Future Imminent IV: Entertainment On Demand

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This installment of *Future Imminent* is focused on what many in the interactive industry feel will be a primary application: Entertainment on Demand (EOD). EOD, unlike video on demand (VOD), includes anything you might watch at home on your VCR which would include all types of information and entertainment. The VOD products heralded in 1994 have fallen on hard times in 1995 because barriers exist related to the technology and current cost structures. We'll look at how to get around these barriers and explore a near-term solution that meets a broad range of needs and can be deployed almost immediately.

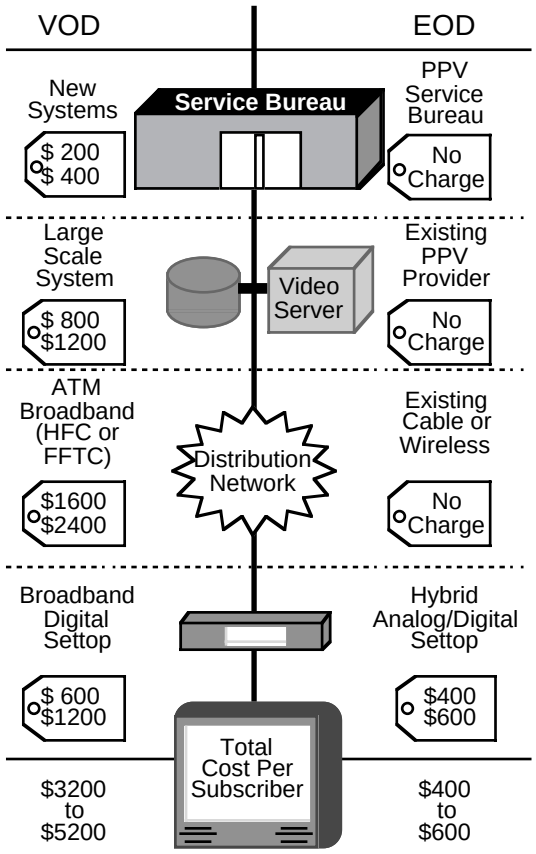
Both VOD and EOD are based upon delivering compressed digital video to the home. To make this happen, four layers of technology have to be put into place and integrated to work together. Each of the layers represents a monumental shift from the current environment. Compounding the problem is the absence of standards-based products, because agreement on the various standards required to build compatible products has—as usual—been agonizingly slow in coming. Ergo, the lab experiments for VOD, none of which represent a commitment for wide-scale deployment. These trials and the related technology have received extensive coverage, so we will just do a quick review for the purpose of contrasting VOD and EOD approaches (see Figure 1).

The first layer that has to be in place for VOD is a *broadband distribution network* capable of delivering hundreds (or thousands) of digital channels simultaneously to the home. Several architectures exist, including Fiber To The Curb (FTTC), Hybrid Fiber/Coax (HFC), and Asymmetrical Digital Subscriber Line (ADSL). All require a switching component, with the Asynchronous Transfer Mode (ATM) fast packet format gaining the consensus as the long-term winner. Another alternative is similar to cellular telephony, where channels are assigned dynamically to subscribers. These approaches require a tremendous investment in proprietary solutions which may (or may not) become "de facto" standards if they reach a high enough level of deployment. Where VOD and EOD diverge is that EOD is intended to be an overlay to existing infrastructures, allowing them to migrate to broadband rather than deploying parallel networks. Further, EOD utilizes a broadcast scheme as opposed to creating a virtual channel to the subscriber's home.

The second layer is the *digital set-top box* required in the subscriber's home to receive and decode the digital signals. A number of companies are designing digital set-top boxes, most of which have a common baseline in their design—specifically, the use of MPEG as the digital video format. The fully digital broadband box required for VOD is both more expensive and complex than the hybrid analog/digital box used for EOD. The functionality is essentially the same, as are the picture and audio quality.

