CHAMP - Chippewa Homestead Antenna & Mission Program

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INTRODUCTION

On January 28, 2021 the Michigan Aerospace Manufacturing Association (MAMA) announced the site selection for the Michigan Launch Initiative (MLI) Satellite Command and Control Communications (C3) center. The Chippewa Homestead Antenna & Mission Program (CHAMP) was selected to host, implement, and conduct the C3 functions for MLI's vertical and horizontal launch capabilities. This poster presents in detail the CHAMP phased implementation strategy to support the complex mission operations needs of the next generation Hybrid Architectures and Mesh Networks.

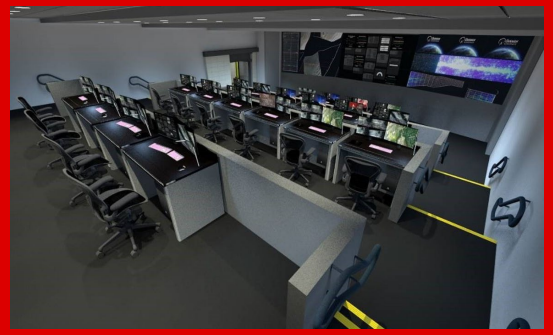
PHASED IMPLEMENTATION STRATEGY

Phase 0 – Homestead Pathfinder & Risk Reduction
Homestead is a full C3 ground station utilizing a high-gain 5.5-meter parabolic dish antenna supporting S-band uplink/downlink and X-band downlink for satellite communications and data processing. This smaller, fully operational ground station will be used to develop, test, and verify requirements and procedures for the larger CHAMP effort.

Phase I – CHAMP System Architecture Design & Development
Phase I will leverage key lessons learned and established architecture from the Phase 0 Homestead Pathfinder & Risk Reduction efforts already underway. System Architecture, Trades and Analyses, and CHAMP Mission Operations Center will commence leading to a baselined CHAMP capability.

Phase II – Implementation, Checkout, Joint-Exercises, & Certification
Phase II implementation will establish the baseline procedures, protocols, and processes for Mission Operations to support vertical and horizontal launch. Mission Operations is responsible for developing and implementing a workable, cost effective system that satisfies overall mission objectives and customer operations requirements.

Phase III – Mission Operations, Launch, Satellite Operations
All procedures, protocols, and safety measures have been tested and certified for operations. CHAMP operators will be trained and certified for mission operations, and have all necessary Mission Operation skills required for successful operations.



HYBRID ARCHITECTURE TESTLAB

CHAMP is designed to support on-orbit operations for satellite technology boundary missions. As the industry, to include government and commercial, continues to develop large constellations of smallsats, integrating these Hybrid Architectures to realize the full data chain (capture – ground – end user) will encounter a number of hurdles and roadblocks. Launching a representative sub-set of a desired constellation with unproven technical capability is often used as proof-of-concept missions. These missions, however, fail to fully validate the requirements of the end system. CHAMP's Homestead ground and control station will serve as a Hybrid Architecture modeling and simulation testlab with real-time on-orbit validation capability for proof-of-concept missions.

Complete with high fidelity asset modeling, simulation tools and state-of-the-art virtualization technology, CHAMP's Hybrid Architecture testlab will allow users to generate a high fidelity model of their desired constellation system. This "sandbox" structure can be integrated with on-orbit assets, creating real time training for operators, managers technicians, support staff and engineers to conduct simulated mission operation tasks and verify on-orbit effects. **CHAMP's hybrid simulated/hardware-on-orbit system will provide higher confidence system validations and valuable hands-on training.**

CISLUNAR DATA LINK

The Homestead antenna is a 5.5-meter prime focus reflector capable of transmitting in S-band and receiving in both S- and X-bands. Utilizing high-performance earth-station components with wide bandwidth, the system is capable of downlink rates exceeding 200Mbps from cislunar spacecraft and can be rapidly reconfigured for compatibility with current and future missions.

The average lunar access window from the antenna site exceeds 10 hours, allowing an average of 1 terabyte downlink capacity per access. **A high-capacity link like the Homestead antenna will help enable the next generation of spacecraft to send home the high-resolution data that we've been waiting for.**