

Opportunities for Data Broadcasting in Digital TV

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DTV Broadcast Stream



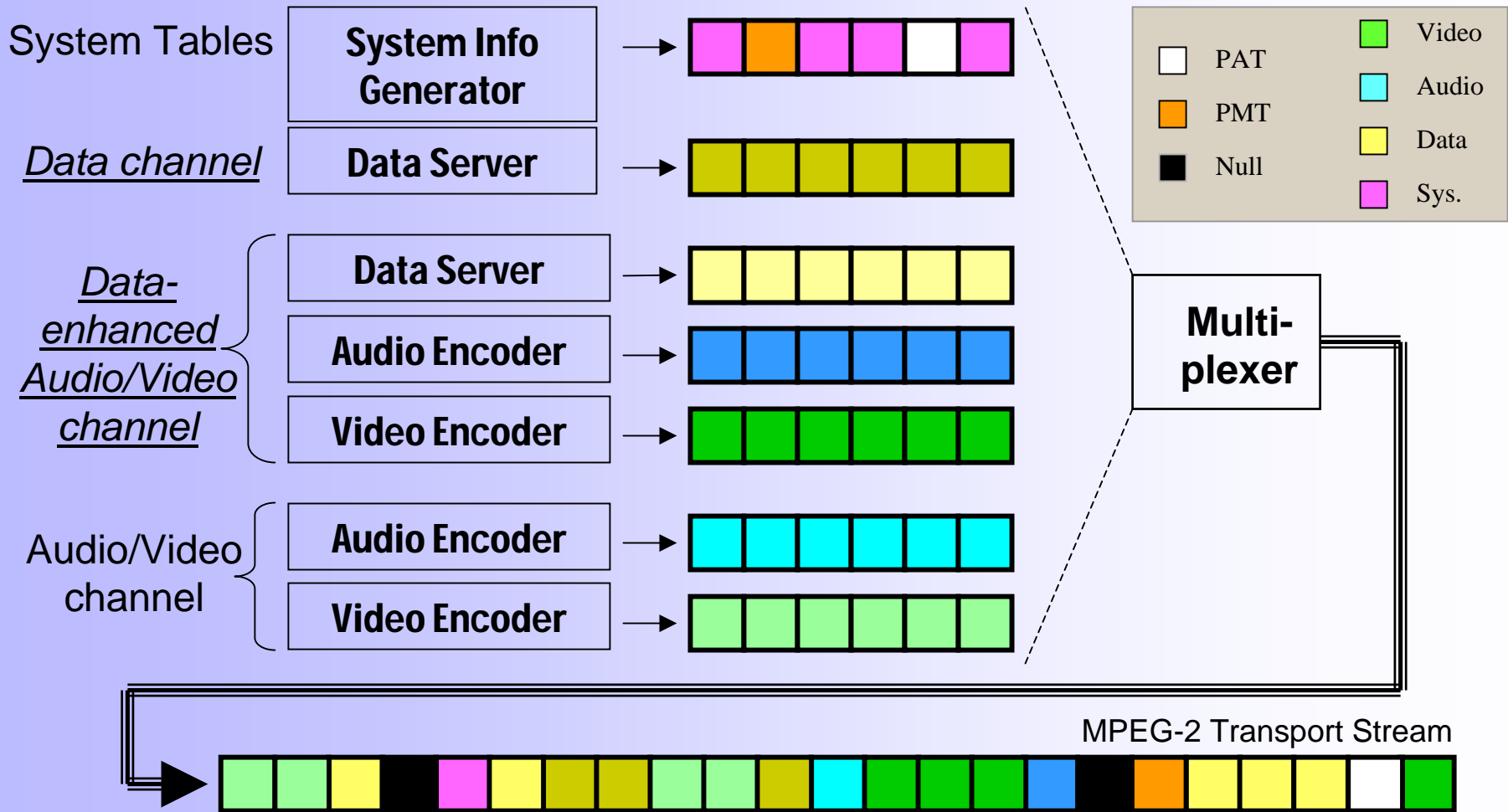
- Based on *MPEG-2 transport stream*
- May contain multiple *virtual channels*:
 - Video channels, each with a video stream, one or more audio streams, and possibly one or more data streams.
 - Audio channels, each with one or more audio streams and possibly one or more data streams.
 - Data-only channels, each with one or more data streams.
- Data can be anything - files, directories, streams!!

MPEG-2 Transport Stream

- Consists of 188-byte **transport packets**; 4 byte header, 184 byte payload in each
- Conveys interleaved **program elements** and system streams -- audio, video, data, PSI, ...
- **Packet id (PID)** in packet header identifies the program element or system stream.



