DS 2000
A Proven Commercial Platform

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WSRF 2012, Dubai
I. Space Business Overview
I. Corporate & Space Business Overview

DS-2000 Heritage

DS-2000’s highly reliable design & quality proven in orbit

has grown to 10 spacecrafts

- No incident in orbit which resulted in any insurance claims.
- Least premium for launch insurance for the latest ST-2 communication satellite.
- Both SB-C2 (-7) and ST-2 in excellent health.
- Just finished PDR and Insurance Brief for TURKSAT-4A&B.

DS-2000 Family – Currently 10 satellites

DTRS  MTSAT-2  ETS-VIII  Superbird-C2  QZS  ST-2  Himawari-8/9  Turksat-4A&4B

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II. DS-2000 Coming of Age
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Platform Overview

- **Life**: 15+ yrs (16+ yrs maneuver life)
- **Maximum Launch mass**: Maximum 6,000 kg
- **Launch Vehicle Compatibility**: Ariane-5ECA, Proton Breeze M, Sea Launch, Atlas, Falcon 9 etc.
- **Payload Heritage**: L, S, C, X, Ku and Ka frequency bands
- **Reliability**: over 0.8

**EPS**: Electric Power Subsystem
100v regulated bus. 12kW in sunlit and eclipse in maximum, automatic battery operation.

**SCS**: Satellite Control Subsystem
Data handling of command/telemetry, satellite House-Keeping (battery, heater). MIL-STD-1553B processor and 64bit MPU (or HR5000) applied.

**SPS**: Solar Power Subsystem
12-13 kW total power generation (GaAs cells, EOL equinox, 1 string failure, 4 standard size panels/wing). Each strings isolated by diodes.

**BPS**: Bi-Propellant Subsystem
Fuel (MMH) and Oxygen (MON-3) Bi-propellant. 1 Apogee Kick Motor + 12 Thrusters

**AOCIS**: Attitude and Orbit Control Subsystem
Uses 4-skewed reaction wheel; standard highly accurate attitude control by STT & IRU with 0.03deg for three axis. CSS for sun acquisition.

**STR/TCS**: Structure/Thermal Control Subsystem
CFRP/Al-skin Honey-Comb Cylinder and Heat pipes panels.

**TC&R**: Telemetry Command and Ranging
Maximum 4 command telemetry units. Standard bit rate 7.68 kbps for TLM, 500 bps for CMD. TLM, CMD and RNG operated simultaneously. Auto/variable heater control.

**Battery**: Li-ion 100-175Ah
Earth sensor or Star Tracker.
II. DS-2000 Coming of Age

Background

• MELCO, historically had been equipped with the following aspects to become competent supplier of commercial COMSAT platform:

1. **Key BUS components heritage stemming out from the late 1980s** (Solar Panels and Li Ion Batteries; we currently command up to 40% of global share for these products).

2. **Prime contractor experience since the 1970s** with institutional customers, strong focus on quality/reliability assurance helped us develop unique in-house mechanisms and practices such as “BMS 100.00 Program” & “KSCB”).

3. **Advanced mission design/development experience** throughout the period (eg. INTELSAT V/VII, N-STARs). Also, an innovator in Ka band field, such as APAA development.
II. DS-2000 Coming of Age
Capability of Advanced Mission (1)

- MELCO has been an innovator in advanced antenna development, such as in Ka band and this has enabled us to become a major payload subsystem provider for the commercial market ever since INTELSAT V series (1980s).

- The heritage in Ka field, has recently resulted in developing APAA for an institutional high speed broadband satellite.

Photos Courtesy of JAXA
II. DS-2000 Coming of Age
Capability of Advanced Mission (2)

Based on its longstanding heritage, MELCO has grown into a provider of complex payload subsystem for the commercial market and secured OPTUS-C1 prime contractor, which eventually paved a path to a full turnkey contractor with DS-2000.

