NEW TECHNOLOGY APPLIED TO TELEMEDICINE

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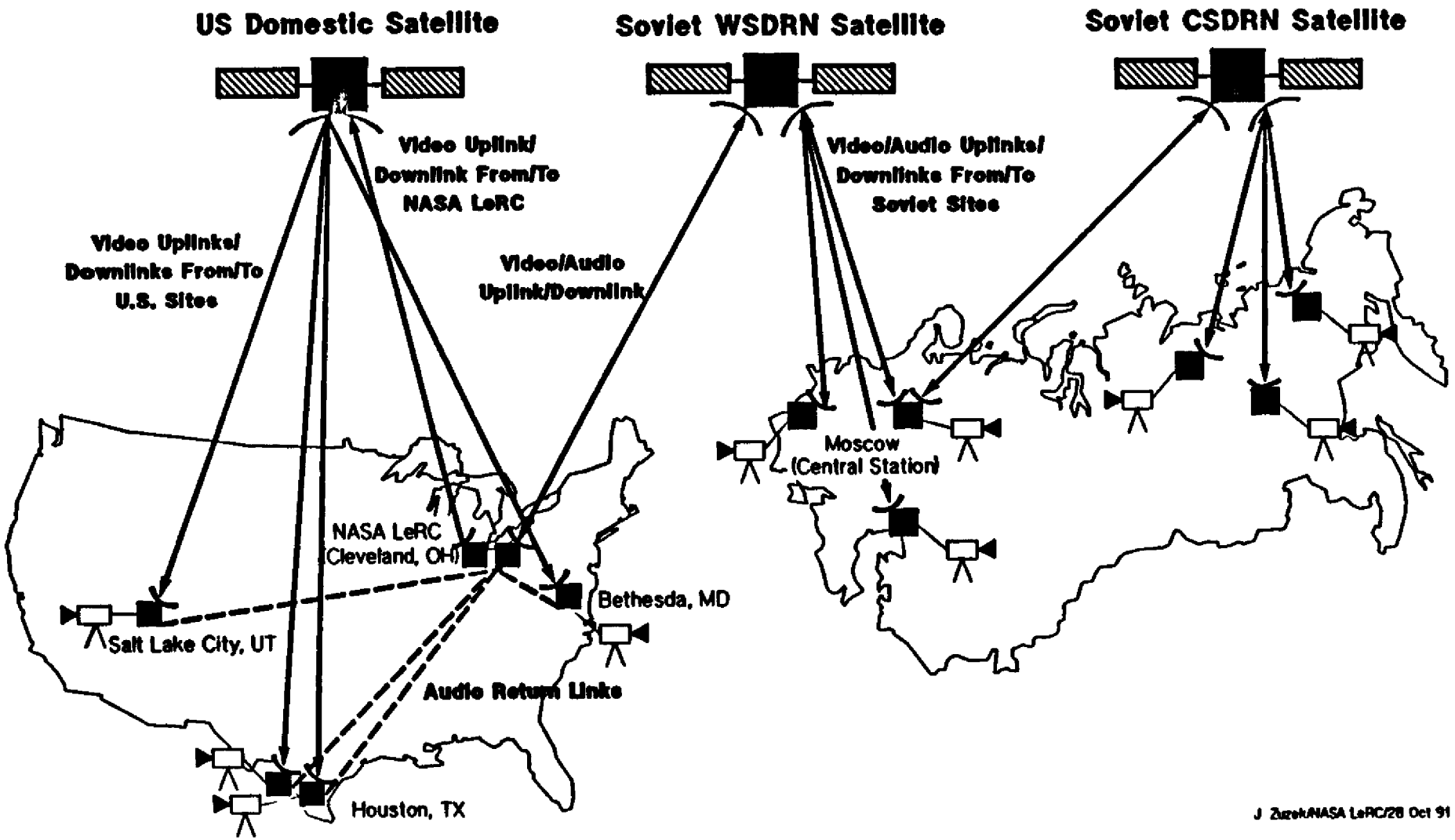
1.0 INTRODUCTION

SATELLITE COMMUNICATIONS TECHNOLOGY HAS BEEN USED FOR ESTABLISHING INTERNATIONAL TELEMEDICINE COMMUNICATIONS LINKS IN A NUMBER OF INSTANCES, (E.G., TELEMEDICINE SPACE BRIDGE BETWEEN ARMENIA AND THE UNITED STATES IN 1989, AND THE PROPOSED LINKAGES SHOWN IN THE FIGURE, FOR DEMONSTRATION DURING THIS CONFERENCE AND DURING 1992 AND 1993). IN THE CURRENT EXAMPLE, GEOSTATIONARY SATELLITES ARE USED TO PROVIDE INTERCONTINENTAL COMMUNICATIONS LINKS BETWEEN THE TWO COUNTRIES AND ALSO FOR DISTRIBUTION WITHIN EACH COUNTRY.

