

# Unified Broadcasting Management System for Static BCMCS in CDMA2000 1xEV/DO

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## Abstract

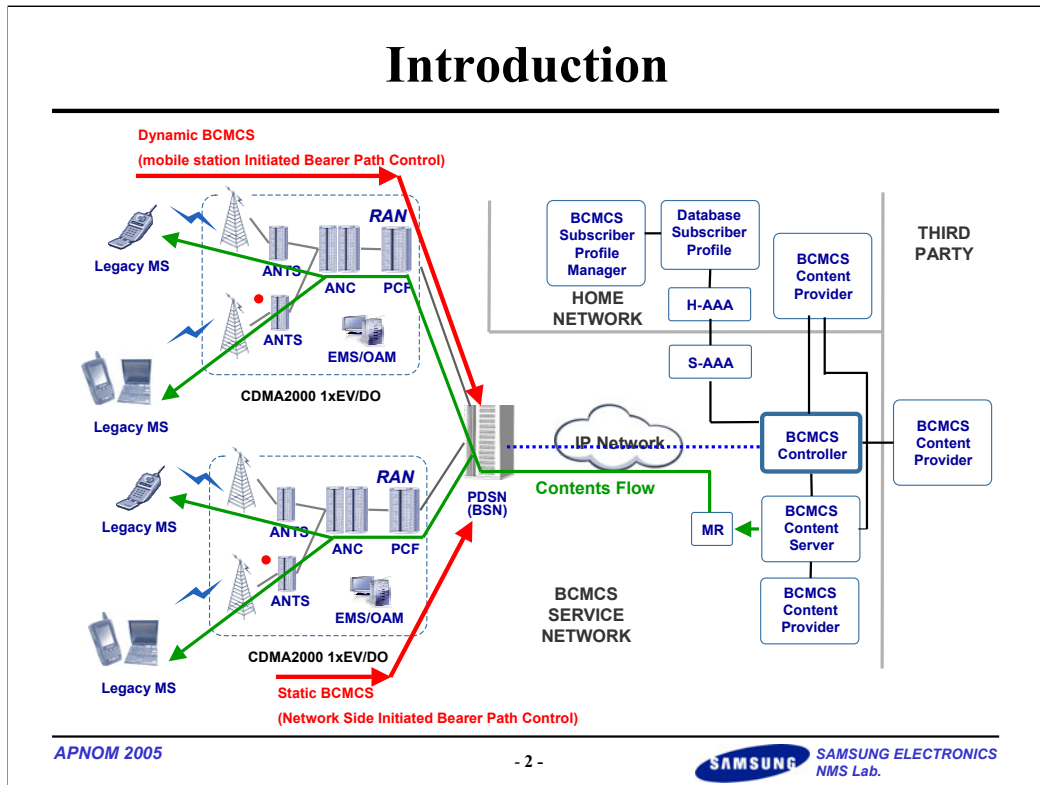
Recently, various kinds of additional services are examined in mobile network. The broadcasting service in mobile network environment is one of the most lively issues. BCMCS (Broadcast and Multicast Service) is a technology that is proposed to provide the broadcasting service in legacy CDMA 2000 1xEV/DO network.

BCMCS offers many users the same information (multimedia including streaming, text message, voice etc.) through one link. It is a technology that do broadcast without repeated transmission of the same information in CDMA2000 1xEV/DO radio section.

BCMCS consists of Static BCMCS and Dynamic BCMCS. They are defined as "Static BCMCS is the broadcast service wherein the bearer path is provisioned by operator (e.g via OAM&P) regardless of the user presence in the cell/sector. Dynamic BCMCS is the broadcast service wherein the bearer path is established based on the user presence in the cel/sector.". In another word, the network side takes charge of the main role of service control without intervention of the mobile station in Static BCMCS, and the mobile station takes charge of the main role of service control in Dynamic BCMCS. In the case of Dynamic BCMCS method, complicated negotiation procedures are needed between mobile stations and BCMCS elements, because contents are provided by the request of the mobile station. However, in the case of Static BCMCS, the procedure is simple than Dynamic BCMCS, because contents are transmitted one-sidedly in network side without intervention of mobile station.

There are kinds of technical difficulties to apply Dynamic BCMCS because of the complexity. Then, Static BCMCS is easier way that gives Telecommunication Companies an opportunity that can enter to the Broadcasting Market early. However, there are several difficulties to offers and to manage Static BCMCS, with the BCMCS standard only. On this paper, we propose a solution to solve these difficulties and to offer the broadcasting service on CDMA2000 1xEV/DO network using Static BCMCS.

