

Dr. Mark F. Medress

Vice President
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**GENERAL
INSTRUMENT**

VideoCipher Division

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**GENERAL
INSTRUMENT**

From the desk of:

MARK MEDRESS

3/9/92

Tau -

Enclosed is some Digicipher material I gave to Luli last week in Washington. I hope we can get together with Panther Sat very soon.

Mark Medress

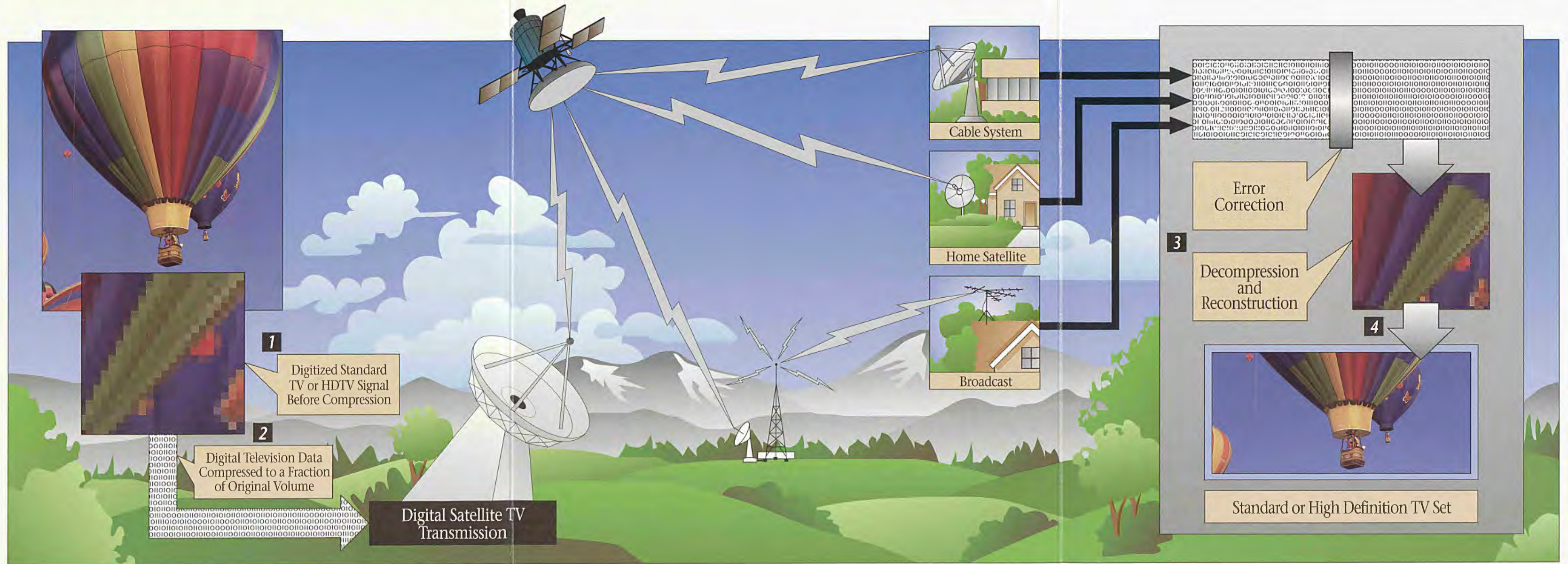
DIGICIPHER™

DIGITAL TELEVISION



The Beauty of General Instrument's
All-Digital Television Transmission System.

Watch DigiCipher Technology In Action.



Step 1. A DigiCipher Encoder digitizes the source material (video, film, computer-generated art) at the cable/satellite programming uplink site or at the broadcast studio. The digital video is then processed by sorting each video frame into essential and non-essential data.

Step 2. Using proprietary techniques, the television signal is then compressed so that only a fraction of the bits—representing only the essential data—is actually transmitted via satellite to cable system headends, local broadcasting stations, and satellite TV homes.

Step 3. DigiCipher Integrated Receiver/Decoders (IRDs) receive and demodulate the signal and use powerful error-correction processes—unique to digital signal transmission—and then decompress and reconstruct the original television signal.

Step 4. The completely reconstructed video is converted to an analog signal for display on existing television sets, producing clear pictures with no subjective loss in picture quality. In fact, the improvement in the DigiCipher picture over standard analog TV pictures is comparable to the level of audio quality that digital compact discs have over vinyl records!

The DigiCipher System At A Glance

There are numerous benefits to the DigiCipher system. Here's a quick look at just some of the key features that provide major benefits to prospective customers:



■ Digital Quality

Digitally transmitted video results in vastly superior picture quality.

Dolby® AC-2 digital audio system enhances listening enjoyment.

Advanced digital signal processing eliminates the effects of transmission noise and interference. Pictures displayed on TV sets will be true replicas of transmitted material.