Telemedicine Space Bridge

(Two–Way Video)



J Zuzek/NASA LeRC/28 Oct 91

SATELLITE COMMUNICATIONS, TECHNICAL CHARACTERISTICS

WSDRN SATELLITE	
ANTENNA DIAMETER	1.6 m OR 3.0 m
TRANSMITTER POWER	13 W
WSDRN EARTH STATION	
ANTENNA DIAMETER	2.0 m OR 5.0 m
TRANSMITTER POWER	100 W OR 240 W
US DOMSAT	
ANTENNA DIAMETER	1.6 m
TRANSMITTER POWER	20 W
DOMSAT EARTH STATION	
ANTENNA DIAMETER	3.7 m, TYPICAL
TRANSMITTER POWER	300 W OR 600 W

TECHNICAL CHARACTERISTICS OF CURRENT TELEMEDICINE LINKS BY SATELLITE

SATELLITE ANTENNAS	1.6 TO 3.0 m
SATELLITE TRANSMITTER POWER	10 TO 20 W
EARTH STATION ANTENNAS	2 TO 5 m
EARTH STATION TRANSMITTER POWER	100 TO 600 W
CHANNEL BANDWIDTH FOR ANALOG VIDEO	34 TO 54 MHz
FREQUENCIES	Ku-BAND 11-15 GHz

APPLICATIONS OF NEW TECHNOLOGY

VIDEO CODING

- REDUCES BANDWIDTH & POWER REQUIRED
- PRESERVES FULL MOTION AND FULL RESOLUTION

APPROACH

- DEVELOPMENT OF VIDEO CODING ALGORITHMS
  2:1, 5:1, 10:1 COMPRESSION
- PROTOTYPE EQUIPMENT
- DEMONSTRATIONS WITH SATELLITES

BENEFITS

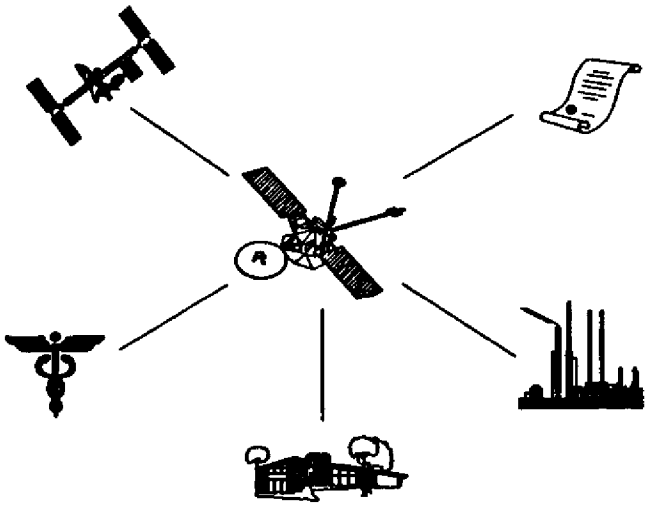
- LOWER COST OF TELEMEDICINE TRANSMISSIONS
- MULTIPLE TELEMEDICINE CHANNELS IN A SINGLE SPACECRAFT TRANSPONDER
- REDUCED POWER, SMALLER ANTENNA SIZES

AEROSPACE TECHNOLOGY DIRECTORATE

SPACE ELECTRONICS DIVISION

NASA Lewis Research Center

VIDEO COMMUNICATIONS BANDWIDTH COMPRESSION



SCOPE/OBJECTIVES:

- DEVELOP VIDEO DATA COMPRESSION TECHNOLOGY FOR TRANSMISSION OF IMAGE DATA OVER SPACE COMMUNICATIONS LINKS
  - EFFICIENT BANDWIDTH UTILIZATION
  - INCREASED PROCESSING SPEED THROUGH EFFICIENT CODING TECHNIQUES
  - COST EFFECTIVE HARDWARE IMPLEMENTATION