# Introduction



## 1. Introduction

The broadcasting service in mobile is one of the issues that is getting many interests recently. BCMCS is a technology for broadcasting service in CDMA2000 1xEV/DO. BCMCS provides the broadcasting service in mobile without large scale investment for a new special network. BCMCS offers many users multimedia contents from a source. Representative service instance is video and music broadcasting service etc..

First of all, we mention the definition of broadcasting for this paper. There are various methods that provide the broadcasting service such as VOD, DMB etc. We define "Broadcasting means that contents are transmitted from network side to user side according to program schedule without any user side presence, like DMB, traditional TV broadcasting service.". So, Demand-on style broadcasting service like VOD is not scope on this paper.

As mentioned before, BCMCS have two styles of broadcasting service in the figure above. In case of Dynamic BCMCS, the service is leading by mobile station. It means that the bearer path control is achieved by the request of mobile stations. In case of Static BCMCS, service is leading by the network side (operator in the BCMCS standard). It means that the bearer path control is simultaneously achieved by the network side. Static BCMCS is more similar to the definition of broadcasting above. However, there are several problems and difficulties to implement Static BCMCS for real service in CDMA2000 1xEV/DO. One of the biggest problem is that operators have to control manually bearer paths to transmit service contents. This paper provides a proposal to solve these problems and difficulties to implement Static BCMCS for the real broadcasting service in legacy CDMA2000 1xEV/DO. Furthermore, we want to find the possibility that we adapt our solution to other Wireless Networks which are able to support Broadcast&Multicast Protocol for service data, and which have similar problems with Static BCMCS in CDMA2000 1xEV/DO.

In additional, this paper will not describe detail specification of the BCMCS standard. Also, we assume that BCMCS Broadcast&Multicast Protocol is already applied in CDMA2000 1xEV/DO network.

# Problems in Implementing Static BCMCS

- ◆ Static BCMCS characteristics
  - Network side takes charge of role of leading service.
  - AN should spontaneously control the bearer path for contents transmission.
- ◆ No Scheduler For Broadcasting in CDMA 2000 1xEV/DO Network (AN)
  - There is no elements that could take the role of scheduler for broadcasting in AN.
  - Static BCMCS has to provide broadcasting service based on program schedule.
  - Scheduler have to be able to establish and release the bearer path by the schedule.
  - It is difficult that BCMCS Controller have the role of scheduler.
  - It is more difficult to add scheduler functions into legacy AN element.
- ◆ No Control Interfaces Between CDMA 2000 1xEV/DO Network (AN) and External Network (such as IP network)
  - The bearer path establishment/release are impossible from elements in external network.
  - Network side initiated broadcasting service is impossible without the interfaces.
  - Operators should establish and release the bearer path manually to service Static BCMCS.
  - It is difficult to define and add new interfaces into legacy AN.
- ◆ A new element is required
  - The new element should have broadcasting scheduler functions.
  - The new element should provide the bearer path control interfaces to legacy AN.

## 2. Problem Analysis

### 2.1 Static BCMCS Implementing Problems

Main characteristic of Static BCMCS is achieving the role of leading service in network side without mobile station's intervention. It means that CDMA2000 1xEV/DO Access Network (below, AN) should spontaneously achieve functions that control the service. Usually, the broadcasting service is provided by the program schedule. AN have to achieve control functions for the bearer path establishment/Release according to the program schedule. However, to offer these functions, following difficulties exist.

First, Static BCMCS should be able to broadcast contents from the network side to the mobile station side by the program schedule. But, presently, there are no elements that be able to archive the role of the broadcasting scheduler which manages the program schedule and controls the bearer path in AN. Also, it will be not easy to define and directly add these functions on legacy AN in service already. Furthermore, in BCMCS Standard, Operators have to achieve relevant control by manual through OAM&P, but it is difficult to offer various actual broadcasting service.

Second, there is no interface that current AN can handle control signals from external IP network. Therefore, AN doesn't have ways to handle signals from BCMCS Controller or others, although new BCMCS elements, such as BCMCS Controller, offer these functions. It may need a lot of time and effort to define and apply new interface to solve the problems between BCMCS elements and legacy AN. It is not sure that this attempt can be realized in the near future

To solve referred problems above, a new element is demanded that could manage the program schedule and control the bearer path in AN. The new element should offer interface for the bearer path control in AN, and it have to do the role of Broadcasting Scheduler that could establish and release bearer paths according to the program schedule. It also have to provide unified control and management functions for whole service network. UBMS offers Broadcasting Middleware Functions to solve these Static BCMCS implementing problems

# Management Issues in Broadcasting Service

- ◆ Various District Service Unit Configuration
  - Service Location Configuration has to be flexible.
  - Entire Country, Location Area Group, Each Location Area, Each AN Unit
- ◆ Various Type of Program Support
  - There are many kinds of program types.
  - Each program type have different service styles.
  - Regular Program, Repeat Program, Urgency Program, Commercial Advertisement
  - Daily, Weekly, Monthly, Yearly Program etc.
- ◆ Broadcasting Program Schedule Management
  - Program schedule management should be simple and easy to operators.
  - Program schedule has a lot of complicated factors.
  - Operator's mistakes have to be prevented beforehand.
  - Various format of schedule information should be offered to operators.
- ◆ Broadcasting Network & Service Status Management
  - AN and service status should be monitored to provide stable service.
  - Abnormal status of network elements and service are detected before service time.
  - Do the best effort to guarantee service quality.