■ Multiple Standard TV Signals

The DigiCipher system can transmit up to 10 standard TV channels within one satellite transponder.

The DigiCipher system can transmit multiple channels within today's standard 6 MHz cable/broadcast channel.

By making more efficient use of bandwidth, the DigiCipher system will result in expanded and new-entry satellite/cable program offerings, such as many channels of Pay-Per-View.

■ Other Key Features

Some DigiCipher standard TV modes would allow significant dish size reduction.

Since DigiCipher is an all-digital system, it provides the ultimate video security. Moreover, it will use an advanced encryption/conditional access system including "renewable security".

The HDTV version of DigiCipher will allow graceful evolution to HDTV.



■ Seamless Interface

DigiCipher signals are first transmitted via satellite.

DigiCipher signals can then be retransmitted via standard cable or terrestrial channels.

DigiCipher signals can also be received at TVRO homes using standard dishes and LNBs.



DIGICIPHER

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General Instrument Corporation.

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March 9, 1992

Via Fax

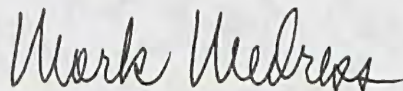
Lourdes Saralegui
Vice President
Alpha Lyracom/PanAmSat
One Pickwick Plaza
Greenwich, CT 06830

Dear Luli:

Just a note to thank you for breakfast in Washington last week. I know how busy you were, and I really appreciated the chance to meet you and discuss digital compression for PanAmSat.

We would very much like to have you, Fred Landman, and others from Alpha Lyracom visit our San Diego facility for a first-hand look at DigiCipher hardware and video quality. We'd also be happy to come to your headquarters in Greenwich for a presentation to a broader audience. Please let me know what would be convenient, so we can schedule things appropriately.

Sincerely,



Dr. Mark F. Medress
Vice President
New Business Development

MFM:mkm
92-078

c: Tom Whitehead/Clay Whitehead Associates

GENERAL INSTRUMENT

DigiCipher™ System Description

Summary

DigiCipher is an all-digital television communications system encompassing digital compression, digital transmission, and conditional access. General Instrument is developing NTSC and HDTV versions of DigiCipher for satellite, cable, and terrestrial broadcasting applications.

The initial version of DigiCipher will be for multi-channel NTSC satellite television applications. By using a high-performance digital video compression algorithm, along with powerful forward error correction and modulation techniques, DigiCipher allows transmission of up to ten entertainment-quality digital NTSC television services per 24 MHz or greater satellite transponder.

The major benefits of DigiCipher relative to analog television include greater bandwidth efficiency (i.e. more channel capacity), improved video quality, and enhanced video security.

The DigiCipher NTSC satellite system allows up to ten NTSC television signals to be digitally compressed, encrypted, and transmitted in a single satellite transponder. At cable headend sites and TVRO households, DigiCipher Integrated Receiver/Decoders (IRDs) demodulate and decompress the digital signal before converting the selected channel back to NTSC for distribution to cable subscribers or for display by TVRO consumers.

Multiple Channel per Carrier (MCPC) and Single Channel per Carrier (SCPC) versions of DigiCipher are being developed for satellite transmission. The MCPC system, available in summer 1992, offers many advantages relating to receive dish size, video quality, and system flexibility. In the MCPC DigiCipher system, all television signals must be available at the inputs to the Uplink Encoding System for transmission in a single carrier on a satellite transponder.

The SCPC DigiCipher system, available in 1993, allows programmers at diverse uplink sites to access specific frequency portions of a transponder's bandwidth. The SCPC DigiCipher system has various compression modes, allowing programmers and system operators the ability to select the desired balance between video quality, number of carriers per transponder, and receive dish size.

DigiCable is the version of DigiCipher under development by General Instrument which will allow the digital transmission of digitally-compressed television signals to cable subscribers. The same benefits described above will also be part of the DigiCable system.

Digital Video Compression

- Motion-compensated Discrete Cosine Transform (DCT) algorithm; DCT is the technology of choice for current and future video compression standards
- DigiCipher algorithm specifically designed and optimized for entertainment television applications with respect to performance and cost
- Multiple compression modes, allowing programmers to make flexible decisions about video quality versus channel capacity
- NTSC resolution (480 lines, 512 pixels per line)
- Entertainment-quality video at up to ten film channels or up to six video channels per transponder (MCPC DigiCipher system)
- Asymmetric design for low cost decoders

Digital Transmission

- Nearly 30 Mbps total information rate and 40 Mbps transmission rate (including Forward Error Correction bits) for MCPC DigiCipher system
- Various bit rates for SCPC DigiCipher system
- QPSK modulation
- Powerful Forward Error Correction (FEC) system using concatenated coding
- Error free performance at low thresholds, resulting in the same or smaller size receive dishes as required for single-channel analog FM reception
- Transmission in 24 MHz or greater satellite transponders for MCPC DigiCipher system
- Various bandwidths for SCPC DigiCipher system