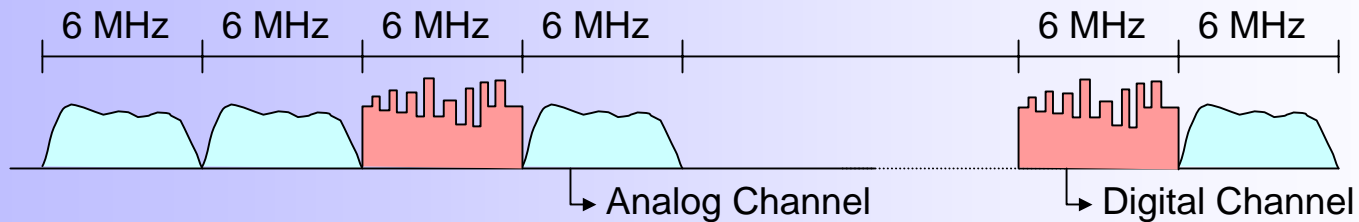
Transport Stream Encoding



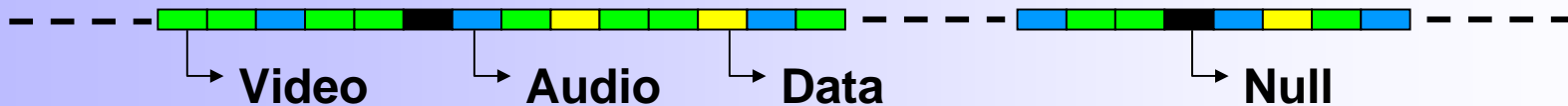
Bandwidth for Datacasting



6 MHz DTV broadcast band



Provides 19.4 Mbits/sec digital bandwidth w/ 8VSB



HDTV: 15 - 18 Mbits/sec for one virtual channel

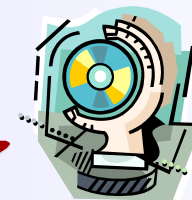
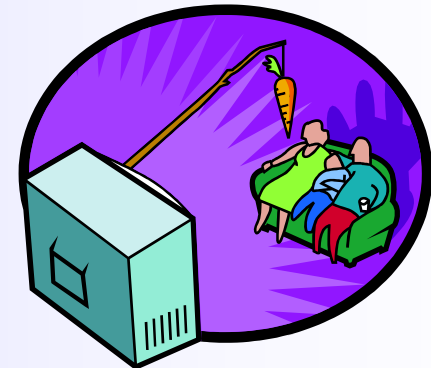
SDTV: 3 - 5 Mbits/sec for one virtual channel

Leaves 1.4 - 16.4 Mbits/sec for data

(1.4 Mbps ~ T1 line; 16.4 Mbps ~ 1/3 T3 line.)

Examples of Applications

- Interactive sports statistics
- Supplemental TV program information
- E-commerce music, software, etc.
- Interactive news, weather, traffic.
- Information kiosks
- Distance learning
- Interactive advertising