## 2.2 Broadcasting Service Management Issues

Another issue that should be considered for Static BCMCS is Service Management. There could be some sub-issues in Broadcasting Service Management issues like below.

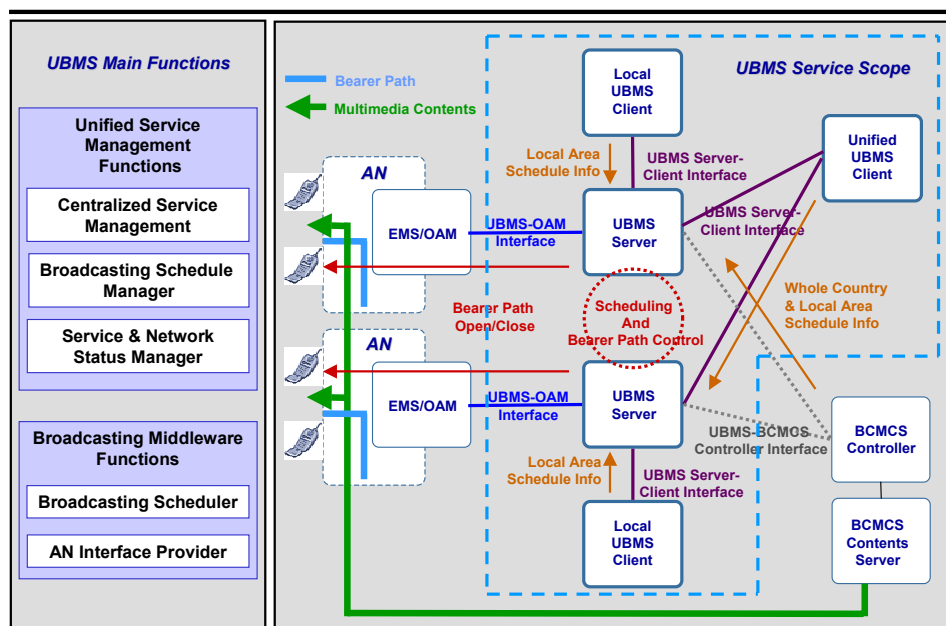
First, the broadcasting service needs various service area configuration. Usually, there could be district broadcasting services such as entire country, area group, and single area broadcasting etc. General CDMA2000 1xEV/DO Network consisted of AN unit, so broadcasting service could be provide the same broadcasting programs to the entire ANs, a group of ANs and each ANs on the same time. However, It is consisted of a set of many ANs, and there are various network configuration models for business policies of each Telecommunication Companies (Below, Telcos). So, it is not easy to offer flexible and various district broadcasting service on the huge network.

Second, various types of programs have to be supported. There are a lot of program types such as repeat, urgency, and commercial advertisement program. Therefore, there are differences in scheduling and service way according to each program type. For example, if it is a urgency program such as disaster information, a current program in service has to be stop and the urgency program could be serviced with the highest priority. In the case of commercial advertisement programs have to be serviced repeatedly with shot term as much as 1 ~ 2 minute between regular programs.

Third, organizing and adapting program schedule should be easy. Static BCMCS usually services contents by program schedule, so exact program schedule is very important. When a wrong information such as service time error, program duplication are included in program schedule, regular broadcasting service could not be provided. Also, various schedules such as weekly, monthly, yearly schedule are could be organized by service policy of Telco. To organize numerous program easily without mistake, schedule management functions are essential.

Fourth, broadcasting service and network status could be monitored and managed. In Static BCMCS, if problems occur to AN elements and communication channels, regular broadcasting service cannot be provided because the bearer path control for the transmission of the contents is impossible. If signal processing for the bearer path control is failed, it could cause service fault. Therefore, monitoring and management functions for network and service status are required.

