

Call Models for Video Dialtone

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ABSTRACT

Video dialtone represents a means for subscribers to access video channels for a variety of high-bandwidth broadband interactive services. In the United States, the video dialtone network employs the concept of the level 1 and level 2 gateways to provide this access. The core function of both gateways, a function we believe to be needed worldwide, independent of the U.S. regulatory environment, is to help the user select and connect to a suitable video information provider and receive a program chosen by the user. The calling and connectivity sequences that effect this are the subject of this paper. We present two different call models and discuss their advantages and disadvantages in various conditions. We also propose a signalling model compatible with emerging broadband signalling standards.

Keywords: Signaling, Video Dialtone, Level 1 Gateway.

1 INTRODUCTION

Cable television companies, network operators, and sometimes other utility providers are now building broadband networks to support interactive video services such as video on demand [1]. Video dialtone is a term used by network operators to denote access to video circuits, which collectively are referred to as the video dialtone or level 1 network. Neither the user terminal equipment nor the meaning of “off hook” is specified or even known yet. In the United States, the Federal Communications Commission (FCC) requires network operators to provide open and fair access to their video dialtone network for any video information provider. The function that provides this interface is called the level 1 gateway, and since its operation is not stipulated by the FCC, various Regional Bell Operating Companies (RBOCs) in the U.S. have issued their own designs.

Figure 1 shows the level 1 gateway in the context of a video on demand delivery network. The level 1 gateway is the major control component in the control path between the set-top and the video server. Its design greatly affects the design of both devices and their associated end-to-end performance. (The level 0 gateway performs signal conversion only.) In this paper, we introduce our definition of the level 1 gateway and suggest two different call models. The concept of the level 2 gateway is also introduced. One of the key points of this paper is that the level 1 gateway and level 2 gateway can be very similar. In the following sections, we introduce the level 1

gateway, propose a signalling model, and describe two call models for connecting users to video sources.

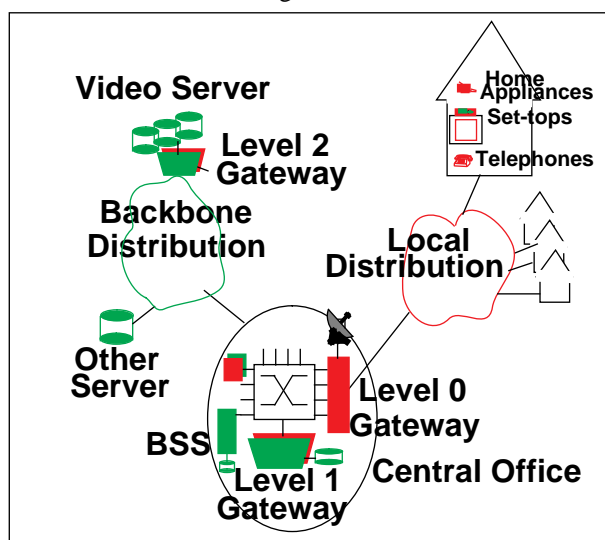


Figure 1 Video On Demand Delivery Network

2 What is the Level 1 Gateway?

Two main concepts shape the basic definition of the level 1 gateway. The first concept comes from the FCC comments on the video gateways [2]. The second concept is mentioned in a Bell Atlantic document that distinguishes the level 1 gateway from the level 2 gateway [3]. The FCC made the following comments on video gateways.

1. “A gateway is a service that enables consumers to select among a number of communications services.”
2. “A video gateway provided by a telephone company would permit consumers to select and receive video programming made available by video programmers.”
3. “The video gateway could also provide access to, and be integrated with, non-video programming services.”
4. “A video programmer would not be required to be part of a video gateway in order to be accessible by the consumer.”

From 1 and 2, the core gateway function is *selection* of video programmers. 2 adds the *receive* function, which implies that the level 1 gateway could be involved in the establishment of the video connection. In 3, the video

gateway function is extended for other applications, and could be a *general* device for multiple broadband applications. In 4, the video programmer is accessible outside the video gateway, which means that a user can bypass the gateway and access video programmers directly. This raises the interesting issues of whether or not the level 1 gateway is actually in the video data path and even whether going off hook in a video sense mandates a connection to the level 1 gateway.