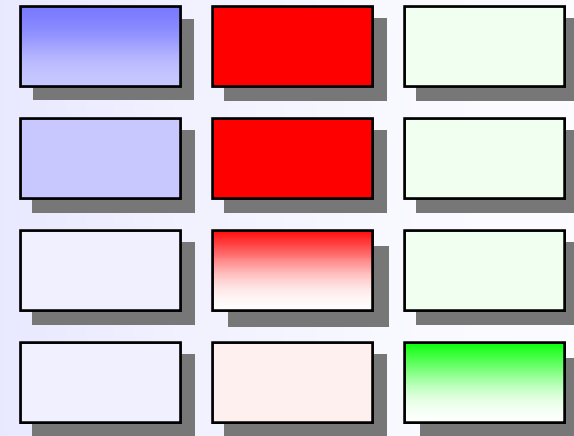


Application Classification

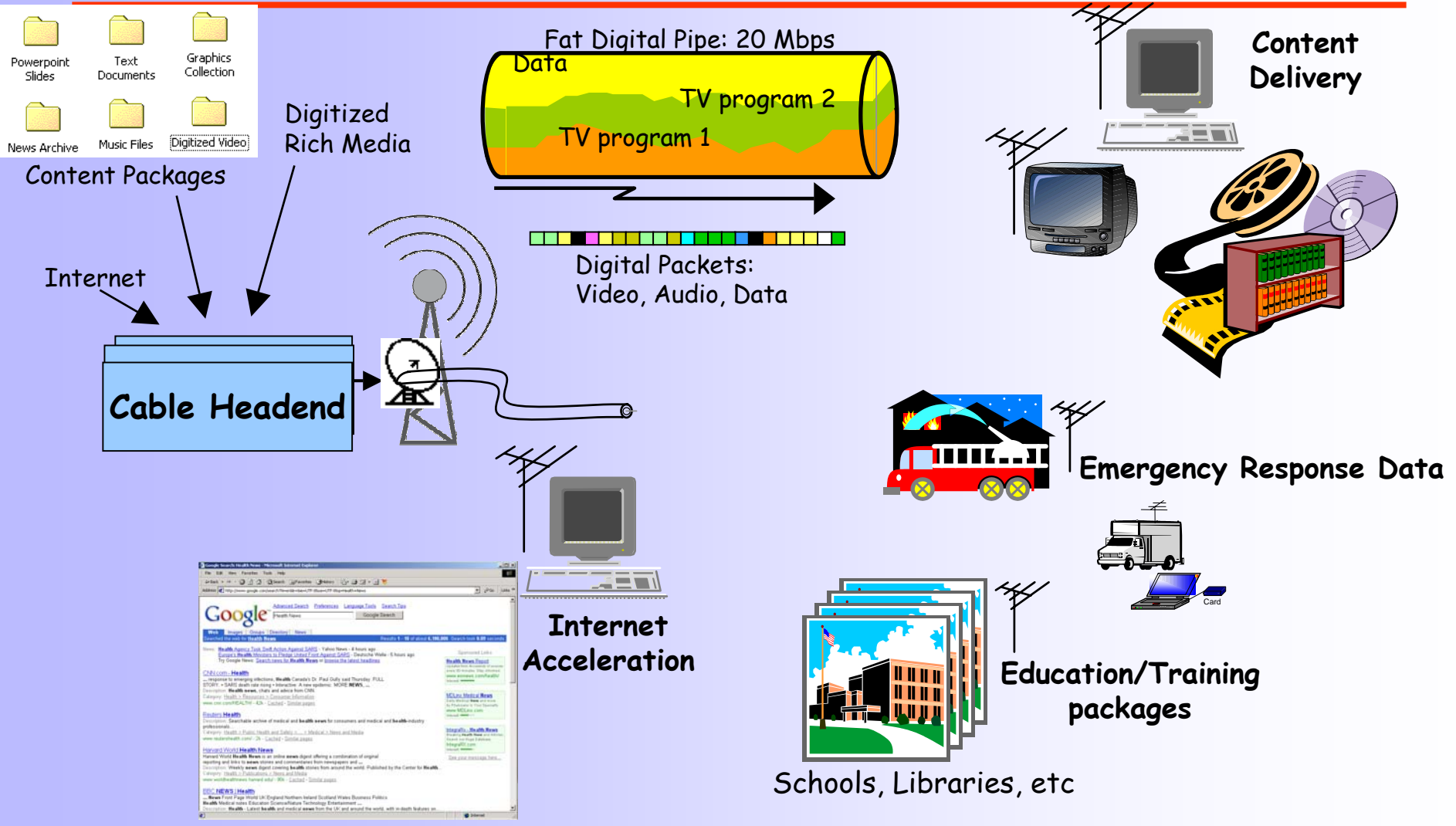
Three semi-independent axes:



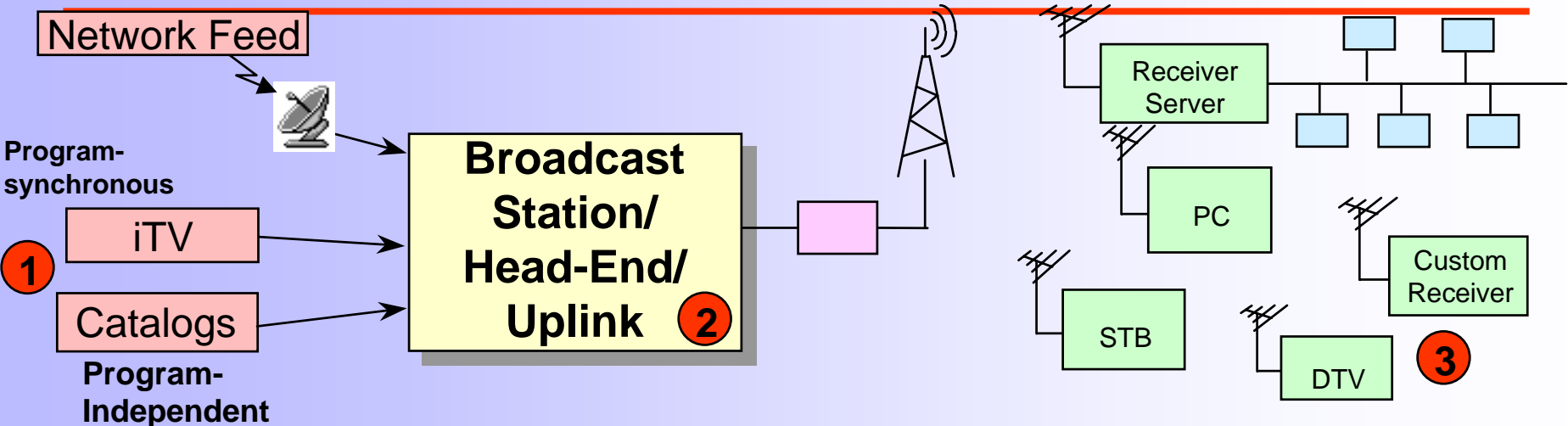
- Interactive sports statistics
- TV program supplementary info
- E-commerce fulfillment
- Corporate communications