The third layer is the *video server*, which reads prerecorded digitized compressed video information off of some storage media (usually optical disc) and feeds it to the subscriber's home for the digital set-top box to decode and display on the television screen. This server for VOD must be able to handle many high-speed channels simultaneously. The VOD server and the set-top box must use the same control signals, and the broadband network must be able to pass

Figure 1
Comparison of VOD and EOD



Source: S. Evans

those signals end-to-end for VCR-like functions (pause/stop, fast forward, rewind) to work. The EOD approach uses a smaller server that only sends out a limited number of video streams, constantly broadcasting the same information in a repetitive pattern known as a Marquee.

The fourth layer is the *service bureau* which takes the order from the subscriber, creates the billing stream, and authorizes the delivery of the video signal. Whether you call it a back office system or look at it like a service bureau, it still has to exist before the service can be deployed. The VOD version of the service bureau is still being defined, while EOD makes use of the existing pay-per-view (PPV) bureaus.

Cost per Subscriber Versus Willingness to Pay

The cost of putting this all together is given in the price tags shown in Figure 1. Is there a business case or economic model that holds up under scrutiny? How quickly does the subscriber pay back the service provider's investment in this infrastructure? The answer for VOD is not very quickly. Measured against the video store model, you can go to your neighborhood video store and rent a movie for $2.99. How much more are you willing to pay for the convenience of sitting at home and selecting a movie from a menu? The VOD trials to date show promise in terms of consumer usage, but not in their willingness to pay (WTP). When the price point is competitive with the local video store, the subscriber is willing to buy an average of four movies per month. That's roughly 2.5 times the PPV rate of 1.6, but not dramatically over the three movies per month average of the video store patron.

This creates a serious problem, as reflected in the RBOC Video Dialtone filings with the FCC Carrier Bureau, which showed the payback stretching out between eight and 12 years—well beyond the seven-year depreciation schedule under which the investment would be made. To paraphrase the head of a computer company who had initially placed great importance on the VOD server market, "every subscriber would have to sit home and watch movies 24-hours-a-day for 10 years in order for this to pay off!"

With EOD, all of the various products that can be time shifted will contribute revenue. Sports, soap operas, your favorite sitcom, distance learning—they all add up in the revenue column. Trials by Your Choice TV show that viewers are willing to pay $1 for a TV show they missed and up to $2.99 for miniseries and specials. So EOD, with its broader range of choices and lower cost for deployment, gives the service provider a fighting chance at showing a profit in a timeframe that can be financed.

Breaking Through The Barriers

Technology aside, there are ways to deliver digital signals to the home. While the telephone companies commit their billions of dollars to MMDS and PCS auctions in an effort to secure spectrum that will allow them to beam digital signals into homes without launching satellites or plowing the earth to bury fiber, the cable companies are beginning to overlay their analog signals with digital ones to make sure they can coexist peacefully without further degrading the already murky picture quality most of them deliver today.

What's needed is a way to deliver a digital video signal to the subscriber willing to pay an additional $10 to $20 per month for programs (including movies) in digital format. The monthly subscription fee pays for the EOD hybrid analog/digital set-top box that receives both analog and digital information and decodes the signals. An internal modem that plugs into the subscriber's telephone jack provides telephone access to order movies, TV shows, or any other type of programming made available on a "pay-per-play" basis. The same service bureaus that take the orders for PPV movies and events take the subscriber's EOD order and send a message to the broadcast point (MMDS or cable headend) to relay the enabling code to the subscriber's set-top box, and tell it to decode a specific digital channel so the program can be viewed. This effectively eliminates the need for a broadband delivery system while leveraging the existing PPV program provider and/or service bureau capabilities to solve the back office and billing problems. For the service provider, the existing PPV providers are more than willing to provide a digital encoded signal along with the traditional analog signal.