Figure 2 shows the distinction between the level 1 and the level 2 gateways. The level 1 gateway resides inside the network and is part of the network equipment; the level 2 gateway is outside the network and is considered customer premises equipment (CPE). The level 1 gateway is therefore regulated, whereas the level 2 gateway is unregulated.

In general, the level 1 gateway provides the selection for users to choose content providers (level 2 providers), which in some views relegates the level 1 gateway to the equivalent of a “white pages” service. The level 2 gateway provides the selection for users to choose actual contents, such as a specific movie. Previews, enticements, and other promotions are allowed, making the level 2 gateway more resemble the “yellow pages.” For some implementations of the level 2 gateway (Bell Atlantic for example), other functions such as application control (e.g., pause, fast forward, rewind), and network access signalling (with the level 1 gateway) for network control are also included. A level 2 gateway could serve many video servers.

Also note in Figure 2 that the level 1 gateway can send selection information through either the control channel or the data (video) channel (shown in unidirectional arrow) to the set-top. We expect the latter case to predominate in the future to provide higher bandwidth for multimedia selection information.

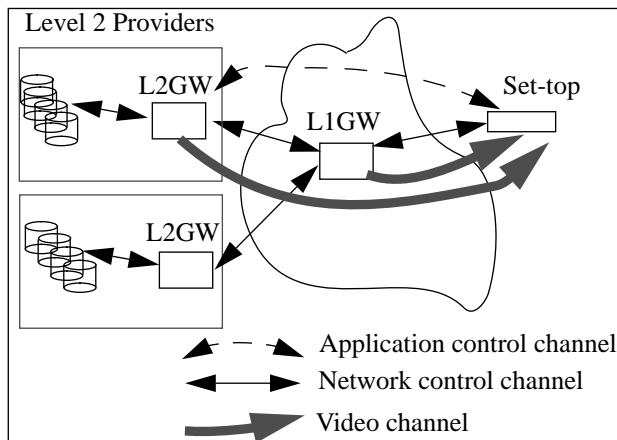


Figure 2 Level 1 vs. Level 2 Gateway

3 Signalling Model

Figure 3 shows a proposed signalling model comprising three signalling levels. Level 0 signalling represents the broadband signalling transport layer. Level 1 signalling employs the session layer (call) protocol to manage the service between the set-top and the level 1 gateway, and level 2 signalling uses the session layer protocol to manage the service between the set-top and the level 2 gateway. (Application control, shown in Figure 2, is not

considered signalling.)

The network controller deals only with the connection setup and tear-down, and has a bidirectional link with the set-top. Level 0 signalling includes the protocol layers from the physical layer all the way to the transport layer. The level 1 gateway has a bidirectional channel for the control part of the selection service, and a unidirectional data channel for the data part. The level 1 and level 2 control channels actually go through the network controller (and via the signalling network) using the level 0 protocol as the transport. Also shown is the signalling between the level 1 gateway and the network controller for connection establishment. Only the logical relationships are shown in the figure.

The level 1 signalling should be a subset of the level 2 signalling to reflect the functional similarity between the two gateways, and allowing the level 1 gateway and level 2 gateway to employ the same session layer protocol simplifies the set-top. We believe that level 0 signalling should use protocols that are compatible with standards for existing or emerging broadband networks. For example, UDP/TCP/IP is employed in the Internet, numerous private, enterprise networks, and new broadband networks controlled using distributed computing; Q.2931/SSCOP¹ will be used for both public and private ATM networks; and SS7, the mainstay of today’s networks, is a potential candidate, though we do not expect it to be implemented in the set-top.