# Designe Concept



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## 3. Proposed Solution

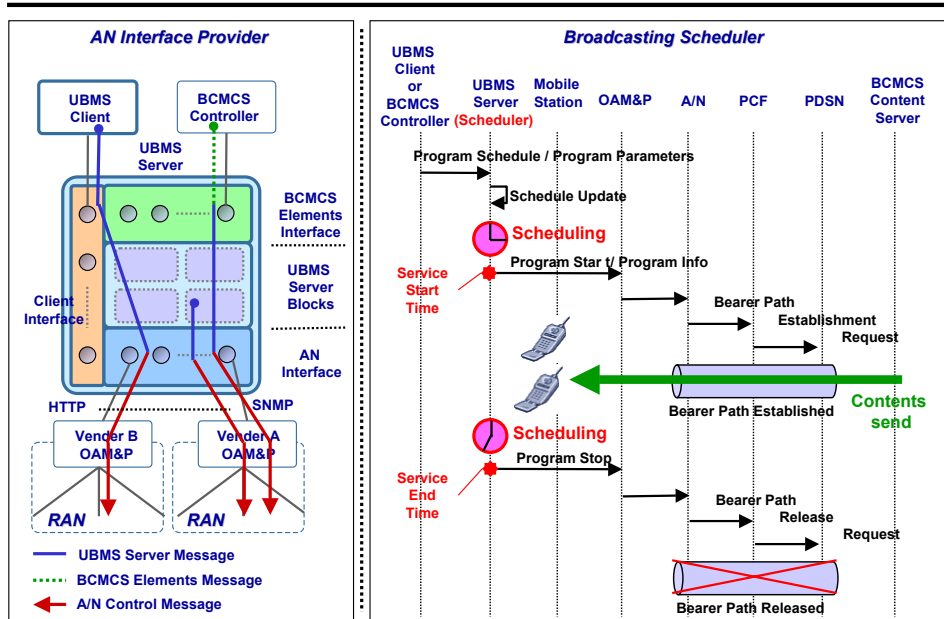
To solve referred difficulties in implementing Static BCMCS and to maintain broadcasting services efficiently, we propose UBMS (Unified Broadcasting Management System).

UBMS offers Broadcasting Middleware Functions and Unified Service Management Functions. Broadcasting Middleware Functions take the role of providing interfaces to control AN and bearer paths according to the broadcasting scheduler. Unified Service Management Functions have Centralized Service Management and Broadcasting Schedule Management to organize schedules of broadcasting program efficiently and easily.

To achieve Broadcasting Middleware Functions, UBMS server is placed in AN as new element. UBMS connects to management systems such as OAM&P Module, EMS etc (below, AN management systems) which is inside the AN to support control interface with the AN. UBMS takes charge of interfacing with one or more AN. Also, UBMS server takes charge of the role of the broadcasting scheduler. UBMS server transmits the signal for the bearer path control to the connected AN management systems to establish and to release bearer paths for contents. Additionally, if BCMCS Controller provides a interface to organize program schedule from BCMCS Controller to other external elements, UBMS could also connect to BCMCS Controller to get the program schedule, and to control broadcasting service.

To offer Unified Service Management Functions, UBMS uses Client-Multi Server Architecture which differ from general Client-One Server Architecture. UBMS Clients could have multi-session of many servers on the same time. It makes that UBMS client accesses to multiple UBMS servers in the network and controls all ANs through the servers. With the Client-Multi Server Architecture, UBMS clients provide functions to control and to manage various broadcasting service simply on the entire network.

# Broadcasting Middleware



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## 3.1 Broadcasting Middleware Functions

### 3.1.1 AN Interface Provider

One of the primary roles in UBMS Broadcasting Middleware Functions is providing interfaces for the bearer path control. UBMS uses AN management systems such as OAM&P, EMS etc that is located in AN to offer interfaces for the bearer path control with AN. Usually, AN management systems already have interfaces to control AN elements inside the management area. Especially, UBMS could use client interfaces or OSS interfaces of AN management systems, so it makes easy to get AN control interface without additional new interfaces. Also, it could make it easy to collect and to monitor various information about AN, such as configuration information, fault information, status information etc. from the AN management systems.