Conditional Access

- General Instrument's state-of-the-art third generation system, with Renewable Security
- 256 consumer programming tier bits (upgradeable to 512 tier bits)
- Digital encryption of video and audio for highest possible security
- Fully operational national Authorization Center for TVRO consumers
- Independent programmer control for commercial affiliates

Major Additional Features

- Impulse Pay-Per-View (store and forward)
- CD-quality Dolby^{®1} AC-2 digital audio, with up to four audio channels per video channel
- Personal Message and Tier-Addressed Message capabilities
- Text and Data Channels
- Program black-out capability
- Copy Protection capability
- "Seamless" interface for DigiCable applications
- Local subscriber control, commercial insertion, and local compression for DigiCable/broadcast applications

¹Dolby[®] is a registered trademark of Dolby Laboratories Licensing Corporation.

DigiCipher Uplink Encoding System: Major Features

- Composite or Component inputs for up to ten NTSC television channels
- Up to four digital audio channels per video channel
- Programmer can start with one configuration (e.g. 4 channels) and upgrade to more channels (up to 10) with same chassis
- Flexible ability to change compression modes (Decoders automatically adjust)
- Statistical Multiplexing for better and more consistent video quality
- Single computer for multi-channel program definition and commercial affiliate authorization
- Redundant configuration with automatic switchover to Secondary Encoder upon occurrence of programmer-defined faults
- Fully Encrypted and Fixed Key conditional access modes
- Monitor Port for Encoder health and status (on-line)
- Off-line Encoder self-test and diagnostics

DigiCipher Commercial IRD: Major Features

- 3.5" Rack Height
- Renewable Security
- Video outputs with and without On-Screen Diagnostics (OSD)
- External user-replaceable, redundant battery
- L-band loop-through for "chained" IRD units from same LNB/antenna
- Dot Matrix LCD front panel display for selection of transponder, video channel, audio channel, data channel and OSD
- Automatic Retune to other DigiCipher channels
- Contact closures for local ad insertion and summary alarm
- High-speed digital output for compressed digital transmission to cable subscribers
- Switchable H and V inputs
- C-band and Ku-band (FSS) frequency plans
- Composite and Component video outputs
- Simultaneous processing and output of up to four audio channels

DigiCipher Consumer IRD: Major Features

- **Receives DigiCipher, VCII PLUS, and clear NTSC signals**
- **Renewable Security**
- **Dolby Pro-Logic Surround Sound**
- **Built-in TI filter**
- **Subcarrier stereo for clear NTSC channels**
- **Internal antenna actuator power supply**
- **64 satellite memory**
- **Pre-programmed satellites**
- **Color on-screen displays**
- **Multiple VCR timers**
- **Integrated infrared/UHF remote**
- **Custom vacuum fluorescent display**
- **Composite and Component video outputs**
- **EZ SAT Locator**
- **MasterPeak and AutoPeak**
- **Favorite channel categories**
- **Parental Lockouts**

DigiCipher™ Questions & Answers

1. What is DigiCipher?

DigiCipher is an all-digital television communications system encompassing digital compression, digital transmission, and conditional access. General Instrument is developing NTSC and HDTV versions of DigiCipher for satellite, cable, and terrestrial broadcasting applications.

The initial version of DigiCipher will be for satellite television applications. By using a high-performance digital video compression algorithm, along with powerful forward error correction and modulation techniques, DigiCipher allows transmission of up to ten entertainment-quality digital NTSC television services per satellite transponder.

2. What are the benefits of DigiCipher?

The DigiCipher system offers exciting advantages to all participants in the satellite television industry.

Satellite programmers will be able to multiply their program offerings without a corresponding increase in satellite transponder cost. This allows an expansion of multiplexing, narrowcasting, and pay-per-view programs, and will provide more programming choices and variety to consumers.

Video quality will be superior due to the digital transmission of the entire television signal and due to the excellent performance of the DigiCipher video compression algorithm. With digital video transmission, the received picture will be a true replica of what was transmitted, without the degradations typical of analog video transmission.

Hardware distributors and dealers will have a new generation of exciting products to sell based on digital technology. Digital video will be revolutionary for the consumer television industry, similar to the revolution created by CD players in the audio industry.

Finally, DigiCipher offers the ultimate in security since the entire television signal (video and audio) is digitally encrypted, making the video equally secure as the audio. This digital encryption is combined with General Instrument's state-of-the-art conditional access system based on Renewable Security.

