

# A New C-band SAR Satellite Payload and its Mission Operations Concept for Disasters Management

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**Abstract:** Monsoons and typhoons bring along heavy precipitation and they can cause significant disasters (i.e., mud/land slide, flooding, etc.) in Taiwan in addition to the earthquake disasters. Ever since a small satellite Synthetic Aperture Radar (SAR) mission defined in 2009 and it has been analyzed for a few years for seeking a payload development solution. A new C-band SAR satellite payload has thus been successfully defined by flying the satellite in the mission architecture familiar to the satellites operators of NSPO. The SAR mission and payload system requirements have been derived from the surveyed applications requirements gathered from the domestic users in Taiwan. The C-band reflector SAR payload system was thus derived based on these payload system requirements and defined because of the significant rain fade for the X-band wave propagation in the local atmosphere during heavy rains and the project requirement of the SAR payload development parts to be free from any critical technology item.

A mission orbit concept has been constructed under the mission system architecture with two sun-synchronous orbits selected which are possible for the satellite to perform orbit transfer from one orbit to the other with ground control. One orbit was selected for imaging Taiwan twice per day (near 561 km) within a fixed time period and the other (near 537 km) selected for global coverage. The mission objectives have been grouped into two main categories and these objectives are to provide 1) Disasters Management (DM) operations support in Taiwan, and 2) Earth Observations (EO). The EO capability planned at least provides ships target detection and land cover assessment with imaging swaths of 25 km and 90 km for the 5-m resolution Stripmap mode and the 20-m resolution ScanSAR mode, respectively. The payload system requirements of the C-band system have been established via various design efforts for a system of NESZ= -18 dB and they will be verified through airborne testing. Along with the existing airborne SAR testing capability in Taiwan, the satellite payload subsystems hardware and software design, fabrication, and integration capabilities can be quickly demonstrated except the payload antenna and Power Amplifier (PA) subsystems. Thus, a C-band antenna development with a PA enabling technology will be employed with the power combining technique using available GaN SSPA products and a 6 m x 2 m deployable reflector antenna for the space application.

This paper will describe this new satellite payload and its mission operations concept (under the mission operations support feature of a satellite bus similar to the NSPO FORMOSAT-5 bus) mainly for satisfying the DM operations support. It is envisioned that most of the EO mission objectives can be easily satisfied if the DM operations support functions established. Reliable stacked C-band SAR images for the targets change detection can be made easily with the daily revisit 561-km orbit for the DM operations support, i.e., one can image most of the target(s) of interest in the Taiwan island twice per day when the satellite passing above Taiwan in either the ascending or the descending direction. Then, there will be significant advantage with this C-band SAR images provision by comparing it with any of the other optical or SAR images providers for the Taiwan DM images application users.

Keywords: Satellite Payload, Synthetic Aperture Radar, SAR, Mission Operations, Disasters Management