.

1. Megaco Master generates the Modify message towards both the Megaco IP Phone1(Phone1) and Megaco IP Phone2(Phone2) to check for offhook on the terminations.
2. Phone1 sends the Notify message towards the Megaco Master.
3. The Megaco Master issues a Modify command with event descriptor for detecting dial tone and checking digit-map.
4. Phone1 sends the Notify command with dialing digits parameter.
5. The Megaco Master generates a transaction with two Add commands to create terminations.
6. The Phone1 creates two terminations and response to the Add commands.
7. The Megaco Master generates a similar transaction like that of Phone1 towards Phone2.

8. The R-MG2 creates two terminations and response to the Add commands.
9. The Megaco Master issues a Modify command with signal descriptor for playing ringback tone.
10. The Phone2 sends the Notify command with offhook event.
11. ~ 12. The Megaco Master generates a transaction towards Phone1 and Phone2 with two Modify commands in one action.

Both Phone1 and Phone2 send/receive the RTP media flow including voice and video.

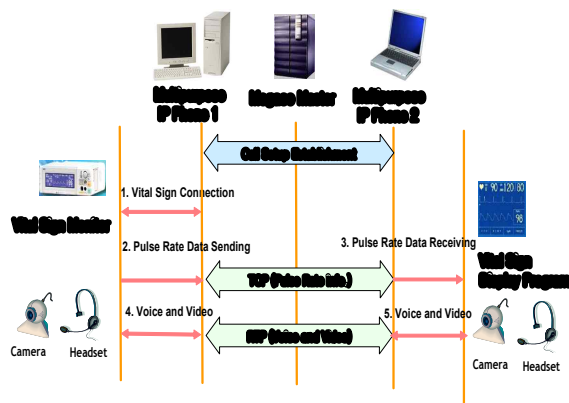


Figure 7. The Healthcare service scenario between two Multipurpose IP Phones

Fig 4. represents the healthcare service scenario between two Multipurpose IP Phones. Multipurpose IP Phone1 means the phone of patient in home, and Multipurpose IP Phone2 means the phone of doctor in hospital. In other words, a doctor treat a patient remotely. The scenario for healthcare service is the following ones.

1. The Vital Sign Monitor is connected to the Multipurpose IP Phone 1.
2. The vital sign monitor measures the pulse rate of a patient and sends pulse rate data to the Multipurpose IP Phone1. The Multipurpose IP Phone1 sends the pulse rate data encapsulated in TCP payload to Multipurpose IP Phone 2.
3. The Multipurpose IP Phone 2 receives the pulse rate data and sends it to Vital Sign Display Program. Vital Sign Display Program analyze it and shows it graphically to a doctor.
4. ~ 5. At the same time, video and voice between Phone1(patient) and Phone2(doctor) is bidirectionally transferred.

2.3 The Architecture of Multipurpose IP Phone

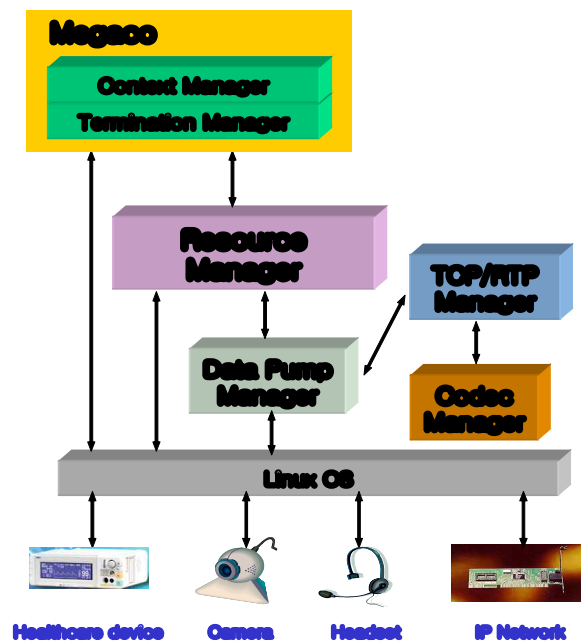


Figure 8. The Architecture of Multipurpose IP Phone

Fig 8. represents the Architecture of Multipurpose IP Phone that we design. The Multipurpose IP Phone is connected with healthcare device, camera, headset, and IP network. The Megaco processing module analyzes Megaco commands received from the Megaco Master and controls the Multipurpose IP Phone by the analyzed commands. The Resource Manager manages resources of Multipurpose IP Phone and control media of Multipurpose IP Phone by the order of the Megaco Slave. In detail, it allocates and releases resources, such as TCP channel, RTP channel. Also, it notifies events to the Megaco Master and sets events requested by the Megaco Master. The Data Pump manager receives voice data from headset, requests the RTP manager to make RTP packet with it, and sends RTP packet returned by the RTP manager towards peer Multipurpose IP Phone. In this case, The Data Pump manager transfers together codec information for the Codec manager to code voice data to G.732.1 or G.729a. Also, the Data Pump manager receives RTP packet from peer Multipurpose IP Phone, requests the RTP manager to make voice data with it, and sends voice data towards headset. In the same manner, The Data Pump manager receives video data from camera, requests the RTP manager to make RTP packet with it, and sends RTP packet returned by the RTP manager towards peer Multipurpose IP Phone. In this case, The Data Pump manager transfers together codec information for the Codec manager to code voice data to H.263. Also, the Data Pump manager receives RTP packet from peer Multipurpose IP Phone, requests the

RTP manager to make voice data with it, and sends voice data towards headset.

Also, The Data Pump manager receives healthcare data such as pulse rate data from healthcare device, requests the TCP manager to make TCP packet with it, and sends TCP packet returned by the TCP manager towards peer Multipurpose IP Phone.

3. Test

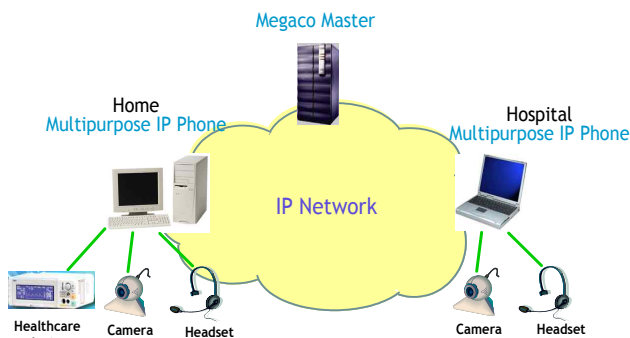


Figure 9. The testbed for Multipurpose IP Phone test

Fig 9. represents the testbed for Multipurpose IP Phone. Currently, We implemented the Multipurpose IP Phone prototype of S/W type. Multipurpose IP Phone prototype was loaded in PC and laptop. Multipurpose IP Phone for Home and Vital Sign Monitor, camera, headset is connected together. We are developing Multipurpose IP Phone H/W and are going to load Multipurpose IP Phone S/W in the developing H/W.

4. Conclusion

This paper represents the architecture for Multipurpose IP Phone that includes the concepts of new termination and context and new call scenario for various services such as healthcare device, and video, except voice. In the future, We are developing Multipurpose IP Phone H/W and are going to load Multipurpose IP Phone S/W in the developing H/W.

ACKNOWLEDGEMENT

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