BENEFITS:

- INCREASE ORBIT/SPECTRUM CAPACITY
- ENABLE COST EFFECTIVE COMMERCIAL DIGITAL VIDEO TRANSMISSION
- ENHANCE NASA SCIENCE MISSION VIDEO CAPABILITIES
- REDUCE SPACE SEGMENT COSTS BY REDUCING BANDWIDTH REQUIREMENTS

ACCOMPLISHMENTS:

- PATENT PENDING ON IN-HOUSE DEVELOPED ENHANCED DPCM CODEC PROVIDING BROADCAST QUALITY ENCLODING IN REAL TIME
- UNIVERSITY GRANTS IN PLACE FOR INVESTIGATION AND DEVELOPMENT OF NEW ENCODING TECHNIQUES
- RECENT SCAR AWARD TO COMSAT FOR DEVELOPMENT OF FLEXIBLE-RATE HDTV CODEC

APPLICATIONS OF NEW TECHNOLOGY (CONT.)

SPOT BEAM & MULTIPLE BEAM ANTENNAS

- FOCUS SPACECRAFT POWER ON INTENDED REGIONS
- HIGH GAIN SPACECRAFT RECEIVE ANTENNA

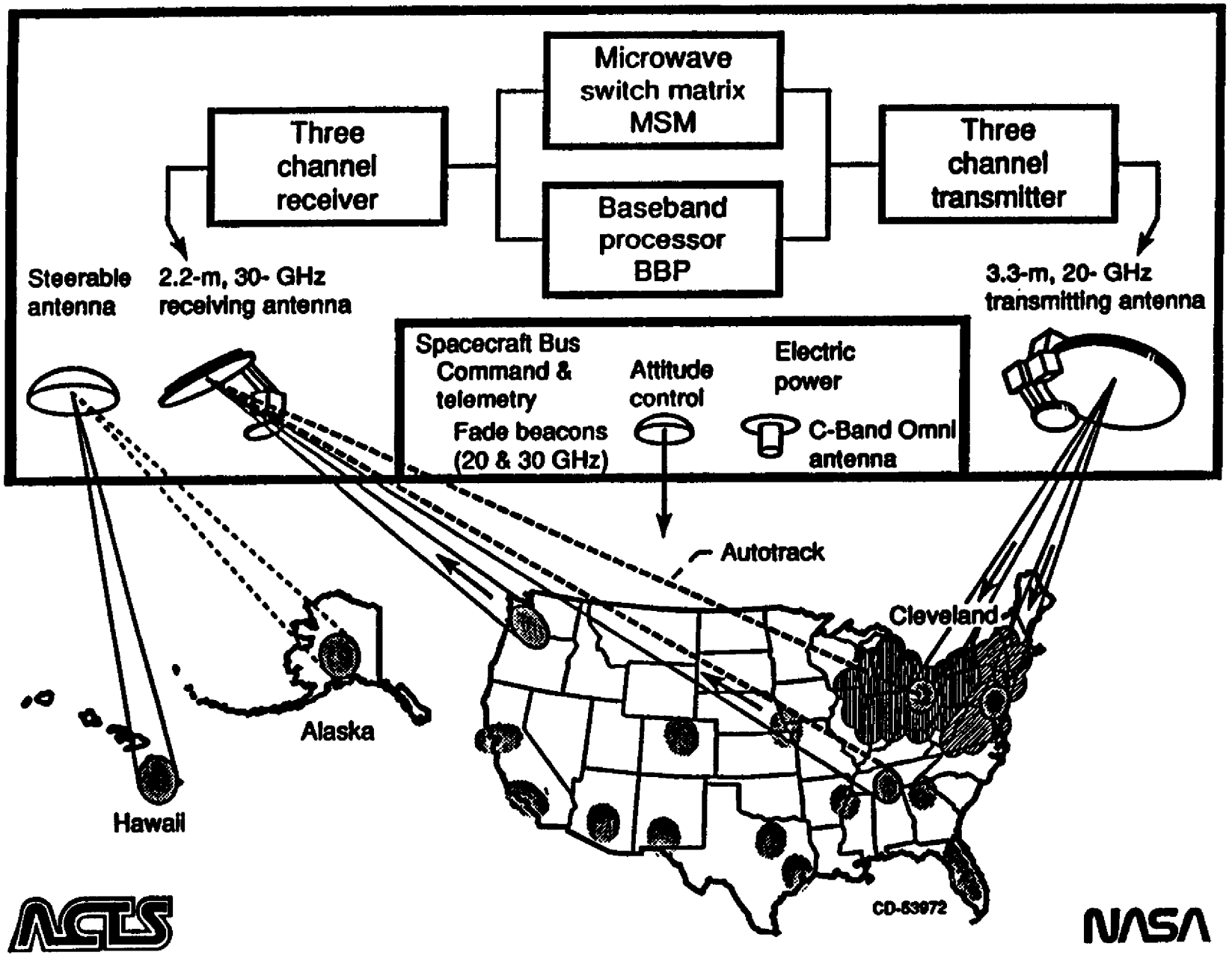
APPROACH

- MULTIPLE FEED ANTENNAS FOR MULTIPLE SPOT BEAMS
- ARRAY ANTENNAS FOR SCANNING BEAMS
- PROTOTYPE HARDWARE
