FUTURE COMMUNICATIONS SATELLITE APPLICATIONS

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SWITCHED POINT-TO-POINT NARROWBAND COMMUNICATIONS

CHARACTERISTICS:
SMALL/LOW COST TERMINALS
SINGLE HOP COMMUNICATIONS
VOICE COMPATIBLE
FULL MESH NETWORKING
ISDN COMPATIBLE
POSSIBLE LIMITED USE OF FULL MOTION VIDEO

TARGET APPLICATIONS:
VOICE/DATA NETWORKS BETWEEN PLANTS AND OFFICES IN A CORPORATION
DATABASE NETWORKING FOR COMMERCIAL AND SCIENCE USERS
CELLULAR RADIO INTERNODAL VOICE/DATA NETWORKING

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COMMUNICATIONS SATELLITES GENESIS

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CELLULAR RADIO INTERNODAL NETWORK

COMMUNICATION SATELLITES
CHARACTERISTICS COMPARISON

CURRENT
0 CONUS COVERAGE ANTENNAS
0 BENT PIPE TRANSPONDERS
0 C AND Ku BAND
0 LIMITED BANDWIDTH
0 LARGE EARTH TERMINALS
0 STAR NETWORKS

FUTURE
0 SPOT BEAM & SCANNING ANTENNAS
0 REGENERATIVE PROCESSING TRANSPONDERS
0 Ka BAND
0 UNCONGESTED
0 SMALL EARTH TERMINALS
0 MESH NETWORKS
BUSINESS/RESIDENTIAL VIDEO PHONE SERVICE

CHARACTERISTICS:

LOW COST TERMINALS LOCATED AT CABLE HEAD ENDS
TRAFFIC FROM TERMINALS SWITCHED/ROUTED THROUGH SATELLITE
SINGLE HOP TO ANY OTHER TERMINAL IN CONUS
VIDEO CAMERA REQUIRED AT EACH RESIDENCE
USES TELEPHONE CIRCUITS FOR AUDIO

ADVANTAGES:

USES EXISTING HOME TELEVISION SET AND TELEPHONES
USES EXISTING CATV DISTRIBUTION SYSTEMS
PROVIDES VALUE ADDED SERVICE FOR CABLE TV SUPPLIERS
SATELLITE & TERMINAL COSTS SPREAD OVER LARGE CUSTOMER BASE

DISADVANTAGES:

REQUIRES REVERSE CHANNEL REPEATERS
MAY EVENTUALLY BE DISPLACED BY OPTICAL FIBER

COMMUNICATION SYSTEMS CHARACTERISTICS

- 27.5-30.0 GHz UPLINK 17.7-20.2 GHz DOWNLINK
- TDMA WITH DAMA
- MW MATRIX SWITCH MODE
  220 MSPS UPLINK 220 MSPS DOWNLINK
  (NOTE-EXPERIMENTS POSSIBLE AT ANY BIT RATE AND MODULATION IN EITHER TDMA OR FDMA FORMAT)
- BASEBAND PROCESSOR MODE
  FOUR-27.5 MSPS UPLINKS TWO-110 MSPS DOWNLINKS
  TW0-110 MSPS UPLINKS TWO-110 MSPS DOWNLINKS
- SMSK MODULATION IN BASEBAND PROCESSOR MODE
- \( \leq 10^{-6} \) BER
- FADE MARGIN:
<table>
<thead>
<tr>
<th>MODE</th>
<th>UPLINK</th>
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<tr>
<td>MWMS MODE</td>
<td>18 dB</td>
<td>8 dB</td>
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<tr>
<td>BBP MODE</td>
<td>15 dB</td>
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</table>
- FADE SENSING 20 AND 30 GHz DOWNLINK BEACONS
- 20 GHz TWTA
  POWER 43 W
- 30 GHz FET LOW NOISE AMPLIFIER
  5 dB MAX NOISE FIGURE
DATA DISTRIBUTION SATELLITE

BENEFIT:
P.I. HAS DIRECT, IMMEDIATE ACCESS TO HIS DATA

EVOLUTION OF OPERATIONAL SYSTEMS

1988
CURRENT VSATS

1995-1998
NARROW/WIDEBAND

1999
DDS

ADVANCED TO DS SCIENCE PLATFORM

DOUBLE HOP STAR NETWORK
DATA ONLY

SINGLE HOP
VOICE/DATA/VIDEO
FULL MESH NETWORK

SINGLE HOP
VOICE/DATA/VIDEO
FULL MESH NETWORK
TELESCIENCE/TELOPERATIONS
POSSIBLE DDS SYSTEM

CELLULAR RADIO INTERNODAL SERVICE

CHARACTERISTICS:

LOW COST TERMINAL LOCATED AT CELL ANTENNA SITE TRAFFIC FROM TERMINALS SWITCHED/Routed THROUGH SATELLITE SINGLE HOP TO ANY OTHER TERMINAL IN CONUS

ADVANTAGES:

USES IN-PLACE MOBILE SERVICE
TAKES ADVANTAGE OF ESTABLISHED CUSTOMER BASE/MARKET
AVAILABILITY OF ADEQUATE BANDWIDTH/NO FREQUENCY ALLOCATION PROBLEM
COST EFFECTIVE MOBILE RADIOS ALREADY AVAILABLE
PROVIDES BYPASS OF TERRESTRIAL TOLL NETWORK
DIRECT VOICE QUALITY LINK BETWEEN MOBILE USERS
INTERCONNECTION OF CELLS IN NEWLY LICENSED RURAL AREA