Data Distribution



Three Component Architecture



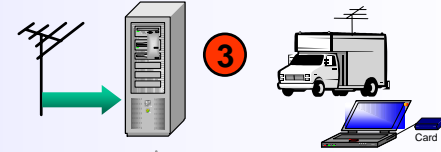
1



2



3



DATA SPECIFIER

- Specify content
- Specify schedule
- Prioritize: guarantee/best effort
- Encrypt - customer access
- Generate catalogs

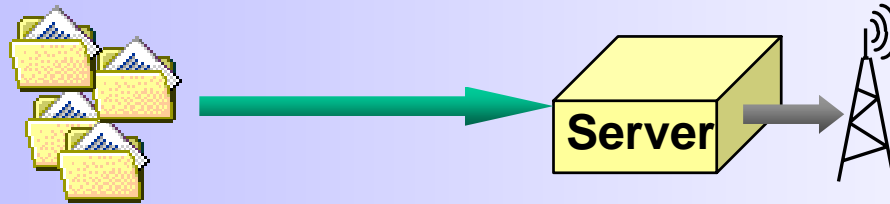
DATA SERVER

- Enforce Contract
- Allocate/control/optimize bandwidth
- Meter bandwidth usage
- Bill based on tiered rates
- Activate, deactivate new accounts

DATA RECEIVER

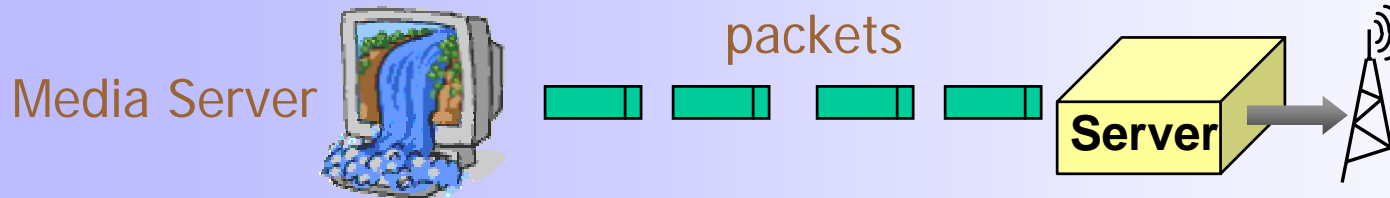
- Tune to channel, (view A/V)
- Present catalog, select data stream
- Extract data from stream
- Render / launch players
- Clean up local cache

Applications - 1



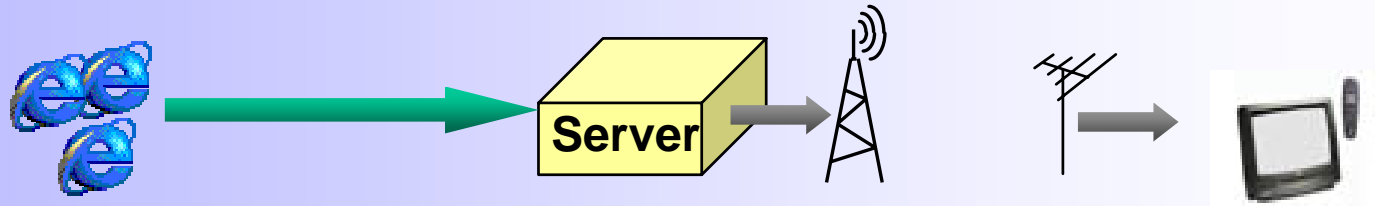
- Broadcasting “Uncoupled” File Content
 - Carried in data-only virtual channels
- Schedule Parameters:
 - Carousel count, interval between transmissions,
 - Bitrate to be allocated,
 - Content-location,
 - Mime-types for files

Applications - 2



- Broadcasting Streaming Content
 - Media server provides IP packets to the data server.
- Schedule Parameters:
 - IP addresses for receiving packets,
 - Time periods when packets will arrive at Data Server,
 - Bitrate at which packets will arrive at Data Server.
- No carousel counts or transmission intervals.