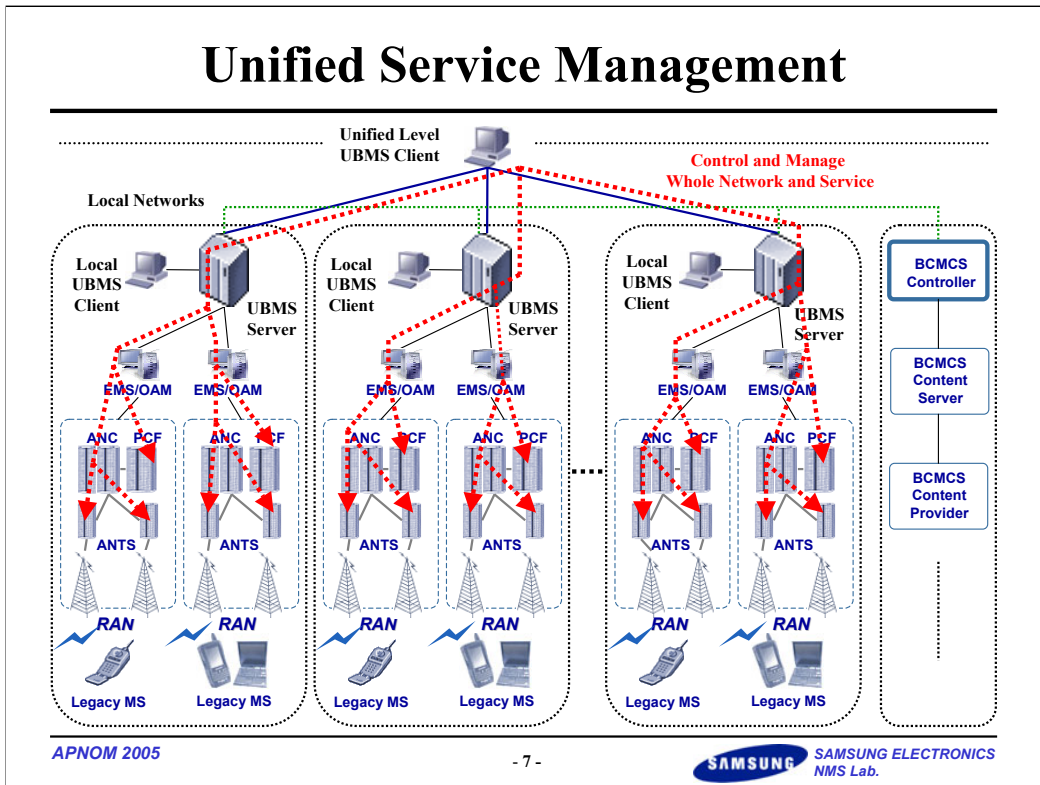
UBMS offers various interface adaptors such as SNMP, HTTP, SOAP, CORBA, RMI etc. It provides easy way to implement interfaces between UBMS server and AN management system. Also, in case that BCMCS Controller provides a interface for external elements, it could be implemented easily. UBMS provides the control path for AN with these various interface adaptors without big investment of cost and time to add new interface on AN elements.

### 3.1.2 Broadcasting Scheduler

One another of the primary roles in UBMS Broadcasting Middleware Functions is establishing and releasing bearer paths according to broadcast program schedule. To transmit contents from BCMCS Content Servers to mobile stations, bearer paths should be established for the contents in AN on exact time. UBMS Broadcasting Scheduler generates the signal for the bearer path establishment and send it to AN on exact start time of a program according to the schedule. Also, it generates release signals for the bearer path release and send it to AN on exact finish time of the program to release resource of AN.

As mentioned above, UBMS server offers Broadcasting Scheduler. The scheduler archives scheduling functions according to the list of the broadcasting program schedule that is provisioned from UBMS client or BCMCS Controller (if possible). UBMS scheduler is the most important module in UBMS server, because it actually controls services. To guarantee services, UBMS provides the redundancy of scheduler modules to overcome software faults, and provides the redundancy of UBMS servers to overcome hardware faults.

# Unified Service Management



## 3.2 Unified Service Management

With UBMS Unified Service Management Functions, UBMS Clients are able to manage broadcasting service efficiently to the entire AN widely distributed on huge area. Usually, the most of Telcos have a lot of service network groups separated by district units, AN etc. In many of cases, accessing to AN from external network is usually prevented for security. Also, Telcos usually have their own service area policies. UBMS servers will be placed in the Telco's each service area units, and they manage and control broadcasting service of the areas.