- SPACE EXPERIMENTS/DEMONSTRATIONS

BENEFITS

- REDUCED POWER & COST PER TELEMEDICINE CHANNEL
- AREA ADDRESSABLE COMMUNICATIONS
- PORTABLE OR MOBILE EARTH STATIONS BECOME POSSIBLE

ACTS Flight Segment



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APPLICATIONS OF NEW TECHNOLOGY (CONT.)

ON-BOARD DETECTION AND SWITCHING

- RECONSTITUTED SIGNAL IMPROVES IMMUNITY TO NOISE
- MESSAGE/DATA ROUTING PERFORMED ON SPACECRAFT

APPROACH

- DEVELOP IMPROVED MODULATION AND CODING
- DEVELOP BULK DEMODULATORS (MULTI-CHANNEL DEMODULATORS)
- DEVELOP BASEBAND SWITCHING FOR INDIVIDUAL MESSAGES
- PROTOTYPE HARDWARE
- SPACE EXPERIMENTS/DEMONSTRATIONS

BENEFITS

- REDUCED POWER AND COST FOR TELEMEDICINE DATA AND VOICE MESSAGES
- MESSAGE ROUTING TO SUPPORT A LARGE NUMBER OF USERS

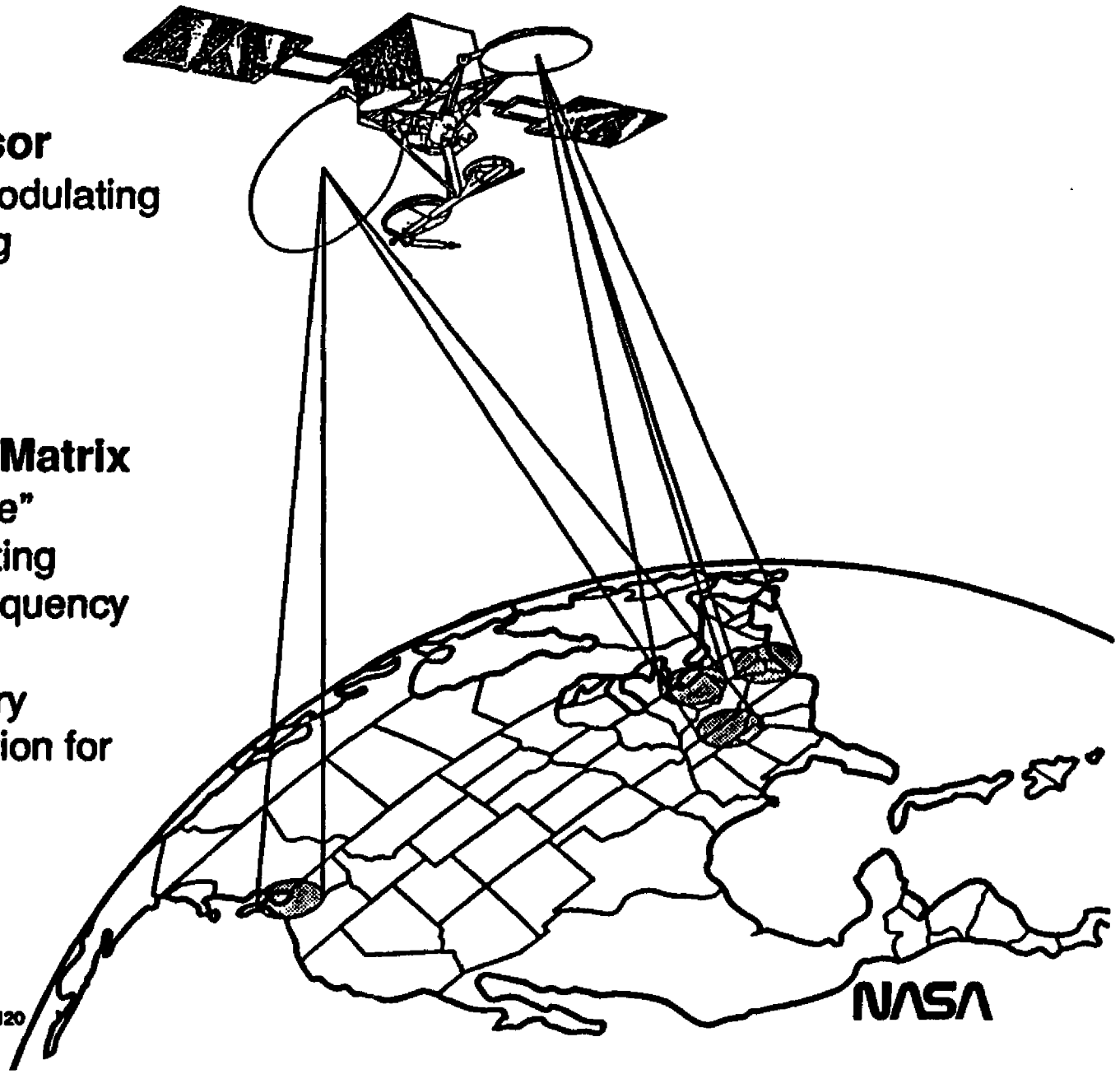
ACTS Switching and Processing Technology