3. What type of digital video compression algorithm does DigiCipher use?

A very important aspect of DigiCipher's video compression algorithm is that it is based on a technique called motion-compensated Discrete Cosine Transform (DCT). DCT-based compression algorithms have been proven to allow the best video performance for entertainment quality signals, and DCT techniques are rapidly becoming the worldwide standard for digital video compression algorithms. For example, all four digital HDTV systems submitted to the FCC are based on DCT, as are the CCITT px64 standard for videoconferencing, the emerging JPEG standard for still images, and the emerging MPEG standards for digital storage media. The overwhelming worldwide support for DCT-based algorithms is an extremely positive endorsement of the basic technology utilized by DigiCipher.

In addition to being based on motion-compensated DCT, the DigiCipher algorithm has been designed and optimized specifically for high-quality entertainment television transmission applications. Slightly different versions of the DigiCipher algorithm have been optimized for the NTSC and HDTV resolution versions of DigiCipher. Finally, the DigiCipher compression algorithm is designed asymmetrically, allowing low cost decoders.

4. What programming will be available in the DigiCipher format?

Many programmers have announced their plans to begin using digital compression technology in the next 1-2 years. While programmers have not yet announced definitive plans to adopt the DigiCipher system, we expect the many benefits and features of DigiCipher will lead to a wide variety of DigiCipher programming, including subscription and pay-per-view movies, sports, and special interest programming.

5. What products comprise the DigiCipher system?

The three major hardware products comprising the DigiCipher system are the Uplink Encoding System, the Commercial IRD, and the Consumer IRD. The Uplink Encoding System is used at the programmers' uplink sites to digitize, compress, and encrypt up to ten television channels for transmission in a single satellite transponder. The Commercial IRD will operate at cable or broadcast affiliate downlink sites. The Consumer IRD will operate in TVRO households in conjunction with standard TVRO equipment.

6. What will DigiCipher mean for VCII PLUS programming and today's VCII PLUS TVRO consumers?

DigiCipher is intended to supplement rather than replace VideoCipher II PLUS programming. We expect that VideoCipher II PLUS and DigiCipher programming will coexist for many years. TVRO consumers with VCII PLUS IRDs will continue to receive all VCII PLUS and clear NTSC programming. The DigiCipher Consumer IRD will be capable of receiving DigiCipher, VCII PLUS, and clear NTSC signals. This means that with an upgrade to a new DigiCipher Consumer IRD, TVRO consumers will be able to receive all three programming formats with one unit.

7. How much will DigiCipher Consumer IRDs cost?

General Instrument is currently developing an initial model Consumer IRD, called the Innovation 950D. This unit will have many attractive features including:

- Capability of processing DigiCipher, VCII PLUS, and clear NTSC channels
- Integrated VIDEOpal IPPV modem
- Dolby^{®1} Pro-Logic Surround Sound
- Color On-Screen Displays
- Integrated infrared/UHF remote control
- Custom vacuum fluorescent display
- EZ Sat Locator
- MasterPeak and AutoPeak

It will also include many other features typical of high-end Consumer IRDs such as favorite channel categories, VCR timers, parental lockouts, extensive satellite memory, and component video outputs.

The Innovation 950D is a very high-end product and will be priced, after two steps of distribution, toward the high end of the prevailing retail price range for VideoCipher II PLUS Consumer IRDs. As more programming is available in the DigiCipher format, and as other Consumer IRD manufacturers are licensed for DigiCipher, there will be a variety of DigiCipher Consumer IRDs available with different features and prices.

¹Dolby[®] is a registered trademark of Dolby Laboratories Licensing Corporation.

8. If a TVRO household upgrades to a DigiCipher Consumer IRD, will the consumer also need to replace his dish, LNB or feedhorn?

We are designing DigiCipher to be compatible with the vast majority of existing C-band TVRO installations.

9. What audio system does DigiCipher utilize?

DigiCipher uses the Dolby® AC-2 digital audio system. This is a state-of-the-art, CD-quality digital audio system from Dolby Labs, a recognized leader in audio technology.

10. What conditional access system does DigiCipher use?

The DigiCipher security and conditional access system is the most advanced system of its kind. It is based on Renewable Security such that if a security upgrade is necessitated, the original IRD will continue to operate in conjunction with a new, user-installed security card, the TV Pass Card. The DigiCipher conditional access system represents the utmost in flexibility and security, with a user-friendly path to a new generation of security in the event of a security breach. Unlike some smart card systems which require new smart cards to be distributed frequently to subscribers, DigiCipher only requires a new TV Pass Card in the event of a security breach.

11. What other features will the DigiCipher system have?

The DigiCipher system will have numerous attractive features and capabilities based on General Instrument's extensive experience in developing and fielding pay television systems for the satellite and cable industry. Program Titles, Data Channels, Blackout capabilities, Personal Messaging, Tier-Addressed Messages, Closed Captioning transmission, and Copy Protection for potential PPV applications are just some of the many features designed into the DigiCipher system.