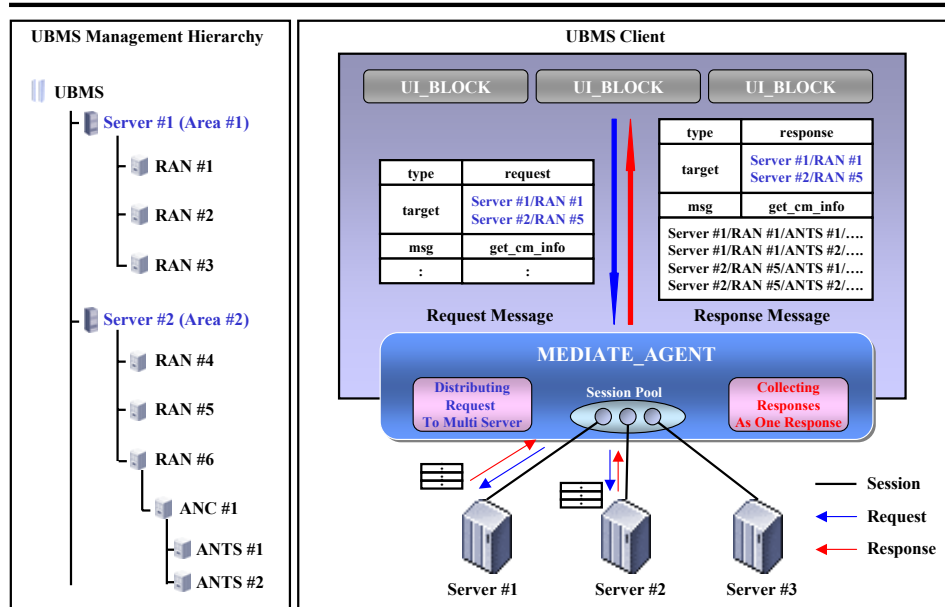
In the figure above, a Local UBMS client accesses to a UBMS server located in the area included the client. The client manages and controls AN of the area. However, Unified Level UBMS clients could control and manage services on entire network because the client could access to all UBMS servers in the entire network. In order to provide accessing function to the entire network from one client, UBMS uses Client-Multi Server Architecture.

Unified Level UBMS Clients could access to all UBMS servers in entire network, so that operators could archive to control and provision the same jobs to the entire network with one operation simply. Also, operators could organize various location service configuration such as a location, location group etc. And, as mentioned before, UBMS has connections to AN management systems, so UBMS could collect and monitor the various information of AN elements. Therefore, Unified Level UBMS Client could control, monitor and manage the entire service network. It help UBMS to provide Unified and Centralized Broadcasting Service Management.

In additional, Unified and Centralized Management Functions help UBMS to provide flexible scalability. If broadcasting service capability has to be increased or broadcasting service area should be added, these procedures could be simply completed with only adding UBMS server and registering the server to clients.

Also, UBMS Broadcasting Schedule Manager provides functions that could obviate broadcasting service faults by eliminating human errors of operator mistakes, and that could manage the schedules for broadcast programs. Various monitoring functions for broadcasting service status are provided to fix the service problems beforehand.

# Client Multi-Server Architecture



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## 3.2.1 Client-Multi Server Architecture

UBMS Clients regard servers as management hierarchy's top-level node. So, clients could organize various management scopes including the entire network, and provide centralized service management by registering servers as their management nodes. In other words, if a UBMS client registers one UBMS server, it could be worked as Local UBMS client. Also, if a UBMS client registers several or all UBMS servers, it could be worked as Group Level UBMS client or Unified Level UBMS client.

To offer these functions mentioned above, UBMS clients use Multi-Session Interface (below, MEDIATE\_AGENT) that could open and control multiple sessions for many UBMS servers. UBMS MEDIATE\_AGENT provides Multi-Session Management Function and Message Mediator Function.

UBMS MEDIATE\_AGENT could establish multiple sessions to multiple servers in the similar way to the authentication procedure of general Client-Server Architecture, such as login etc. And, MEDIATE\_AGENT could manage the status of the sessions on real time through monitoring the all sessions to provide stable management functions. Also, if there are problems on the sessions, MEDIATE\_AGENT notifies them to operators and retries establishing the session automatically.

MEDIATE\_AGENT transmits messages to proper servers by analyzing messages from UI. It collects and merges the responses from each servers as one response. UBMS messages include target information on the message header, and MEDIATE\_AGENT watches the information to send the message to multi servers included in the target information. It works like multicasting protocol. Also MEDIATE\_AGENT receives the responses for the messages and merges them as one response. UI could process the merged response as well as one response without any complicated considering multi server environments.

Regarding servers as nodes and using MEDIATE\_AGENT, there is no complicated considering for UI design. There is no heavy work on UI to send messages to multi server, and to merge the response from multi servers. Also, Operators could easily control and manage the entire service network with just selecting targets that operator wants.

MEDIATE\_AGENT is designed to implement Client-Multi Server Architecture with the simplest way. It helps providing Centralized Service Management and flexible scalability without big modification of general Client-Server based Management System Architecture, by changing client communication interface to MEDIATE\_AGENT.

# Flexible Broadcasting Configuration

## ◆ Flexible Broadcasting Area Configuration

- UBMS Clients could access to all UBMS Servers in entire network.
- UBMS Clients could add programs into the scheduler module of UBMS server by operator's area selection.
- Operator could select service area flexibly according to programs.
- Various service district area by programs could be configured easily.
  - Entire country program : program is added to all UBMS servers on the entire service network.
  - Local program : program is added to a UBMS server in the selected local area only.
  - Local group program. : program is added to the all UBMS servers in the selected group.