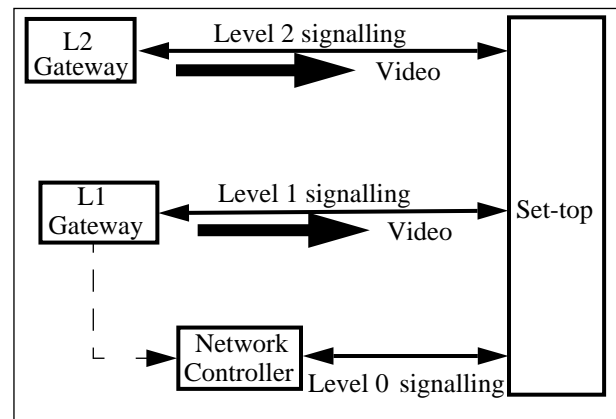


Figure 3 The Signalling Model

The network controller resides not only in broadband networks, but also in local distribution networks. Depending on the kinds of local distribution network (e.g., ADSL, hybrid fiber/coax), the network controller also processes some physical layer specific signalling functions (not shown in the figure). For example, hybrid fiber/coax requires fiber, channel, and subchannel allocation for the downstream flow and some multiple access scheme for shared access to the upstream control channel².

We advocate at least a logical separation of the level 1

1. Q.2931, formerly known as Q.93b, is a signalling protocol currently being standardized by the ITU. SSCOP (Service Specific Connection Oriented Protocol) is part of the signalling ATM adaptation layer (SAAL) for reliable data transport.

2. The signalling protocols specified by Scientific-Atlanta, Control System Messages for Interactive Video Services, are basically in this layer.

gateway functions and the generic connection control functions because we do not see a one-to-one mapping between broadband network controllers and level 1 gateways and because connection control should be service independent, which the level 1 gateway is not. The simplest form of level 1 gateway is merely a directory server of video programmers. Note that this design does not preclude employing the connection control function at the level 1 gateway, in which case the level 1 gateway sends messages to the network controller to set up the connection for the user.

In our model, the level 1 gateway, similar to the level 2 gateway, has a video connection to the broadband network. In this case, the level 1 gateway selection service can be delivered through the data network. This will help to extend the current white pages service into the yellow pages in the future, which requires higher network bandwidth for multimedia.

As a comparison, Figure 4 shows Bell Atlantic's signalling model, which separates the signalling network (X.25) and the broadband network. The level 1 gateway uses a special signalling protocol to control the network controller, and the white pages selection information is sent through the signalling network, not the broadband data network.

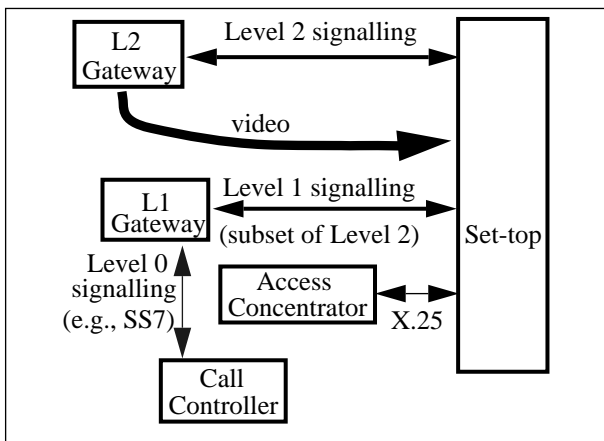


Figure 4 The Bell Atlantic Signalling Model (Stage One)

This solution is not a general one because the signalling transport layer, X.25, is not compatible with the broadband signalling network. Furthermore, the signalling message from the set-top goes to the level 1 gateway first, which is distinct from other applications (e.g., telephone) that directly interact with the network controller. This presents a video-only solution and a more expensive infrastructure. Since the level 1 gateway in this model sends data (selection messages) only over the signalling network (X.25), the model is difficult to extend to a video yellow pages service due to the limited bandwidth in the signalling channel (16Kbps currently).

4 Call Model

We now introduce two call models for the level 1 gateway and level 2 gateway. One is the direct dial model, in which a user initiates a call from the set-top. The other is the operator assist model, in which the level 1 gateway sets up a connection for the user. These models apply to both the connection of a user to a level 2 gateway by the level 1 gateway and the connection of the user to an

actual video server by the level 2 gateway.

4.1 Direct Dial

The direct dial model is similar to today's telephone directory service (e.g., 411 call). A user gets the destination number from the directory server, and then dials the number directly. Figure 5 depicts a video example. Once a user connects to the level 1 gateway, the level 1 gateway loads some selection information such as a menu to the set-top. Each selection on the menu comprises a hyper-pointer (address) to a level 2 provider. When the user selects a level 2 provider, the set-top dials directly. The user can request more menus (by traversing a navigation tree) or go back to previous menus during the navigation. To maintain the continuity during the navigation, the links among the hierarchical menus are maintained either at the set-top or the level 1 gateway.