12. What is the difference between MCPC and SCPC?

General Instrument is developing Multiple Channel per Carrier (MCPC) and Single Channel per Carrier (SCPC) versions of DigiCipher.

The MCPC DigiCipher system combines multiple television services together in one bitstream for transmission in a single carrier on a satellite transponder. The MCPC system is advantageous for programmers who have multiple television channels at a common uplink site. With MCPC, the satellite transponder can be operated fully saturated, allowing maximum efficiency in terms of transponder output power and receive dish size. MCPC also allows statistical multiplexing between channels sharing the bitstream, leading to better and more consistent video quality. Finally, MCPC allows the

programmer a convenient mechanism for making a video quality versus channel capacity decision, and allows flexibility in changing that decision over time. Of course, MCPC requires that all signals sharing a transponder are available at the inputs to the Uplink Encoding System.

The SCPC DigiCipher system allows programmers at diverse uplink sites to access specified frequency portions of a transponder's bandwidth. Thus, each carrier is comprised of only one television service, but many carriers can coexist on a satellite transponder, each using a different frequency portion of the transponder. The SCPC system is ideal for programmers uplinking a single channel from one location, for backhauls (e.g. sports feeds), and for business television and private network applications.

13. What is DigiCable?

DigiCable is the version of DigiCipher under development by General Instrument which will allow the digital transmission of digitally-compressed television signals to cable subscribers. Many of the same benefits and features as described above will also be part of the DigiCable system.

14. How does this all relate to High Definition Television (HDTV)?

In June 1990 General Instrument submitted an HDTV version of DigiCipher to the FCC for consideration as the U.S. terrestrial broadcast HDTV standard. This monumental announcement subsequently caused nearly all of the other HDTV system developers to switch to digital systems, following General Instrument's lead. Companies in Europe and Japan, where analog HDTV systems have been under research and development for many years, are now beginning to incorporate digital HDTV into their plans.

In collaboration with MIT, General Instrument is developing two different DigiCipher HDTV systems for testing with the FCC. The alliance between General Instrument and MIT is called the American TeleVision Alliance. The FCC lab testing is expected to conclude in summer 1992, and the FCC plans to select an HDTV standard for terrestrial broadcasting by mid-1993.

15. When will DigiCipher products be available?

The multi-channel NTSC satellite version of DigiCipher will begin field testing in spring 1992 and begin production in summer 1992. We expect programmers will finalize their digital compression plans by the end of 1992, allowing widespread utilization of DigiCipher during 1993. The SCPC version of DigiCipher will be available in early 1993.