## ◆ Various Program Type Support

- Each program type work different style.
- Manual provision by operator is not efficient.
- Configuration of various program types is supported.
- Scheduler controls programs by each type automatically
- Various program types exist.
  - Regular Program : Serviced at once and deleted from schedule list
  - Urgency Program : Urgency program have the highest priority
  - Advertisement Program : Short and repeatable service
  - Daily Program : program is service on reserved time every day.
  - Weekly Program : program is service on reserved day and time every week.

## 3.2.2 Flexible Broadcasting Configuration

As mentioned before, UBMS provides Unified Level UBMS client that could access to entire service network. It could support flexible and simple ways to configure the broadcasting service area. UBMS could define service area by each broadcasting program. Unified Level UBMS client provides easy way to service programs on exact time at exact area simultaneously. It is done by adding the programs into Broadcasting Scheduler of UBMS server where is placed in each areas. For example, if a program have to be provided to the entire network, the client will add the program to all UBMS server automatically by one operation.

There are many program types in broadcasting service. In general, there are regular program, repeatable program, urgency program, commercial advertisement, etc. Also, there could be daily program, weekly program, monthly program, and yearly program etc. These program types have different service way by each program type. In the case of a regular program, it have to be provided on reserved time once. An urgency program should be serviced after stopping currently serviced program with the highest priority. A commercial advertisement have to be serviced among regular programs for short time as much as 1 ~ 2 minutes. Daily programs is serviced once everyday at reserved time. Another program types also have there own service ways.

Actually, it is very difficult that operators provision the various kinds of program types manually. In UBMS, Operators could provision the various types of programs simply by selecting program type and filling some additional information for the each program type when program added. UBMS controls these complicated and various service way automatically by program types. For example, in case of weekly program, if operator select weekly type for the program on UI, UBMS will services the program at every week on the same day and time without adding the program into schedule list week by week.

# Broadcasting Schedule Manager

Program Info		Date / Time Info				Day Info							ATTRIBUTE	
Flow ID	Program	Start Date	End Date	Start Time	Play Time	MON	TUE	WED	THU	FRI	SAT	SUN	...	AREA
#0001	Daily News	05.01.01	05.01.01	09:00	30	O	O	O	O	O	O	O	...	ALL
#0002	Sport Weekend	05.08.01	05.09.30	23:00	80	X	X	X	X	X	X	O	...	ALL
#0003	Monthly Music	05.12.30	05.12.30	12:00	60	X	X	X	X	X	X	O	...	LOCAL
#0004	Today's Movie	05.11.01	05.12.30	22:00	120	O	O	O	O	O	O	X	...	LOCAL
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
#0978	Commercial Message 1	05.12.01	05.12.30	00:00	5	O	X	O	X	O	X	X	...	LOCAL

- Program Add, Update, Delete
- Program Information List Display
- Service Status Display
- Validation Check for Added Program or Updated Program
- Available Resource Presentation to Operator
- Various Search and Sorting Function

Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10
O	X	O	O	X	O	O	X	X	O

<span style="background-color: #ADD8E6; border: 1px solid black; padding: 2px;">O</span> ON AIR	<span style="background-color: #FF4500; border: 1px solid black; padding: 2px;">O</span> FAIL ALL
<span style="background-color: #90EE90; border: 1px solid black; padding: 2px;">O</span> READY	<span style="background-color: #FF69B4; border: 1px solid black; padding: 2px;">O</span> PARTIAL FAIL
<span style="background-color: #A9A9A9; border: 1px solid black; padding: 2px;">O</span> FINISHED	

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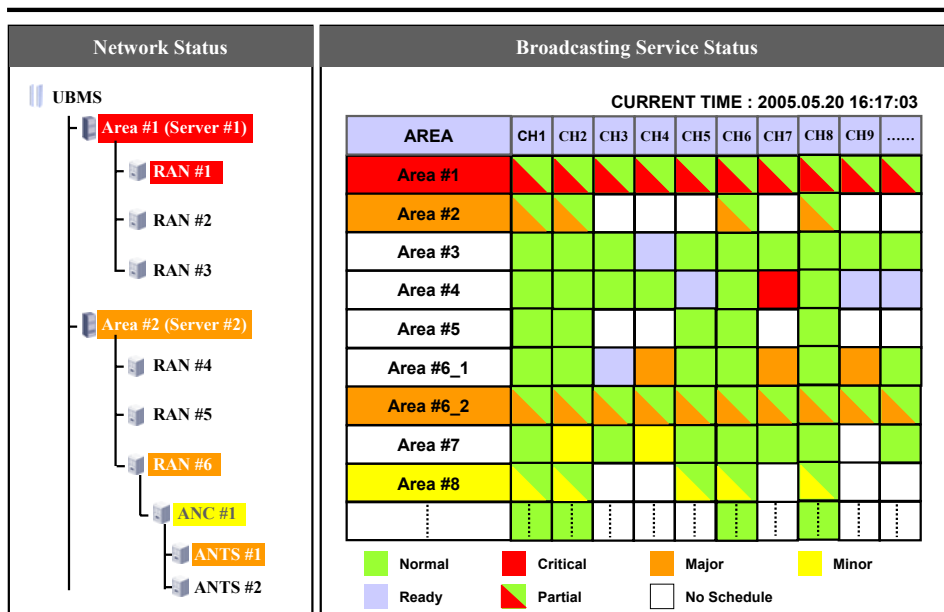
## 3.2.3 Broadcasting Schedule Manager