Driving The Demand

What's left is to make the service more "on demand" capable. PPV service today is "start time" and "carriage" driven. In the quest for increased revenues, the PPV model yields two ways to increase the "buy rates," which are the holy grail. First, offer more start times for movies. Extensive studies and marketing trials have all yielded the same results. Make the movies available at more frequent intervals and the buy rate goes up, usually in proportion with the frequency. Double the start times, double the buy rates.

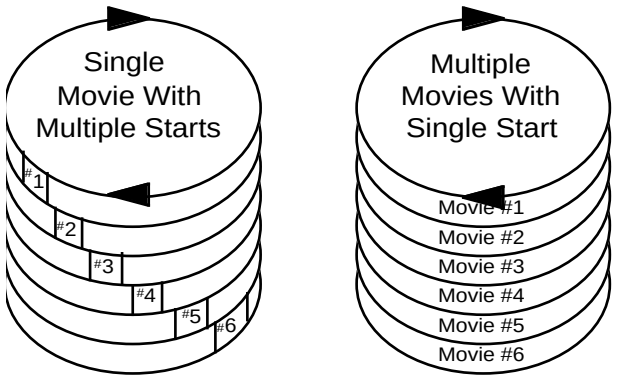
But increasing the start times impacts carriage. Carriage means providing a channel to carry the signal on. A combination of regulatory hassles and aging cable plants have caused most cable systems to run out of channel capacity. Bad news for PPV providers, which currently have between two and four channels available to them on a cable system. Especially since the second factor in increasing the buy rate is to offer more movies, as long as they're in the "top 10" at the local video stores. Double the number of movies available, and you double the buy rates. So a "push-pull" dynamic exists here, where more movies and more start times both drive the buy rates up. Yes, doubling the number of movies *and* the number of start times effectively quadruples the buy rates. But carriage restrictions constrict the opportunity, forcing an upgrade or rebuild of the system to provide more carriage, which increases the mortgage, which reduces the profits because of the spiraling costs. How can this problem be solved?

In a way, you probably already know what to do. Drive by your local Cineplex, and the answer is staring you in the face. Offer a choice of movies in one place, showing simultaneously. Oddly enough, the digital video equivalent of Cineplex is Multiplex. No, we're not mixing metaphors. It has to do with digital compression for video. The MPEG format allows for between six and 10 video streams to be multiplexed into one television channel frequency. In the cable world, this is known as channel replacement, i.e., replace one analog TV channel with up to 10 digital ones. This is the source of John Malone's famous "500 channels." Most cable systems have 50 usable channels, and if you replaced all of the analog channels with digital ones, the result would be 500 digital channels. This is not practical, since every subscriber would need a shiny new digital set-top box—but at least the math works.

Let's use the MPEG compressed digital video format to multiplex video streams and make them function as if they really were "on demand." We need a video server, but only a small one that plays the same movies over and over and over again, with one multiplexed stream feeding into an analog television channel. In this scenario, the movie is sent out in a repetitive stream, creating the Marquee mentioned earlier, with the whole movie being broadcast in chunks that are multiplexed together in the digital video stream (see Figure 2). Chop the movie into pieces, and it reduces the playing time to broadcast the whole movie. Broadcast only one movie per channel and you can have 10 starts in the same time allotment, typically 120-minute intervals. Another option is to broadcast multiple movies on one channel with only one start time, which is the Cineplex model.

The Marquee contains the compressed video information, surrounding it with a frame pattern that identifies what information is present and the relative location in the overall sequence. Embedded in the frame pattern is a control channel providing the information necessary to capture and reconstruct the video stream so it can be decoded by the EOD set-top. The control channel is reserved for information required to distribute and manage the multiplex streams to minimize overhead.