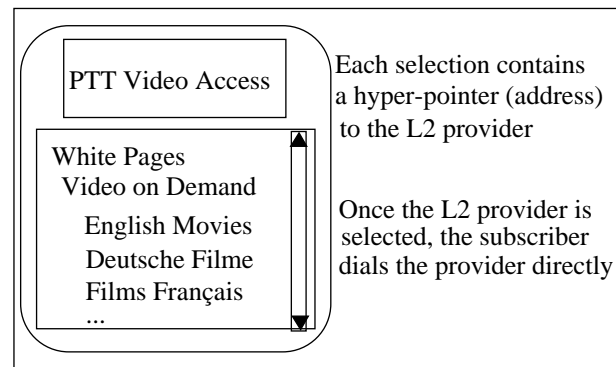


Figure 5 Call Model: Direct Dial

Figure 6 shows the sequence to establish the connections.

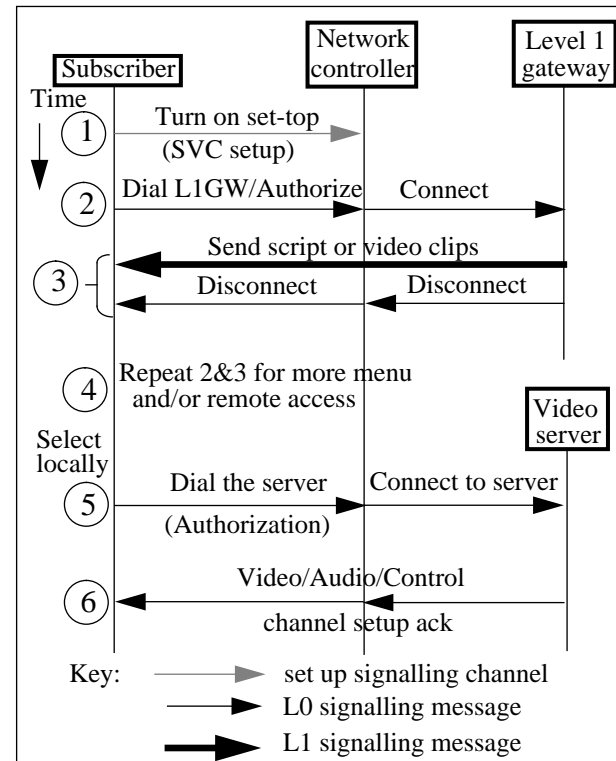


Figure 6 Direct Dial Connection Sequence

1. When a user turns on the set-top, a signalling channel (switched virtual channel (SVC)) is set up between the set-top and the network controller.

2. The user dials the level 1 gateway via the network controller. The level 1 gateway authorizes the user to proceed if the network charges for the video dialtone selection service.

3. Once linked with the level 1 gateway, the user receives scripts or video clips from the level 1 gateway. The connection is then torn down.

4. The user employs local intelligence (in the set-top) to display the menu on the screen and navigate through the items. If additional menus or scripts need to be down loaded, steps 2 and 3 are repeated. If a level 2 provider cannot be found locally, the user can access remote level 1 gateways from the menu, and repeat steps 2 and 3 to dial them directly.

5. The selection is made locally. Once done, the set-top uses the corresponding hyper-pointer to dial the level 2 gateway.

6. When the user connects to the level 2 gateway, the procedure repeats until the application control channel and the application video and audio channels are set up.

The above figure shows the direct dial model using local intelligence in the set-top for display rendering, querying the database, and navigating. Figure 7 shows an alternative using network intelligence. In this case, the information search and the navigation requests are sent back to the level 1 gateway and processed there.