Applications - 3



- Broadcasting Interactive Content
 - Tightly coupled to the program it enhances,
- Schedule Parameters:
 - Precise timing for sending triggers,
 - Complex schedules for inserting content,
 - Additional metadata like announcements.

- Enhanced TV
 - Television program experience enriched using HTML pages

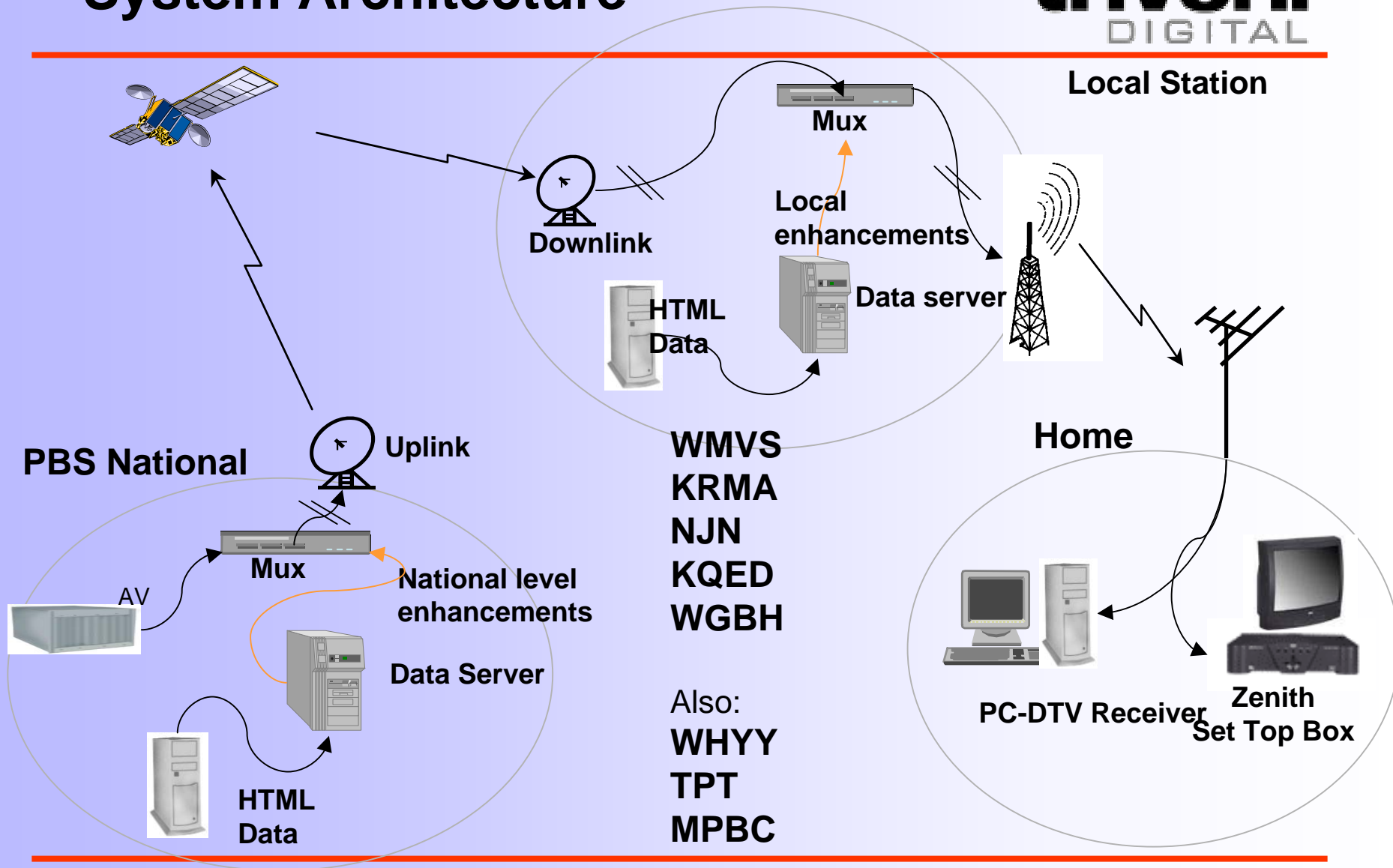
- Distance learning
 - Delivery of training material to schools.