Figure 2
Multiplex Marquee

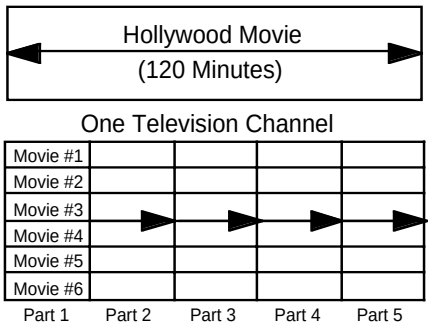


Source: S. Evans

Depending on the multiplex scheme used, the balance between the number of movies and start times can be adjusted to optimize the buy rates. Broadcast two movies per channel, and you can have five starts in the same time. Five movies can have two starts per hour. Send the signal out in a more complex interleave pattern, and you can have enough movies and start times so that the quadruple effect kicks in. Again, this has been proven by the Cineplex model, which allocates more screens to those movies that can fill the seats. The net result is to replace the traditional analog signal showing the movie in linear mode with a digital signal that allocates the bandwidth as time slots so traditional multiplexing schemes can be applied (see Figure 3).

This brings the cost per subscriber into the realm of reality, somewhere between $400 and $600 per box if the only application to be supported is EOD. The cost may vary slightly, depending on whether the service is provided over cable, MMDS, or satellite (including DBS), but the basic platform remains the same. A plug-in module known as a Network Interface Module (NIM) is used to adapt the box to a specific medium or delivery system format. The balance of the circuitry included is common for what is known as a "hybrid" set-top box capable of receiving both analog and digital signals and displaying them on a television screen. Information delivered with the video stream identifies which movies and programs are available, along with the price for viewing. A button on the special remote control provided with the box activates an on-screen menu which displays the list of movies available, the start times, and the price. The subscriber selects a movie by scrolling through the list and pressing the "Order" button. The box uses an internal modem to dial the service bureau, which, in turn, issues the enabling command to the box, either via the modem connection or over the same channel carrying the digital signal.

Figure 3
Digital Multiplex Marquee Channel Versus Linear Analog Channel



Source: S. Evans

The result is an inclusive business model, with both the service provider and their subscribers benefiting from the competition. The EOD model can be used to deliver programs from one or more sources to the subscriber's home, with channels allocated to each programming provider for their multiplex signals. The traditional PPV providers can continue to do business by offering an enhanced service with more movies and more start times, and the service provider can take advantage of multiple program sources, including licensing the movies (and other forms of programming) directly from the distributors. Other program services can piggyback onto the EOD model by providing their own multiplex streams. A new type of service provider will take programming from various sources and multiplex it based on market demand. The distributors can protect their intellectual property rights by encoding the source video stream with a copy protection signal, which will still be present when the signal is decoded. This will allow the program to be seen on a TV, but prevent it from being recorded on a standard VCR.

Hierarchical distribution networks will evolve, placing the most frequently ordered programs on a primary server dedicated to playback of the pre-multiplexed streams. Regional servers will have pre-encoded versions of the next tier of programs (e.g., movies ranking 11 to 100 in popularity). These servers will create the multiplex Marquee "on the fly," based

Set-Top Bugaboo: Watching Versus Taping

A common complaint with today's cable boxes is the inability to watch one premium channel while taping another show at the same time. Solving this problem requires providing a second tuner that can provide a different signal to the VCR than the one going to the television set. This problem is being addressed by some set-top developers who are making use of dual tuner chip sets originally intended to provide "picture-in-picture."

The use of the dual tuner in a hybrid or digital set-top box usually has one tuner receiving the analog television channel, while the other locks on to the digital channel carrying control and other digital signals. With the addition of inexpensive switching circuitry in the set-top, the digital signal is routed to the MPEG decoder and the analog output is routed to the jacks feeding the TV. The output of the analog tuner (including the normal descrambling of the existing premium channel) can then be routed to separate jacks connected to the VCR. In most cases, the VCR jacks always receive the analog video and audio from the tuner dedicated to regular viewing, allowing normal recording of broadcast channels.