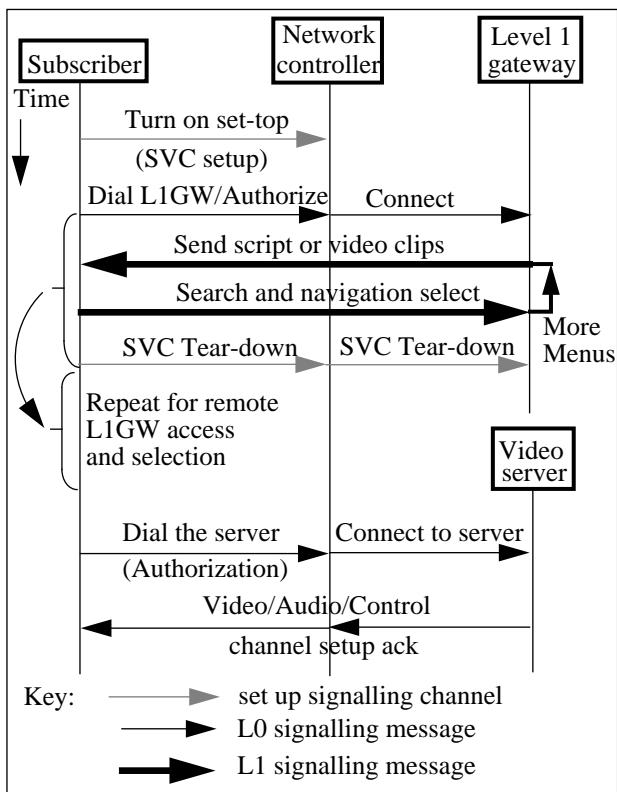


Figure 7 Direct Dial with Network Intelligence

4.2 Direct Dial Without the Level 1 Gateway

7. We should not forget that once the set-top has the capability of dialling directly, it can keep a cache of favorite numbers, or accept them as real-time input in some way from the user, and dial them directly, saving the user from having to deal with the level 1 gateway menu navigation every time. What this means in terms of the video dialtone network or even whether or not this will be allowed is unknown.

4.3 Operator Assist

The operator assist (or third-party connect) model is similar to that used in public and private telephony today. In this model, a user connects to the operator and tells the operator the destination number, and the operator makes the connection. Once a user connects to the level 1 gateway, the level 1 gateway loads a menu on the set-top. Each selection on the menu triggers a message sent back to the level 1 gateway. When the user makes a level 2 provider selection, the level 1 gateway then sets up the connection between the set-top and the level 2 gateway.

Figure 8 shows the sequence to establish the call.

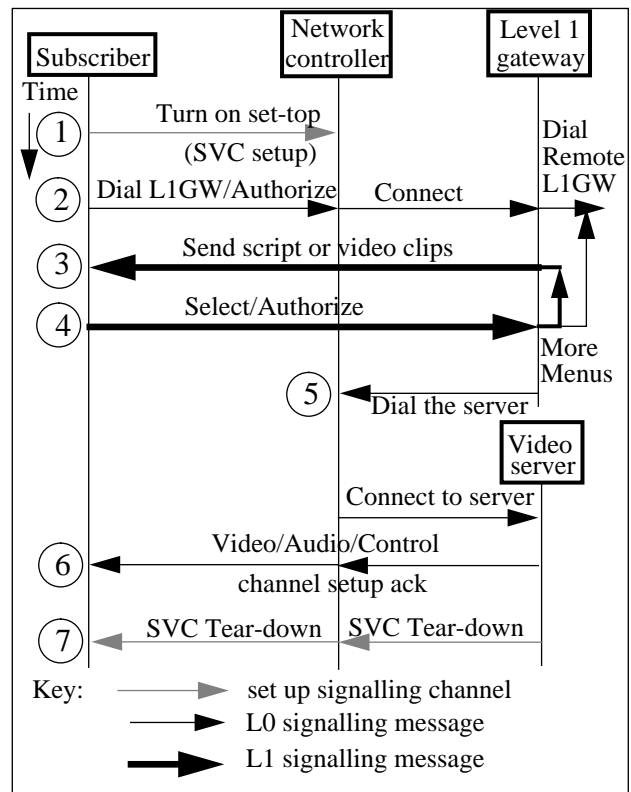


Figure 8 Operator Assist Connection Sequence

1. When a user turns on the set-top, a signalling channel (switched virtual channel -- SVC) is set up between the set-top and the network controller.

2. The user dials the level 1 gateway via the network controller. The level 1 gateway authorizes the user to proceed if the network charges for the video dialtone selection service.