DigiCipherTM

**Digital Television Compression,
Transmission, and Conditional Access System**

March 1992

GENERAL INSTRUMENT

Fortune 500, NYSE-traded company until 1990

Purchased by Forstmann Little & Co. in August 1990 for \$1.6 billion

Broadband Communications

Jerrold Division - CATV Equipment

VideoCipher Division - Satellite TV Encryption Systems/HDTV

Comm/Scope - Coaxial and Fiber Optic Cable

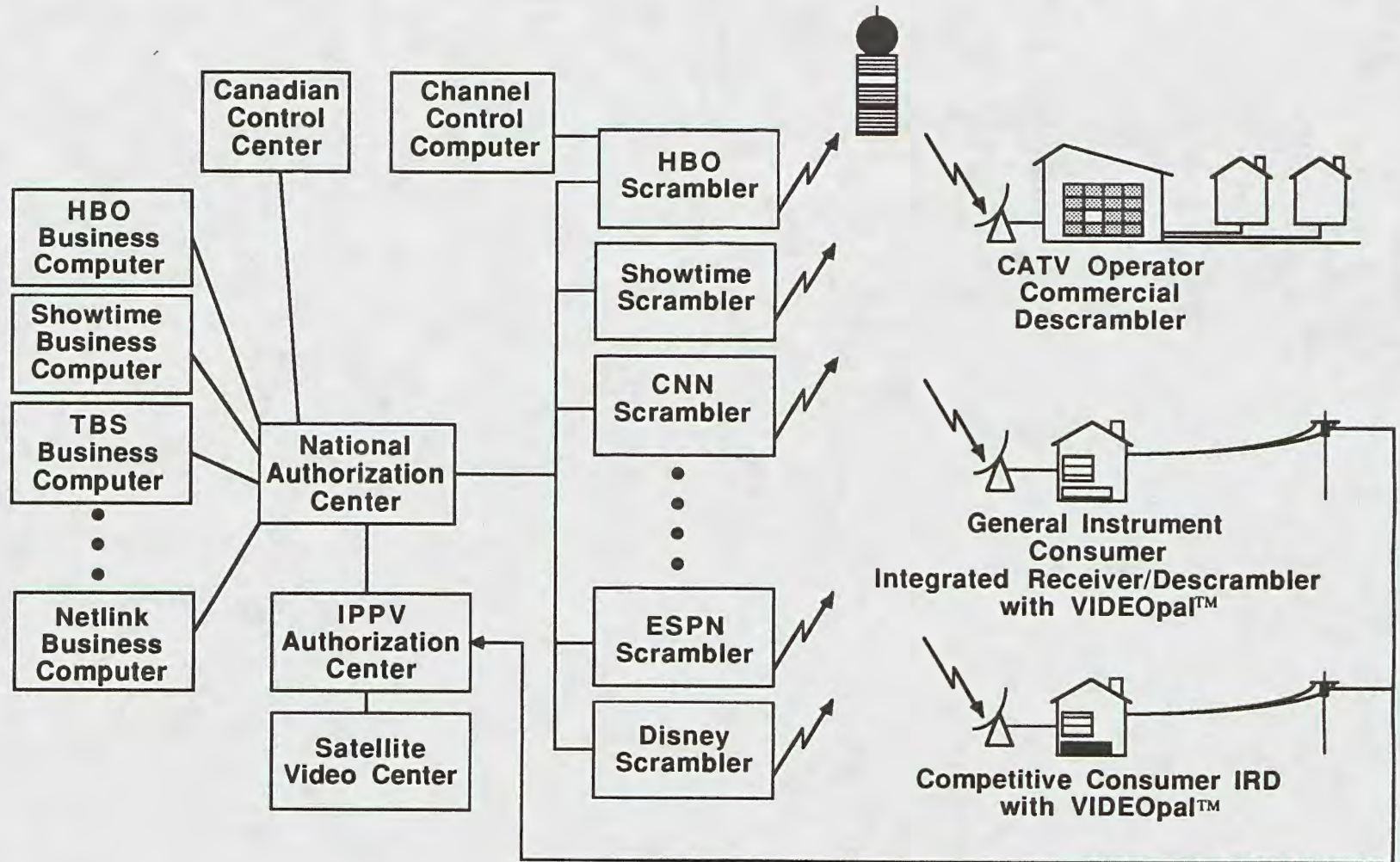
Components