The issue in providing this feature is the $25 to $50 per box difference in the retail price. Will consumers pay? The picture-in-picture feature has been limited to high-end televisions because mass demand by consumers has been lacking. The option may be available in the next generation of high-end televisions, which are being designed to include digital video capabilities. Just as "cable ready" sets drove subscription of cable services, "digital ready" sets will increase acceptance of "on demand" services. Sets including digital decoders and digital videodisc players are on the drawing boards today, for delivery beginning in late 1997. Consumers will continue to vote with their dollars for the options they find most appealing.

on requests by subscribers served by a specific feed. This will broaden the program selection without creating huge expense, since the regional server will provide coverage from a single resource. A national server will provide access to less popular programs (e.g., movies ranking 101 to 10,000). The local cable company may allocate as few as three analog channels to provide access to these vast libraries, or allocate more channels based on subscriber interest and WTP.

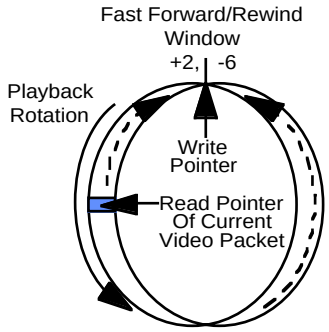
Cache in on EOD

In the EOD model, the primary difference in cost between the $400 box and the $600 box is a hard disk drive. The set-top box is essentially a computer chip along with specialized components that decode the digital data, reconstruct the video so it can be viewed on a standard television set, and the modem and/or NIM that receives the signals and communicates with the service bureau. This provides the basic functionality. What the hard disk adds is the ability to replicate critical VCR functions by temporarily writing the digital information onto the disk.

Using the disk as a data cache allows the box to capture the video stream in advance of viewing. A user menu allows the subscriber to set fast forward and rewind thresholds, with a typical choice being to fast forward for two minutes (skip the commercials if it's a network television show) and rewind for six minutes. The "Pause" button on the remote control freezes the picture, while the box continues to save incoming video to the disk. The "Stop" button causes the box to only save enough information to get it to the next incoming chunk of movie. Just as important is the box capturing the beginning of the movie as a background task, so viewing can start "on demand," rather than forcing the viewer to wait for the next start time. All of this is based on using data cache techniques to create what's known as an "elastic store." A floating pointer is used to read the data from the cache, while the cache itself is managed as a circular buffer (Figure 4). The total cache window is limited to the capacity of the hard disk.

Another option is to capture and show "Coming Attractions" previews and/or advertising that is played as the introduction to the program—duplicating the experience of going to the movies or watching a videotape. The movie previews and advertising inserts represent incremental revenue to the service provider, allowing them to compete with the price points offered by the local video rental shop.

Figure 4
Marquee Cache



Source: S. Evans

Getting Down to Business

Now we have a business model that makes sense. The service provider acquires the low-cost boxes one at a time, typically on lease, and passes the cost of the lease on to their subscriber in the form of a monthly service fee. A revenue generating service product can be delivered at a realistic price that will find enough consumer acceptance to be deemed a success by the market. Both the costs and the problems related to the technology tangle are deferred until a later date when the solutions will be more elegant, cost effective, and build on the base of EOD already installed. The PPV or other program provider delivers a digital multiplex signal containing multiple movies or other programs, with one multiplex stream per channel. The service provider picks which programming providers to do business with, offering their subscribers a broader range of choices. The programming providers can continue to acquire and package programs while offering distribution in analog and digital formats, allowing the consumer to decide whether the expanded selections offered in the digital multiplex format are worth the additional monthly fee charged by their local service provider.

This evolution from today's PPV to an enhanced PPV product that can function like a true "on demand" service (when the box with disk cache is used) shortens the expense before revenue cycle, making it feasible to deploy the digital set-top boxes more rapidly. As the PPV providers digitize their products in the multiplex format and the service bureaus extend their PPV order management to include the new digital set-tops, a de facto standard will rapidly emerge. Each segment of the service delivery chain will step up to this opportunity if for no other reason than to protect existing market share. The primary beneficiaries will be the consumer, with an expanded range of choices at aggressive price points, and the local service provider who will gain larger increments of revenue than are possible under the current constraints. ntq