Baseband Processor

- Demodulating/remodulating
- Decoding/encoding
- Routing
- Circuit switching
- Onboard memory

Microwave Switch Matrix

- Dynamic "Bent Pipe" beam-to-beam routing
- Uplink/downlink frequency translation
- No onboard memory
- Static-mode operation for continuous carriers



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APPLICATIONS OF NEW TECHNOLOGY (CONT.)

MISCELLANEOUS TECHNOLOGY IMPROVEMENTS

- HIGH EFFICIENCY TRANSMITTERS
- AUTOMATIC TRACKING ANTENNAS FOR RECEIVING SYSTEMS
- IMPROVED PERFORMANCE SOLID STATE AMPLIFIERS
  -
  -
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APPLICATIONS OF NEW TECHNOLOGY (CONT.)

MOBILE SATELLITE COMMUNICATIONS SYSTEMS

- UBIQUITOUS TERMINALS FOR POST-DISASTER TELEMEDICINE
- LOW EARTH ORBIT SATELLITES REQUIRE SMALLER TERMINALS

APPROACH

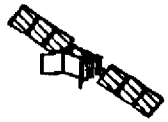
- COMMERCIAL SYSTEMS ALREADY PROPOSED
- DEVELOPING INFASTRACTURE CAN BE USED FOR TELEMEDICINE APPLICATIONS