Enhanced TV



- Sending enhancements to set-top boxes and PC-based receivers:
 - Procedural applications - Java based.
 - Declarative applications - HTML pages with CSS etc.
 - Standards-based vs. Proprietary methods
 - Emerging standards - OCAP, ACAP, MHP.
 - Nationwide PBS trials held in 2001
-

System Architecture



Sample Enhancements

BACK CLOSE NEXT



Fact Mimics Fiction

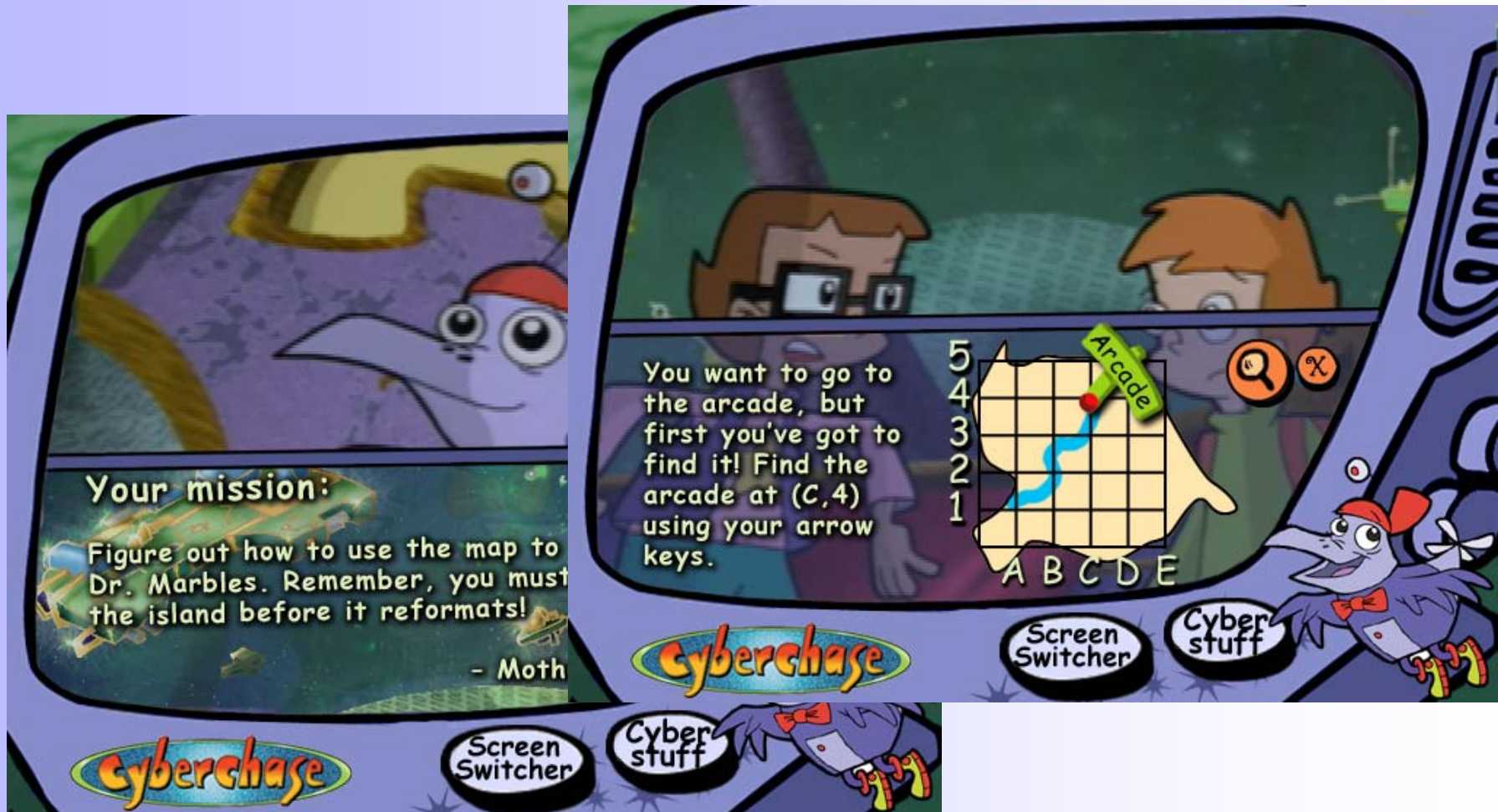
The idea of using brain activity to control machines was dealt with fictionally in the 1982 Clint Eastwood thriller *Firefox*, based on a novel by Craig Thomas. In the film, NATO intelligence forces steal a Russian thought-controlled military aircraft during the cold war.

Photo courtesy Warner Brothers © 2001

Sample Enhancements (Contd.)



Sample Enhancements(Contd.)



Data components:

Carried as IP multicast data in MPEG2 transport packets:

- **Announcements:**
Tells receiver where/how to find content & triggers
(IETF standard for IP multicast services SAP, SDP)
- **Content:**
HTML, graphics, etc that are to be rendered
(HTML 4.0, PNG, JPG, CSS1, ECMAScript, DOM-T)
- **Triggers:**
Tells receiver when to display specific graphics
(URLs, Named vs Script, Automatic vs User-Invoked)

Technical Issues

- Tools for content development.
- Automated test environments.
 - For application developers
 - For middleware developers
- Delivery of interactive content and system information.
- Interoperability between receivers in early deployments.