It is noteworthy that we were able to combine reliable BUS components and advanced mission design to come up with the platform DS-2000.
II. DS-2000 Coming of Age
BMS/KSCB in Action

Visual Inspection prior to final Integration of Payload Panels, overseen by BMS Program.

- Harness Check
- Bonding Check
- Component Check
- Contamination Check
  etc.

KSCB members of mechanical / electrical experts also attend this inspection, and signs off design conformity.
III. New Technology for the Commercial Market
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View of the Market

- Commercial COMSAT market has a tendency to be flat but generates very stable demand, supported by constant replacement demands.

- MELCO views overall commercial market to be generating min 15 up to 23 spacecrafts annum; in the pie, Global Big 4 operators consists up to almost 60% and the rest, shared among regional players.

- Regional operators’ needs vary, and flexibility in mission design is a core requirement; together with MELCO’s flexible mission design capability, proposal of new mission technology should contribute to better address the needs.
III. New Technology for the Commercial Market
Observation through DS2000 Marketing / Sales Activities

- Many potential customers are asking for a total turnkey contract, including LV & insurance; insurance rate is one of the highest priority subject for them.
  ✔ Transparency continues to be on MELCO priority list.

- Price rather than ITAR-free.
- Lighter mass requirements to be able to launch Falcon 9.
- Tailor-made beam & Ka band beam requirements.
  ✔ Membrane Antenna and GaN SSPA applications.

- Orbital slots becoming ever scarce real estate; we are seeing increasing number of potential entities looking for their own satellites.
MELCO conducts briefing for each and all commercial spacecraft at MELCO Primary Facility in Kamakura City, Japan, in order to assure transparency of the DS2000 design & health status.
In order to address tailor-made contour requirements, MELCO is using membrane technology (L/Ku/X) due to its high resistance to thermal distortion (< 0.15mm RMS) & less weight compared to honeycomb design (approx. 1/2).

Together with in-house design & manufacturing capabilities, the technology allow us to achieve higher surface accuracy to meet Regional customer’s needs.

MELCO is now applying the technology to Ka band shaped antenna.

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To address lighter satellite mass issue, MELCO is proposing SSPA instead of TWTA whenever possible.

Although major application is limited to C band, MELCO is targeting higher efficiency/lower mass for C & L/S band SSPAs.

### III. New Technologies for the Commercial Market

#### GaN Solid State Amplifier (1)

- TWTA (catalogue value)
- GaAs SSPA
- GaN SSPA

**TWTA typical config & mass**

- Total Mass: L/S-band : 3400g
- C-band : 2200g
- Foot print: 380 cm²

**SSPA typical config & mass**

- Total Mass: L/S-band : 1200g
- C-band: 1200g
- Foot print: 200 cm²
III. New Technologies for the Commercial Market

GaN Solid State Amplifier (2)

- The following chart shows target efficiencies & mass for each SSPA; the mass reduction is approx. 1/3 with improved efficiencies.
- C and S band SSPAs are now in final stage of customer negotiations.

<table>
<thead>
<tr>
<th></th>
<th>TWTA</th>
<th>GaAs SSPA</th>
<th>GaN SSPA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L/S-Band</td>
<td>C-Band</td>
</tr>
<tr>
<td><strong>Output Power</strong></td>
<td>60-150W</td>
<td>20-40W</td>
<td>150W</td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td>65%</td>
<td>40%</td>
<td>55%</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>3400g</td>
<td>1600g</td>
<td>1200g</td>
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</tbody>
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Conclusion

1. By combining sound heritage of BUS components, such as Solar Panels and Li-I Batteries, together with advanced mission capability, MELCO has completed reliable DS 2000 Platform for the global commercial market.

2. In order to differentiate itself, the focus has been placed on workmanship and versatility in mission design, enhancing them by utilizing methods evolved during institutional prime contractor experience.

3. MELCO is committed to DS2000 Platform for the global commercial customers, strategic focus on Regional Operators, who tend to appreciate MELCO focus more.
Thank you.

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