Historical Review of Reflector Antenna Systems for Satellite Communication Developed by MELCO

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Abstract

Mitsubishi Electric Corporation (MELCO) has developed a lot of novel reflector antenna systems used for satellite communication and made them practicable in corporation with customers such as NTT (Nippon Telegraph and Telephone Corporation), KDD (Kokusai Densin Denwa Corporation,), NASDA (National Space Development Agency of Japan), ISAS (The Institute of Space and Astronautical Science), NAOJ (National Astronomical Observatory of Japan), INTELSAT (International Telecommunication Satellite Organization) and so on. In this presentation, the historical reflector antenna systems developed by MELCO during these 40 years will be introduced in detail.

1. EARTH STATION ANTENNAS

(1) KDD I-1 Cassegrain Antenna (Fig. 1) [1,2,3]
- First practical Cassegrain antenna
- 6.4/4.2, 1.7GHz 20m diameter in 1963
- 6/4 GHz band 22.5m diameter in 1967
- Japanese first TV relay experiment in Nov. 1963, which reported the assassination of the U.S. President J.F. Kennedy

(2) KDD I-2 27.5m Cassegrain Antenna [4]
- Horn reflector fed Near-field Cassegrain antenna
- 6/4 GHz band
- Constructed in 1968

(3) KDD I-3 29.6m Cassegrain Antenna (Fig. 2) [5]
- 4-reflector beam waveguide fed Cassegrain antenna
- Dual shaped reflectors
- Corrugated conical horn
- Constructed in 1971
- 6/4 GHz band
- International standard type earth station

(4) NRO 45m Radio Telescope Antenna (Fig. 3) [6-7]
- 45m beam waveguide fed multiple reflector antenna
- 20GHz-230GHz bands
- Beam waveguide design using beam mode expansion
- Homologous design
- 600 adjustable reflector panels using electric motor
- 65μm rms surface accuracy by radio holographic metrology

(5) ISAS 64m Deep Space Antenna [8]
- Largest size reflector antenna in Japan
- Constructed in 1984
- S and X band deep space communications and 1.6, 4.9, 22 GHz telescope
- Homologous design

(6) NTT 11.5m Ka-band
Offset Cassegrain Antenna (Fig. 4) [9]
- First Offset Cassegrain earth station antenna
- Constructed in 1978
- Ka (20/30GHz) band
- High aperture efficiency and low sidelobe characteristics

(7) NTT Ka-band Elliptical Aperture Shaped Offset Cassegrain Antenna (Fig. 5) [10]
- First elliptical aperture offset Cassegrain earth station antenna
- Constructed in 1979
- Ka (20/30GHz) band
- Model of commemorative stamp design

(8) SNG Elliptical Aperture Offset Gregorian Antennas [11]
- Elliptical Aperture Offset Gregorian Antennas
- Very low cross polarization
- Ku band

(9) Beam Steerable Dual Reflector Antenna by Sub-reflector Drive [12]

(10) NTT Dual Beam Earth Station Antennas (Fig. 6) [13-14]
- Access two N-Stars
- C band, Ku band and Ka band, respectively

(11) Connexion by Boeing^{SM} Small Antenna [15]
- Elliptical Aperture Cassegrain Antennas
- Very low profile
- Ku band

2. SATELLITE ANTENNAS

(1) INTELSAT-V C-band Global Beam Antennas [16]
- Flare-iris type dual mode conical horn antennas
- C band

- Ka (20/30GHz) band
- Launched in 1980

(2) CS C/Ka-band Shaped Beam Horn Reflector Antenna (Fig. 7) [17]
- Launched in 1977, 1983 and 1988
- Shaped Beam covering Japan Islands

(3) Front Fed Offset Cassegrain (FFOC) Antenna (Fig. 8) [18]
- Multi-beam antenna with very small scan loss and low cross polarization level
- Prototype

(4) N-STAR Ka-band Offset Gregorian Antenna (Fig. 9) [19]
- 2.2m offset Gregorian antenna
- Up link; 8 multi-beams and a shaped beam
- Down link; 3 multi-beams and a shaped beam
- Frequency selective sub-reflector
- Launched in 1995

(5) SUPERBIRD-C Dual Grid Reflector Antenna [20]
- Dual overlapped girded reflector
- Ku band
- 0.55m diameter
- Cross polarization level less than -40dB

(6) ADEOS S/Ka-band Antenna [21]
- Frequency selective sub-reflector

(7) HALCA (Muses-B) Large Deployable Antenna (Fig. 10) [22-23]
- 10m diameter
- 22, 5 and 1.6GHz

3. CONCLUSION

This paper has presented the historical reflector antenna systems developed by MELCO during these 40 years [24-25]. MELCO would like to continue to contribute to the development of novel reflector antenna systems.

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Fig.1 KDD I-1 Cassegrain Antenna

Fig.3 NRO 45m Radio Telescope Antenna

Fig.2 KDD I-3 29.6m Cassegrain Antenna

Fig.4 NTT 11.5m Ka-band Offset Cassegrain Antenna

Fig. 5 NTT Ka-band Elliptical Aperture Shaped Offset Cassegrain Antenna

Fig. 6 NTT Ka-band Dual Beam Earth Station Antenna

Fig. 7 CS C/Ka-band Shaped Beam Horn Reflector Antenna

Fig. 8 Front Fed Offset Cassegrain (FFOC) Antenna

Fig. 9 N-STAR Ka-band Offset Gregorian Antenna

Fig. 10 HALCA (Muses-B) Large Deployable Antenna