Appendix III
Statement of Work
Associated with
Implementing Arrangement Number 3

Support Services
for the
Constellation Observing System for Meteorology, Ionosphere and Climate
subject to the
Agreement
between the
Taipei Economic and Cultural Representative Office in the United States
and the
American Institute In Taiwan
for
Technical Cooperation
associated with
DEVELOPMENT, LAUNCH AND OPERATION OF A
CONSTELLATION OBSERVING SYSTEM FOR
METEOROLOGY, IONOSPHERE AND CLIMATE

A. **Continuous Operation, Support, and Maintenance of Remote Terminal Services**

The American Institute in Taiwan's (AIT) designated representative, the University Corporation for Atmospheric Research (UCAR), will provide all required services and personnel to integrate, test, operate and maintain the Remote Terminal Services (RTS) for stations in Alaska and Norway on a 24/7/365 basis for the Taipei Economic and Cultural Representative Office's (TECRO) designated representative, the National Space Organization (NSPO). The RTS will provide ninety percent (90%) or greater operational reliability.

AIT's designated representative, UCAR, will provide ground station data reception services from the ground stations in NOAA/NESDIS' Fairbanks Command and Data Acquisition Station (FCDAS) in Alaska and the Kongsberg Satellite Services (KSAT) ground station in Tromso, Norway, and satellite commanding from FCDAS only. The FCDAS station will include a primary and secondary antenna for COSMIC data reception and COSMIC satellite commanding. The FCDAS station will provide a real-time network interface to TECRO's designated representative, NSPO's Satellite Operation

Control Center (SOCC), for state-of-health telemetry and commanding (T&C). The KSAT station will include a new 3 m receive-only antenna for telemetry. The FCDAS and KSAT ground stations will be able to provide five (5) minute turnaround times from one pass to the next pass. The NESDIS Wallops CDAS (WCDAS) on Wallops Island, Virginia, will provide backup downlink and commanding services for FCDAS on an as-available basis. The National Oceanic and Atmospheric Administration (NOAA) and KSAT will place the received Virtual Channel (VC) data on local servers and initiate the transfer of the data within three (3) minutes of loss-of-signal to AIT's designated representative, UCAR, and TECRO's designated representative, NSPO, via the internet. The NOAA local servers will store the most recent ten (10) days of COSMIC VC data, and the most recent twenty-four (24) hours of raw data.

AIT's designated representative, UCAR, will provide the required RTS for COSMIC that are described in Appendix V: FORMOSAT-3/COSMIC Mission Support Plan for NOAA Ground Stations to TECRO's designated representative, NSPO. The RTS provided under this Agreement will adhere to the following document in Appendix IV: FORMOSAT-3/COSMIC Ground Network Interface Control Document for NOAA Ground Stations.

AIT's designated representative, UCAR, will provide the necessary engineering and program management support to facilitate the current RTS operation provided by NOAA. In particular, UCAR will provide:

(1) Support for ongoing operations and troubleshooting of the interfaces between the NOAA ground stations, UCAR, and the NSPO SOCC;
(2) Management and export control of technical documents to non-U.S. entities (i.e. NSPO and KSAT); and,
(3) Support for, and will chair, weekly teleconferences with NOAA, KSAT and NSPO as required.

B.   Continuous Operation, Support, and Maintenance of the COSMIC Data Analysis and Archive Center (CDAAC)

UCAR's CDAAC system will be operated, maintained, and improved in order to maximize the quantity and quality of COSMIC payload data available to the operational and scientific communities. The main tasks to be performed with the CDAAC include: orbit determination, atmospheric profiling, science data monitoring and improvement, data ingestion/dissemination/archival, and system monitoring. These tasks will be performed by a team of experts from AIT's Designated Representative, UCAR, that are familiar with the operational and scientific aspects of the CDAAC software system.