DISADVANTAGES:

COMPETES WITH TERRESTRIAL TOLL SERVICES
SWITCHED POINT-TO-POINT WIDEBAND COMMUNICATIONS

CHARACTERISTICS:

- SMALL/LOW COST TERMINALS
- SINGLE HOP COMMUNICATIONS
- VOICE/VIDEO COMPATIBLE
- FULL MESH NETWORKING
- ISDN COMPATIBLE
- EXTENSIVE AVAILABILITY OF REDUCED BANDWIDTH CHANNELS FOR VIDEOPHONES
- SIGNIFICANT NUMBER OF CHANNELS AVAILABLE FOR FULL MOTION VIDEO

TARGET APPLICATIONS:

- VOICE/VIDEO/DATA NETWORKS BETWEEN CORPORATE PLANTS AND OFFICES
- IMAGE DATA NETWORKING FOR COMMERCIAL AND SCIENCE USERS
- CABLE TV INTERNETTING FOR DIRECT TO/FROM HOME VIDEOPHONE SERVICE
COMMUNICATION SATELLITES
INTRODUCTION


SINCE THEN, THROUGH BOTH NASA AND INDUSTRY INNOVATION THE COMMUNICATION SATELLITE INDUSTRY HAS GROWN TO PROVIDE $3.5 B/YR. IN REVENUES AND TO BE ONE OF MAJOR GLOBAL INFLUENCE.

THE INFORMATION AGE IS MAKING NEW DEMANDS.

TERRESTRIAL FIBER OPTICS IS BECOMING A COMPETITOR.

NEW COMMUNICATION SATELLITE TECHNOLOGIES PROMISE TO MEET INCREASING DEMANDS AND ENABLE NEW SERVICES.
COMMUNICATION SATELLITES

CONCLUSION

0 COMMUNICATION SATELLITES PLAYED KEY ROLE IN ENABLING INFORMATION ERA AND CREATING ONE GLOBAL COMMUNITY

0 NEW TECHNOLOGIES SUCH AS TERRESTRIAL FIBER OPTICS WILL COMPETE AND FORCE MARKET SHIFTS

0 NEW EMERGING INFORMATION AND COMMUNICATION NEEDS WILL INCREASE DEMAND

0 NEW MODULATION AND CODING TECHNOLOGIES WILL BE IN INCREASING DEMAND TO ENABLE AND ENHANCE THESE NEW SERVICES
COMMUNICATION SATELLITES

ADVANTAGES

○ EASE IN SETTING UP LINK
○ BROADCAST MODE
○ TRANSPORTABLE/MOBILE
○ DISTANCE INSENSITIVE

LIMITATIONS

○ BANDWIDTH
○ DELAY
○ PATH LENGTH

BENEFITS TO NASA

○ OFFERS SOLUTION TO NASA'S BURGEONING NEED FOR ADVANCED HIGHER CAPACITY TELECOMMUNICATIONS SYSTEMS TO SUPPORT FUTURE SHUTTLE, SPACE STATION, AND SCIENCE NEEDS.

○ WILL INFUSE STATE-OF-THE-ART SATELLITE TECHNOLOGY INTO NASA'S CONTINUED MODERNIZATION OF ITS INFORMATION SYSTEMS NETWORK.

○ GREATLY IMPROVED ACCESS BY PI'S AND OTHERS TO SPACE SCIENCE DATA, BOTH REAL-TIME AND ARCHIVED.

○ WILL ENABLE "SPACE" TO BECOME A PART OF EXPERIMENTER AND EDUCATOR'S LABORATORY OR CLASSROOM THROUGH TELEPRESENCE (MONITORING & CONTROL OF EXPERIMENTS).
Functional Overview of the ACTS Flight Segment

FLIGHT SYSTEM

MULTIBEAM COMMUNICATIONS PACKAGE

THREE CHANNEL RECEIVER

(HBR) MICROWAVE MATRIX SWITCH

BASEBAND PROCESSOR (LBR)

THREE CHANNEL TRANSMITTER

3.3 METER, 20 GHZ TRANSMIT ANTENNA

2.2 METER, 30 GHZ RECEIVE ANTENNA

SPACECRAFT BUS

COMMAND & TELEMETRY

KA BAND CONUS ANTENNA

ATTITUDE CONTROL

C-BAND OMNI ANTENNA

ELECTRIC POWER

FADE BEACONS (20 & 30 GHZ)

AUTOTRACK

CLEVELAND

COMMUNICATION SATELLITES

BENEFITS OF NEW MODULATION AND CODING TECHNOLOGIES

- CONSERVE BANDWIDTH
- CONSERVE POWER
- IMPROVE LINK AVAILABILITY
- IMPROVE INFORMATION INTEGRITY
- IMPROVE INFORMATION SECURITY
COMMUNICATION SATELLITES

CURRENT APPLICATIONS

- TELEVISION PROGRAM DISTRIBUTION
- LONG HAUL TELEPHONE
- DATA TRANSMISSION
- BUSINESS COMMUNICATIONS (STAR NETWORK)