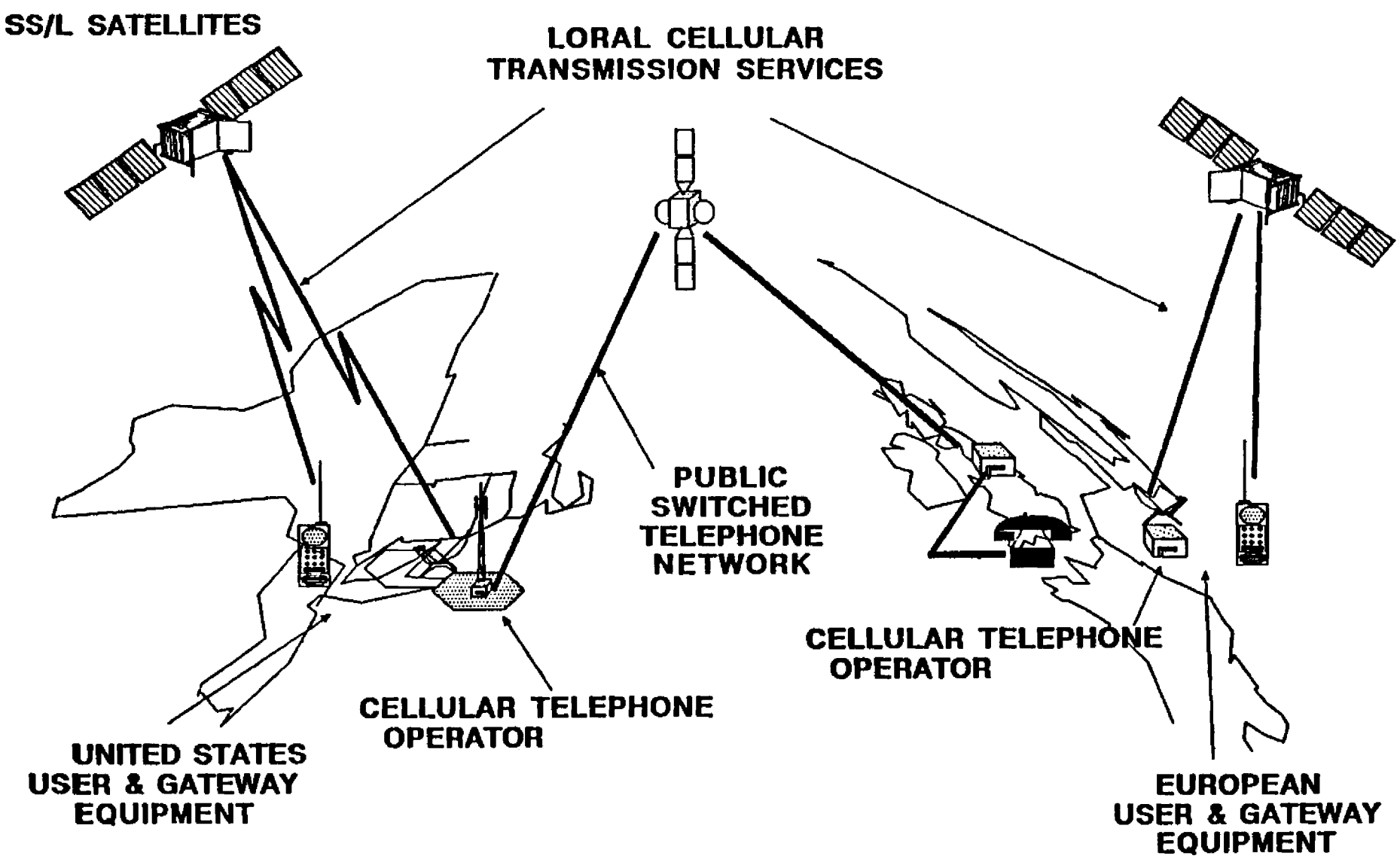
BENEFITS

- LOW COST BY USING DEVELOPED SYSTEM
- WIDESPREAD ACCESS TO NETWORK FOR DATA, FACSIMILE, AND VOICE TRANSMISSIONS

GLOBALSTAR

GLOBALSTAR INFRASTRUCTURE





USE OF HIGHER FREQUENCIES

- PRACTICABLE, HIGH GAIN, SPOT BEAM ANTENNAS
- ACCESS TO UNCROWDED PART OF FREQUENCY SPECTRUM
  (20 GHz AND 30 GHz, FOR EXAMPLE)

APPROACH

- DEVELOP TECHNOLOGIES OF ANTENNAS, ON-BOARD DETECTORS, SPACECRAFT SWITCHING, HIGH FREQUENCY COMPONENTS, ...
- DEVELOP AN EXPERIMENTAL SATELLITE (ACTS - 1993)
- PERFORM EXPERIMENTS TO DEMONSTRATE USE (1993-1995)