Power Semiconductor Division - Rectifiers

VIDEOCIPHER DIVISION TELEVISION SYSTEMS

- **North American Market**
 - **VideoCipher[®] I: Commercial Satellite TV Distribution**
 - **VideoCipher[®] II: Commercial/Consumer Satellite TV Distribution**
 - **VideoCipher[®] II Plus**
 - **VideoCipher[®] Renewable Security (VCRS)/TvPass[™] Card**
 - **DigiCipher[™]**

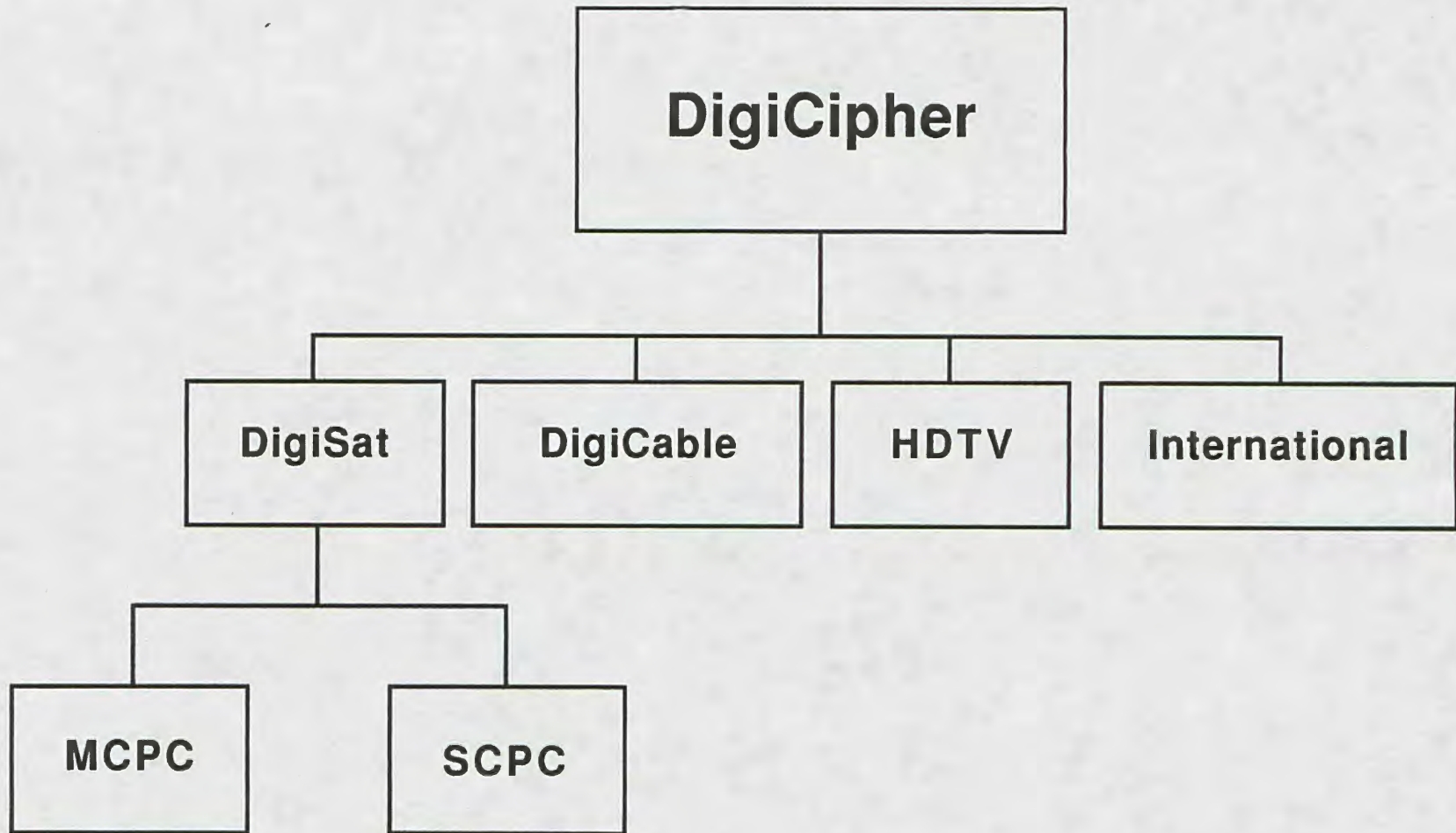
Integrated VideoCipher® II / II PLUS CATV/DBS Scrambling System