3. Once linked with the level 1 gateway, the user re-

ceives a script or video clips from the level 1 gateway. The connection between the set-top and the level 1 gateway is maintained until step 6 -- after the level 1 gateway sets up the connection between the level 2 gateway and the set-top.

4. The user employs local intelligence to display the menu on the screen and remote intelligence to search and navigate. If additional menus or scripts are required, steps 2 and 3 are repeated. If a level 2 provider can not be found locally, the user can access remote level 1 gateways from the menu and via steps 5-7 have the level 1 gateway set up the connection. The user selects a level 2 provider and signals this to the level 1 gateway. The level 1 gateway connects the level 2 gateway and the set-top for video services, or the remote level 1 gateway and the set-top for remote video dialtone services.

5. When the level 2 gateway completes the process to connect the user to a video server, it acknowledges back to the set-top and sets up the application control channel and the video and audio channels.

6. The level 1 gateway tears down connections between the level 1 gateways (including the remote ones) and the set-top.

In all the above discussion, we have not gone into detail about connecting to the video server itself. It is probably the case that the level 2 gateway functions in the near term will be provided by the video server, and the above figures are easy to understand if that is the case. But we expect that over time more menu, promotion, and transaction functions will reside in level 2 gateways or other types of brokers. Separating these functions from the servers themselves could be attractive for either very large video providers whose content spans many servers, or for very small providers who wish to have a well-known broker or dealer handle their promotion.

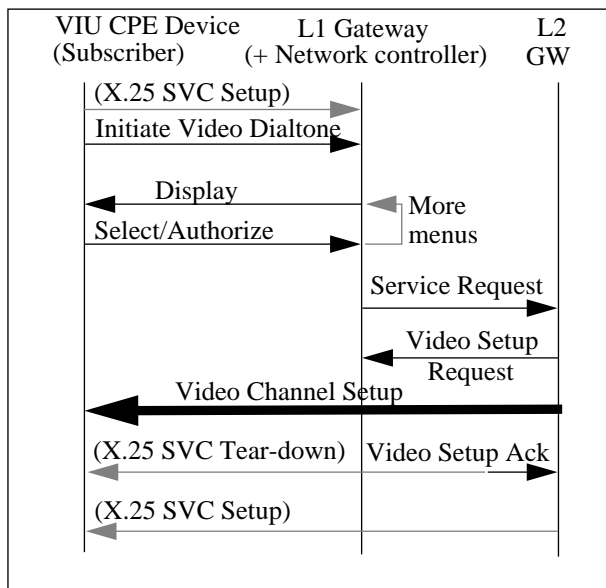


Figure 9 Bell Atlantic Call Sequence

We now look at the Bell Atlantic call model for its video dialtone service, which uses operator assist. Figure 9 shows the timing sequence. Note that the figure combines the level 1 gateway and the network controller functions.

Once a level 2 provider is selected, the level 1 gateway sends a message to the network controller to set up the video channel.

5 Conclusions

We have introduced a signalling model and two possible call models for video dialtone. The signalling model shows that a session layer protocol is required among the set-top, the level 1 gateway, and the level 2 gateway for accessing video information providers, and we propose standard protocols for the level 0 signalling. We also show that the level 1 gateway and level 2 gateway are similar in their function and possibly in their ability to convey video as well.

The call models describe direct dialling and operator assist. About these we make five observations. First, a direct dial model that tears down the connection after each request is a stateless solution. Since a user tears down the connection immediately after each request, no connection state has to be maintained, and the system is probably simpler and more robust as a result. Second, the operator assist model requires maintaining a connection between the level 1 gateway and the set-top during navigation, since the set-top uses this connection to navigate back to the local level 1 gateway. This is not a stateless solution. Third, the direct dial model using local intelligence requires the set-top to store multiple levels of scripts during navigation to avoid the overhead of repeated connection setup and tear-down procedures, so more memory is required in the set-top. Fourth, the operator assist model potentially creates looping during remote navigation when a remote level 1 gateway connects the user back to the original level 1 gateway while keeping the connections with all intermediary ones. Algorithms to avoid looping are therefore needed. Fifth, the operator assist model, which we expect to prevail, requires third-party call setup capabilities in the signalling protocol. This Q.2931 does not have.

REFERENCES

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