Broadcasting service in Static BCMCS is controlled by the list of the broadcasting program schedule. Therefore, Organizing the list of the broadcasting program schedule is very important in Static BCMCS. However, managing the list of the broadcasting program schedule is very complicated and difficult job. Operator have to consider a lot of factors such as a number of programs, program types, avail channel information, and available time information etc. UBMS offers Broadcasting Schedule Manager to help operators to manage the list of the broadcasting program schedule simply and efficiently without mistakes.

Basically, Broadcasting Schedule Manger can offer adding, deleting, and updating various program schedules, such as weekly schedule, monthly schedule etc. Broadcasting Schedule Manager helps operators to handle and to manage the list of broadcasting program schedule easily by providing very intuitional UI like the example of figure above. Broadcasting Schedule Manager displays program information with various formats that operators could understand and analysis them easily. And, various searching and sorting functions are provided to help operator's works. Also, Broadcasting Schedule Manager offers real-time validation check function for schedule inputs, so that it prevents schedule error by mistakes of operators beforehand. Also, it provides auto searching function for available resource such as channels and time etc.

In additional, as showed in the figure above, Broadcasting Schedule Manager offers service status through various colors, and helps operators to confirm service status.

# Service & Network Status Manager



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## 3.2.4 Service & Network Status Management

UBMS offers Service & Network Status Manager to provide stable broadcasting service. Service & Network Status Manager monitors network and service status periodically. UBMS generates alarms when problems occur to network and service status, so that operators can take fast action. It provides opportunity that operators prevent service failure before service start.

UBMS collects processing result about the bearer path control signals from Broadcasting Scheduler, and offers operators current service status on real-time. Service & Network Status Manager provides various types of status display such as status of location area, status by each broadcasting program etc. Operators could detect and fix problems on service through Service & Network Status Manager rapidly as soon as possible.

Because UBMS provides AN interface using AN management system. UBMS can collect various information about AN elements through linked AN management system. Basically, UBMS collects relevant network topology information and each NEs' status from AN Management System. Normal broadcasting service is incomprehensible to relevant network when problems occurred in service elements such as UBMS servers, AN elements, AN management systems, and BCMCS Controller etc.. UBMS does the best effort to provide stable broadcasting service by detecting and notifying the occurred problems to operator before real service failure.

Basically, all detected problems that happen in service and network are notified to operators by alarm. UBMS client notifies relevant alarms to operators by visible alarm (Real Time Alarm View and Monitoring UI) and audible alarm (Speaker). Also, UBMS supplies various alarm information that can be helped to maintain stable service with Alarm History Manager

## Conclusions & Future Work

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### ◆ Conclusions

- UBMS provides a solution that could solve problems and difficulties to implement Static BCMCS on legacy CDMA2000 1xEV/DO network.
- UBMS offers Telcos the chance to entering Broadcasting Market early with minimum costs.
- UBMS provides various service management functions to manage, and to control broadcasting service simply and stably

### ◆ Future Work

- UBMS have some more topics to study on real site implementing
- Studies for adapting UBMS on other wireless networks that have similar problems and could support Broadcast & Multicast Protocol.
- UBMS should be evolved as a broadcasting solution for total wireless network

## 4. Conclusion and Future work

UBMS provides a solution to solve problems and difficulties to implement Static BCMCS in legacy CDMA200 1xEV/DO network. We try to offer opportunity to enter Broadcasting Market early with lowest cost to Telecommunication Companies which have CDMA 2000 1xEV/DO network.

However, the problems and difficulties that we analyzed on the paper, are not only for CDMA2000 1xEV/DO network. Actually, other wireless networks (eg. 802.16e Wireless Internet) have similar issues such as absence of AN and external network interfaces, absence of Broadcasting Scheduler, and difficulties of service management etc.

In the future, we are going to try studies for adapting UBMS on other wireless networks which have similar problems, if the networks could support Broadcast & Multicast Protocol. So, UBMS should be evolved as a total broadcasting solution for various wireless networks.

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