C.   Support for NSPO's Taiwan Analysis Center for COSMIC (TACC)

AIT's Designated Representative, UCAR, will provide up to six hundred and three (603) man-hours per year for routine system maintenance for the TACC. The effort is required

for TACC to operate nominally for the COSMIC mission. The main tasks are described below:

(1) Provide upgrades to sync CDAAC and TACC software as required;
(2) Send patches / fixes to TACC when there are critical problems;
(3) Provide functional level algorithm descriptions and data flow diagrams for CDAAC;
(4) Provide hardware architecture updates;
(5) Provide post-processed COSMIC data;
(6) Provide web access log information;
(7) Assist in acquiring new input data products for the TACC (i.e. ECMWF high resolution forecast and analysis model data, EUMETSAT fiducial data); and
(8) Provide training to personnel operating the TACC.

D.   Payload Operations and Scientific Engineering Support

Payload operations support for CDAAC is required to maximize the quantity and quality of payload data that is delivered to the operational and scientific communities. Payload operations support requires seven (7) days/week monitoring of the data flow from the ground stations to the users, monitoring of the satellite and payload state of health, maintaining the status web pages and database, and monitoring payload data processing for quality control purposes. Anomalies have to be detected and dealt with in a timely manner. As future satellite and payload anomalies arise, UCAR will spend effort to minimize the negative impacts of the anomalies. This effort may include the following tasks:

- discussing and understanding the anomaly
- developing tools for mining and analyzing the data
- developing work-around methods for CDAAC
- discussing firmware changes with the Jet Propulsion Laboratory (JPL)
- discussing possible satellite operations changes with NSPO
- testing effects of changes in CDAAC software and/or firmware
- communicating changes / impacts with the user community

After each firmware upload, AIT's Designated Representative, UCAR, will analyze the new payload data and determine if the new firmware modifications are functioning properly. UCAR will ensure new firmware updates are functioning as designed. UCAR will make sure that CDAAC processing deals correctly with the data from the new payload firmware. UCAR will carefully investigate and track all firmware updates.

Payload work is focused on Global Positioning System (GPS) radio occultation receiver (GOX). Pending user demand, UCAR may have to upgrade its TIP products and its level of in-house knowledge. TIP and TBB require communicating with the user community and providing operations updates as required. UCAR will provide this type of engineering support to the project so that TECRO's Designated Representative, NSPO,

can properly manage the satellites. This support will be required over the life of the mission.

Weekly teleconferences between UCAR, NSPO and JPL will also be conducted as required.

E. Ongoing JPL Firmware Support

JPL designed the Blackjack family of receivers. These receivers were built by Broad Reach Engineering (BRE) of Tempe, AZ. Under a separate arrangement, JPL will provide periodic updates and fixes to the COSMIC receiver firmware. AIT's designated representative, UCAR, will provide technical and contract management of JPL's work to upgrade firmware. UCAR will also contract with BRE to provide GPS hardware engineering analysis and anomaly resolution. The COSMIC constellation is expected to require software updates (to be provided by JPL) approximately every six (6) months for the remainder of the mission.

F. Technical Support for Assessing the Impact of GPS RO Data

To assess the impact of GPSRO data on the prediction of severe weather systems, such as typhoons and heavy precipitation episodes, AIT's designated representative, UCAR, will provide TECRO's designated representative, NSPO, up to eleven hundred (1,100) man-hours of technical support per year in support of the following tasks:

(1) Enhance WRFVAR and WRF/DART components of the TTFRI experimental forecast system at Taiwan's Taiwan Typhoon and Flood Research Institute (TTFRI);

(2) Improve performance of the GPSRO data assimilation for TTFRI regional model applications;

(3) Provide technical assistance for the systematic evaluation of the impacts of GPSRO data on the forecast of extreme weather systems; and

(4) Provide training and technical consultation for the assimilation of GPSRO data and forecast sensitivity of observation (FSO) at the TTFRI.

This assessment of the impact GPSRO data have on prediction of severe weather systems will improve the performance of TTFRI forecast systems when assimilating GPSRO data and thus will be beneficial to effective use of data from FORMOSAT-7/COSMIC-2.

G. Program Management Support

For the smooth operation of the COSMIC constellation and to maximize the scientific productivity of the mission, effective program management and close coordination are required between partners on nearly all aspects of the program. These tasks include management of, support for, and travel associated with payload operation, data distribution policy, data use agreements, data download frequency coordination, joint press releases, Technical Assistance Agreement (TAA), joint scientific meetings, collaborative research, financial and contract management, and education and outreach activities.