BENEFITS

- COMBINED ADVANTAGES OF TECHNOLOGIES USED
  LOWER POWER
  LOWER COST
  MESSAGE SWITCHING
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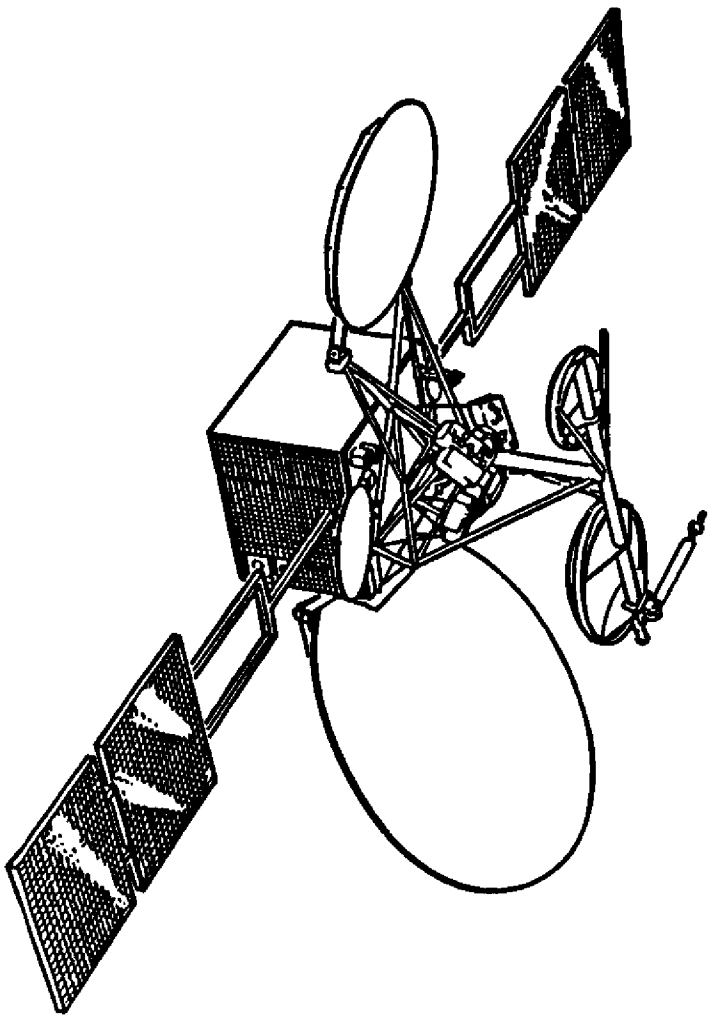
ACTS Spacecraft Characteristics



Weight:	3250 lbs (on-orbit)
Power:	1770 W BOL four panel solar array (134.5 ft^2)
Frequency bands:	Ka-band (30/20 GHz)
Payload:	Multibeam antenna, on-board processing and routing
Spacecraft pointing accuracy:	+ 0.025°
Launch date:	February 1993
Mission requirement:	2 yrs Experiment period 4+ yrs Station keeping fuel

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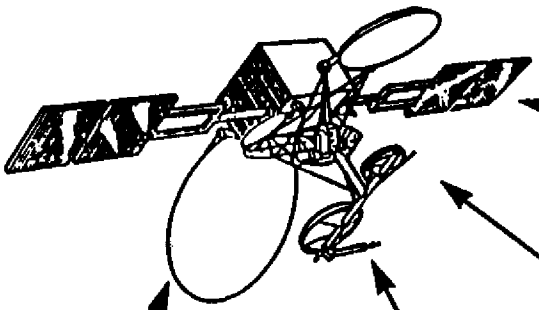
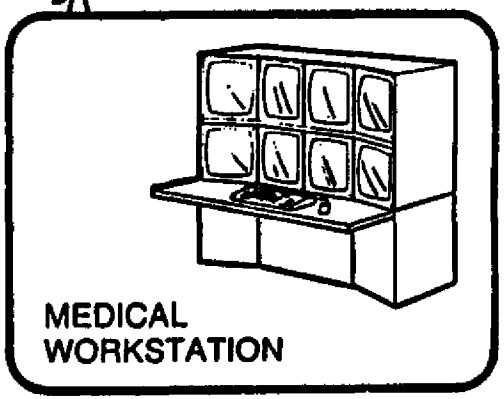
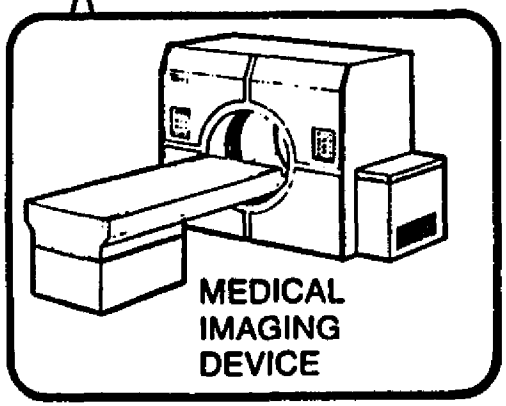
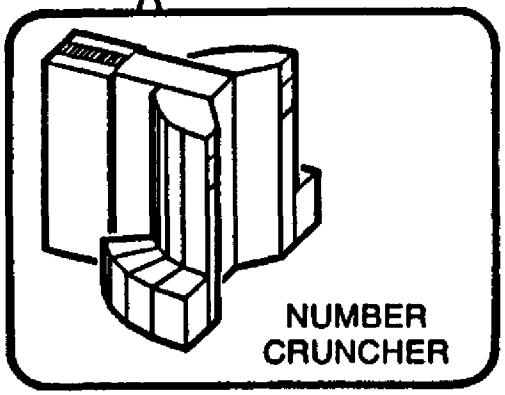
"REMOTE" MEDICAL IMAGING