DIGICIPHER™ BACKGROUND

- HDTV work began over 3 years ago
- Cable and satellite friendly
- Digital system selected as best approach
- FCC HDTV standard proponency
- Multi-Channel Standard Television
- Strength in 4 key technical areas
 - Digital compression
 - Digital processing/transmission
 - Access control/subscriber management infrastructure
 - Custom VLSI design

DIGICIPHER™ FAMILY TREE



FEATURES/BENEFITS - SATELLITE (DigiSat™)

- **2 to 10 standard TV channels per transponder**
- **Multiple channels per carrier (MCPC)**
- **SCPC system for diverse uplink sites**
- **Higher quality video delivery**
- **Better video security**
- **No increase in receive dish size**
- **DigiCipher™/VideoCipher® II Plus Consumer IRD**
- **1 to 2 HDTV channels per transponder**
- **Multi-channel CD-quality digital audio**

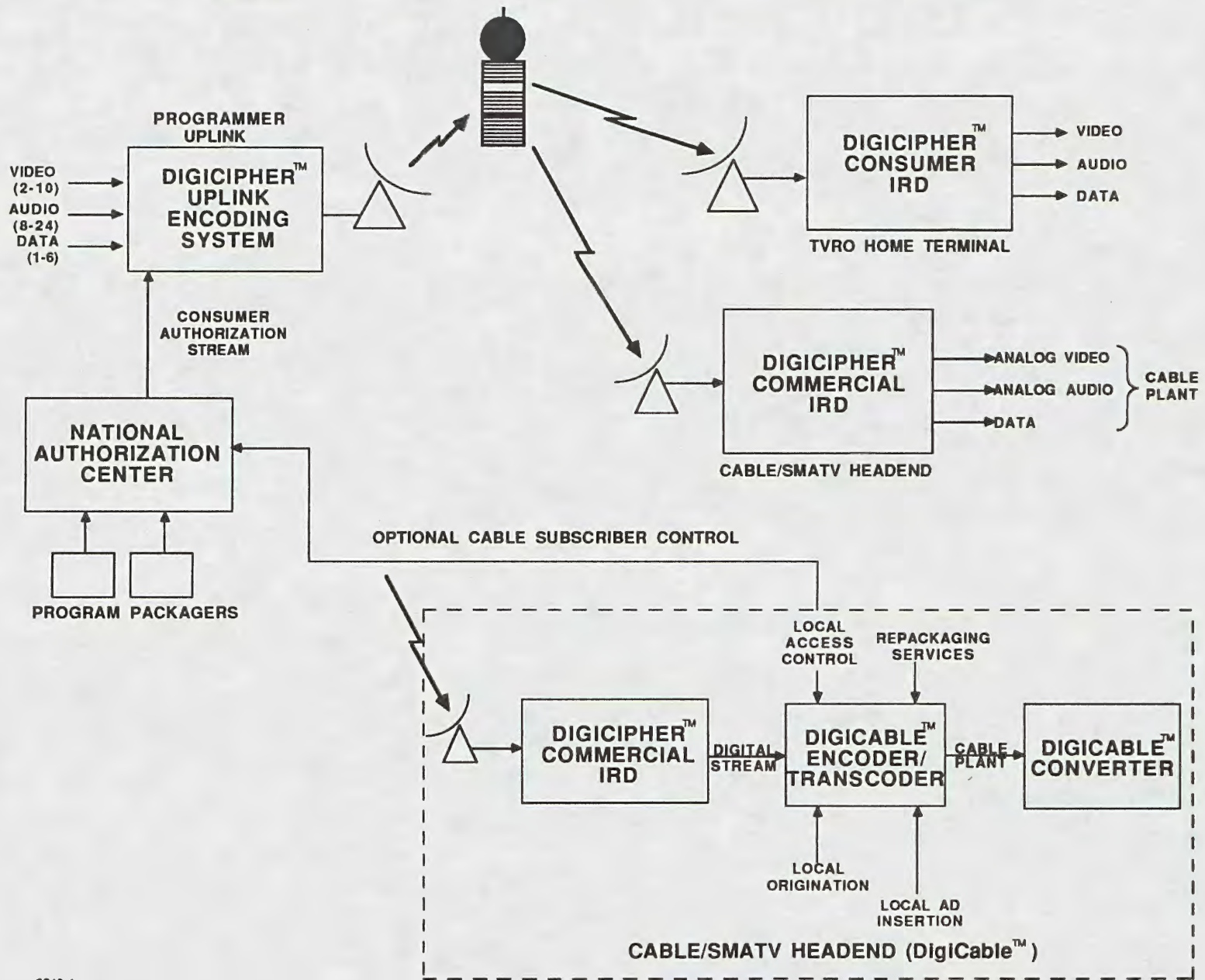
FEATURES/BENEFITS - CABLE (DigiCable™)

- **2 to 10 standard TV channels per 6 MHz cable channel**
- **Uniform high quality delivery to cable subscribers**
- **High security**
- **1 - 2 HDTV channels per cable channel**
- **Low power signal**
- **Local subscriber control and ad insertion**
- **Variable cost "rebuild" to add channels**

DIGICIPHER™ TRANSMISSION

	SATELLITE (MCPC)	SATELLITE (SCPC)	BROADCAST/ CABLE
XMIT Channel B/W	24 MHz or greater	9.8 MHz, 4.9 MHz, 3.25 MHz	6 MHz
Information Data Rate	27 Mbps	13.5 Mbps, 7 Mbps 4.5 Mbps	27 Mbps
Modulation	QPSK	O QPSK	64 QAM
Compression (# of Channels per Xmit Channel)			
Standard TV	2 - 10	1 per Carrier	2 - 10
HDTV	1 - 2		1 - 2

DIGICIPHER™ SYSTEM BLOCK DIAGRAM



**LIVE MULTI-CHANNEL NTSC
DIGICIPHER™ DEMONSTRATIONS**

<u>EVENT</u>	<u>LOCATION</u>	<u>DATE</u>
Satellite Broadcasting and Communications Association	Las Vegas	January 21-23, 1991
National Cable Television Association	New Orleans	March 24-27, 1991
Digital Transmission on Cable Television	New York City	April 11, 1991
National Association of Broadcasters	Las Vegas	April 15-18, 1991
International Television Symposium and Technical Exhibition	Montreux, Switzerland	June 13-18, 1991
Satellite Broadcasting and Communications Association	Nashville	July 11-13, 1991
Cablevision/Rainbow Test	Hicksville, NY	August 14-15, 1991
Western Cable Show	Anaheim, CA	November 20-22, 1991
Satellite Broadcasting and Communications Association	Reno, NV	February 12-14, 1992

DIGICIPHER™ SCHEDULES

- **MULTI-CHANNEL STANDARD TELEVISION**
 - **Real-time hardware demonstrations:** January 1991
 - **Field test:** June 1992 (MCPC)
September 1992 (SCPC)
 - **Products for satellite TV delivery:** Summer 1992 (MCPC)
Spring 1993 (SCPC)

- **HDTV**
 - **Real-time hardware (slot 3):** December 1991
 - **Real-time hardware (slot 6):** June 1992
 - **FCC standard:** Mid-1993

DIGICIPHER™ TECHNOLOGY

- **Core television technology**
- **All-digital**
 - **Compression**
 - **Transmission**
 - **Access Control**
- **Multichannel NTSC and HDTV**
- **Seamless interface**
 - **Source to TV receiver**
 - **Unified system design**
 - **Broadcast**
 - **Cable**
 - **Satellite**
 - **Home video**