Distance Learning



- Current trends in education & training
 - Increasing use of video and other multimedia content
 - Increasing stress on relevant, up-to-date materials
 - Distributed learning environments
 - Asynchronous learning (self-study) as well as classroom
- Challenges posed by these trends
 - Delivering large volumes of educational materials to many sites
 - Updating these materials frequently
 - Doing all this efficiently, reliability and economically

Internet Limitations

- For high quality streaming media delivery:
 - Hopeless with low bitrate Internet connection
 - Shaky even with pretty good Internet connection

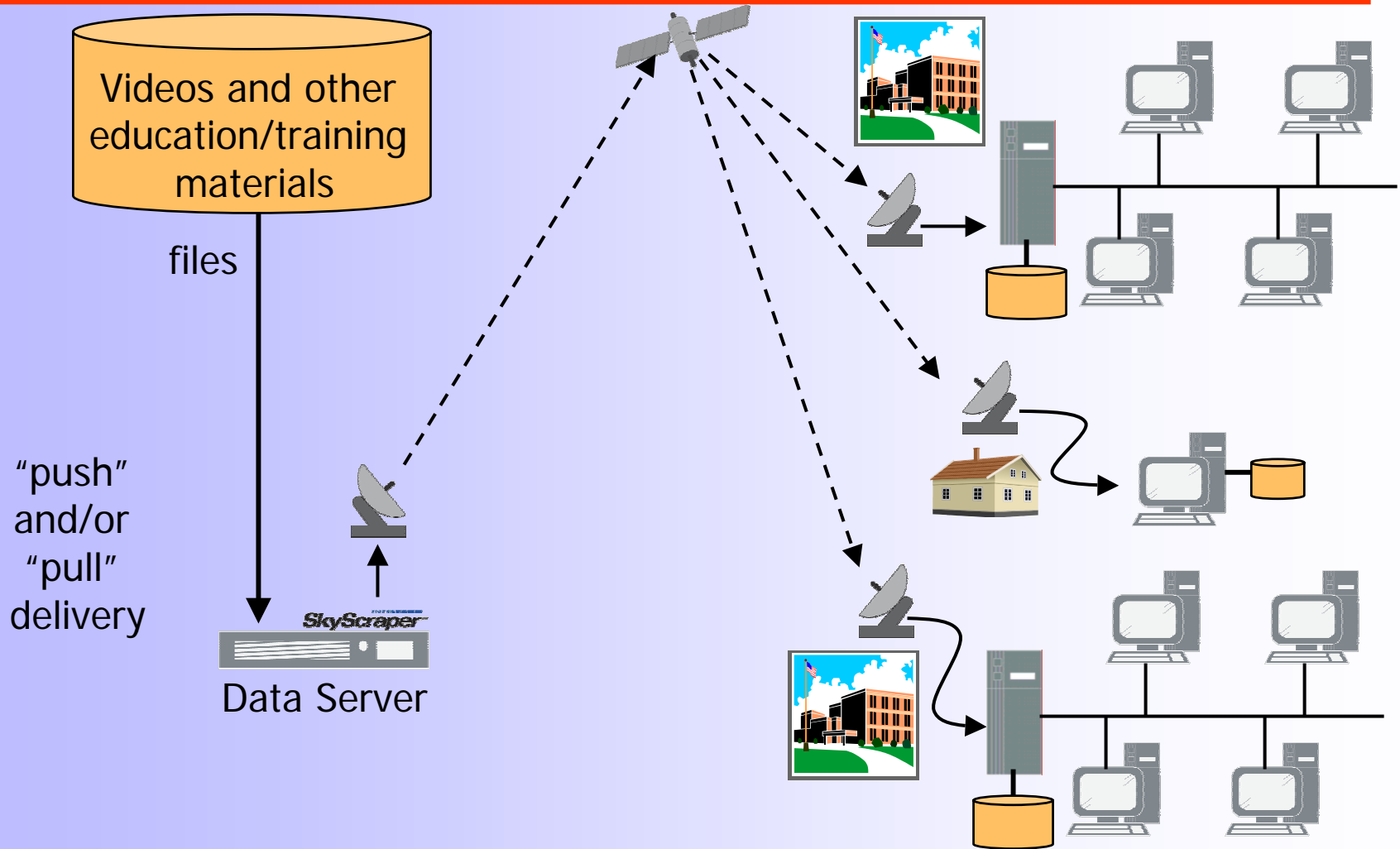
- For high volume file delivery
 - Poor for education/training centers with limited Internet access
 - Rural areas
 - Many homes (self-study)
 - Military units in the field (including ships at sea)
 - Developing countries, etc.
 - Poor for pushing out updates to large numbers of sites