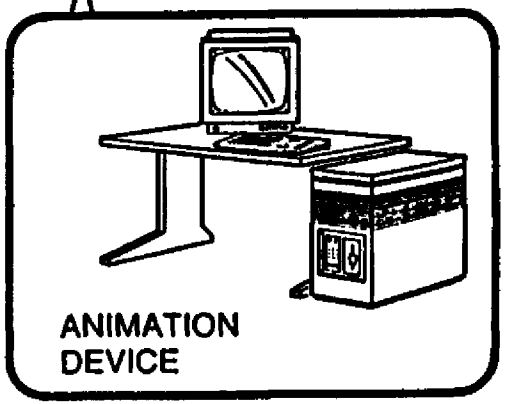
- CAT SCAN TO SUPERCOMPUTER
- SUPERCOMPUTER TO ANIMATION DEVICE
- ANIMATION DEVICE TO MEDICAL WORKSTATION











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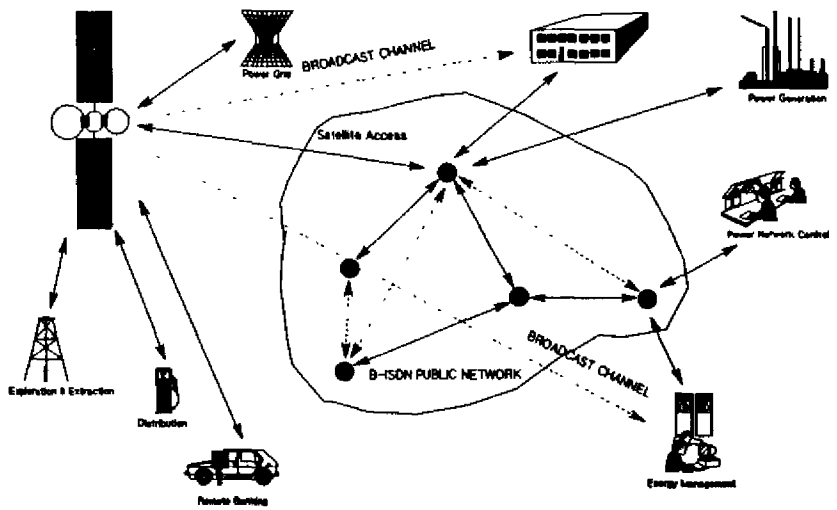
SATELLITE ENHANCEMENT OF B-ISDN PUBLIC NETWORK



SCOPE/OBJECTIVES:

- EVALUATE SATELLITE ARCHITECTURES FOR PROVIDING COMPLEMENTARY MULTICAST/BROADCAST CAPABILITY TO A BROAD-BAND ISDN BASED TERRESTRIAL NETWORK
  - COMPATIBLE WITH PLANNED ATM PROTOCOL
  - PROVISIONS FOR CIRCUMVENTING SATELLITE PATH DELAY

BENEFITS:

- ENHANCES MARKET POTENTIAL OF SATELLITE TECHNOLOGY
- TAKES ADVANTAGE OF B-ISDN FEATURES TO ENHANCE SATELLITE HARDWARE EFFICIENCY AND UTILIZATION
- STRAIGHTFORWARD IMPLEMENTATION OF MULTICAST/BROADCAST ENHANCEMENT OF B-ISDN PROTOCOL

ACCOMPLISHMENTS:

- STUDY RESULTS SUPPORT GENERAL CONCEPT

SUMMARY

NEW TECHNOLOGY DEVELOPMENTS APPLIED TO SATELLITE COMMUNICATIONS CAN FACILITATE TELEMEDICINE APPLICATIONS. BENEFITS FROM USING NEW TECHNOLOGY INCLUDE LOWER POWER, SMALLER SIZE, REDUCED COST, AND GREATER AVAILABILITY IN POST DISASTER SITUATIONS.