Datacasting Strengths

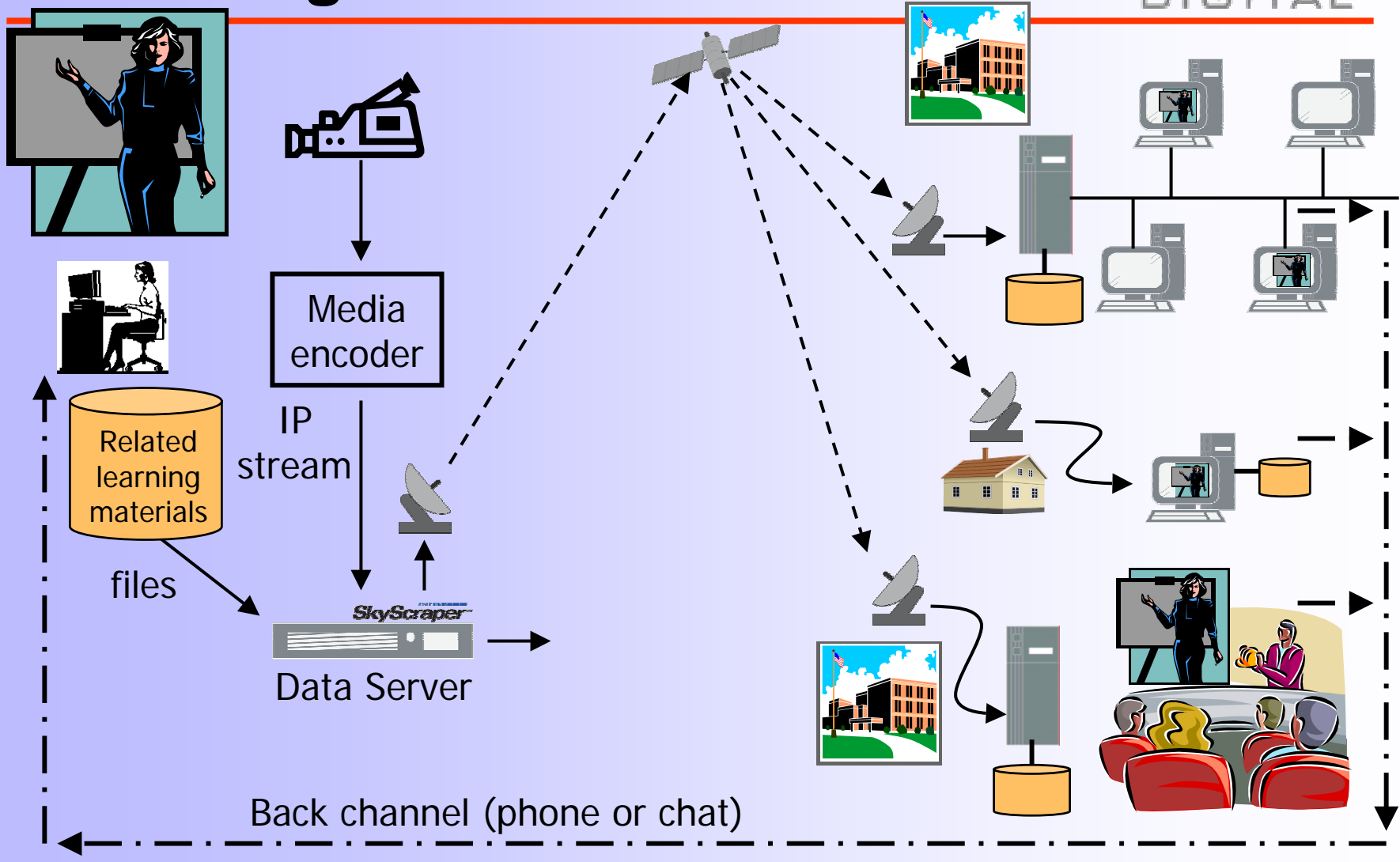


- Delivering high quality media streams
- Delivering large files
(e.g., high quality, multimedia content)
- Updating content frequently
- Delivering content to many sites
simultaneously
- Delivering to sites with poor Internet
connections

Asynchronous Distance Learning



Interactive Distance Learning



Summary



- Data broadcasting in DTV enables different kinds of applications.
 - Provides new revenue opportunities.
- Applicable in different delivery mechanisms.
 - Delivery to hand-held devices is an emerging trend (DVB-H).
- Appropriate architecture is *crucial*.
 - Many technical challenges : loss of packets, bandwidth management, encryption, targeting.