

System Engineering

(A Case Study of NASA's Advanced Communications Technology Satellite)

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Introduction

The research report is developed to explore the competence of the ACTS (Advanced Communications Technology Satellite) project of NASA in terms of the usage of efficient designing and implementation processes. The stakeholders linked with the accomplishment of the ACTS project are highlighted along with elaborating the communication and collaboration process used among them to have effective project completion. Further, the method of decision-making method used within the selection and management of components of ACTS is analyzed and this is ultimately used to document learnings achieved from the project.

Key Objective of the ACTS Project and Respective Scope in Augmenting Communication Technology

The vital objectives of the ACTS project are highlighted as follows along with highlighting the respective scope in augmenting communication technology-

- The project focussed on exploring and implementing innovative techniques of the on-board process. The objective aided the ACTS project to develop the capability of digital processes for managing different communication tasks like decoding and recording easily.
- The project aimed at exploring the implication of the technique of multiple HBA (Hopping Beam Antenna). The finalization of the objective assisted the ACTS project in using and reusing allocated frequencies efficiently (White & Jean, 2011).
- The objective of the ACTS project was to augment the technology of communication exclusively for the Ka-band in order to develop progress in space. The determination of the objective aided the ACTS project to provide flexibility and agility in the enhancement of communication services of U.S. entities.

Challenges Tackled by NASA in Framing and Deploying ACTS

The vital challenges tackled by NASA in the framing and deployment of the ACTS project are-

- The team of the ACTS project faced technical complexities while using and implementing techniques like multiple HBA and on-board processing because of the requirement of time-time experiments.
- The team of the ACTS project faced signal propagation and interference-related challenges while using high frequency during the project management.

- The management of the ACTS project faced challenges in ensuring a collaborative framework across the operation because of the involvement of different disciplines like sociology and philosophy.
- The team of the ACTS project faced a budget limitation challenge as the respective approval made by Congress was limited.

Analysis of the Process of Integration of Different Subsystems of ACTS and Their Contribution to Communication Trait of the Satellite

The process that the team of the ACTS project used for integrating multiple subsystems is detailed below along with highlighting respective contributions to the satellite's capability of communication-

- The OBP (On-board Processing) subsystem was used to manipulate and process the boarded signal before reception. The manipulation process of the subsystem aided in optimizing the adaptability, agility, and efficiency of the overall link of communication.
- The population subsystem was used in the ACTS project to control the satellite for maintaining its respective position in space along with optimizing the link of communication (White & Jean, 2011).
- The deployment of subsystems aided in bringing a greater degree of reliability and stability to the service of communication.
- The link optimization innovation in the ACTS project enabled satellite to communicate with the destination at lower frequency even. The development of low frequency communication ability surged the power and creativity of space researchers to find a competitive approach to enhance the success trait of the satellite projects.

Examination of Coordination Essential Among Stakeholders of ACTS

All the stakeholders like the ACTS team, government agencies, and research institutions are necessary to get a collaborative framework as these aid in establishing a real-time communication channel or medium among them. The establishment of a collaborative communication platform helps all the stakeholders of the ACTS project to share information in real-time and this eventually aids in making innovative and informed decisions to get the goal accomplished (White & Jean, 2011). The project progress communication and changes related to coordination and collaboration are necessary among the stakeholders of the ACTS project as these aid in assisting each of them to know the exact progress of the task to take corrective decisions accordingly. The team members associated with the ACTS project are asked to work

in a collaborative framework using a cloud infrastructure. The availability of collaborative working approach enabled the stakeholders to track the changes in the ACTS project on time without any gap in respective communication which eventually aided in taking corrective action to avoid any project or quality gap.

Technological Innovations Deployed in ACTS and Respective Influence on Augmenting Communication Capabilities of Satellite

The vital innovations applied by the ACTS project in the field of technology are highlighted below along with detailing respective influence in the augmentation of the satellite's communication capabilities-

- S.B. (Spot Beam) technology was innovated by the ACTS project for focusing respective signals of communication on a targeted demographic area. The innovation aided in augmenting the communication efficiency of the satellite by optimizing and processing bandwidth as well as power (White & Jean, 2011).
- ACTS project developed frequency reuse technology for having similar spectrum frequency from different S.B. The innovation helped in augmenting the usage ratio of assigned spectrum which ultimately augmented the satellite's capacity.
- Usage of collaborative communication innovation has enabled all team of space research to work on the development of satellite in parallel style.
- The development of parallel working style has contributed to the satellite project's team to establish and manage effective communication during and after launch.

Scope of Interdisciplinary Team in the Accomplishment of ACTS

The contribution of the interdisciplinary team in the accomplishment of the ACT project is highlighted below-

- The innovative approach aided in collaborating with diversified experts in the designing and development process of the integration system. The collaboration of diversified experts aided in augmenting the innovation and creativity of the satellite and the overall ACTS project.
- The communication system experts aided in developing and innovating technology like frequency reuse and SB along with payload communication. The technical competence aided in augmenting the capacity, efficiency as well as capability of communication to the satellite.

- The discipline of cross-department aided in innovating and augmenting the issue-solving capabilities of entire departments. The development of innovation in solution enhancement aided the ACTS project to have a competitive design and system of communication.

Exploration of Decision-making Process Involved in the Assortment of Components and Technologies of ACTS

The process that the team ACTS project used for deciding on the selection and usage of components and technologies is highlighted below-

- The team of the ACTS project evaluated the final objective of the project and then used a backward analysis process to find efficient components and technologies.
- The backward analysis approach aided the team of the ACTS project in finding the best equipment and technologies in terms of cost and performance.
- A comparison was made by the team of the ACTS project between all components and technologies in view of metrics like cost, reliability as well as overall performance.
- The evaluation of competence in proportion style aided ACTS project to find cost-efficient components over and above technology for the success.

Highlight the Method Used by NASA for Addressing Potential Risks and Irregularities in the Operation and Development of ACTS

NASA castoff analytics (predictive) to explore the critical uncertainties linked with the ACTS project. The custom of the approach (analytical) assisted the ACTS project to find the probable risk based on historical related data. This empowered ACTS to take modest action to mitigate the development risk. The ACTS project team castoff a simulation line to address potential uncertainties in its operation. The simulation line enabled the ACTS project team to simulate the possible risk by forming a related scenario. The hypothetical testing aided in mitigating the uncertainties and this occurred because of the competence of the method in finding the probable causes and impact of each practice precisely by developing and testing related environment. The ACTS project team castoff timeseries analysis method for projecting how the practices related to the project will work in different scenario which eventually aided in finding the associated risk in the form of non-economic and financial metrics.

Long-term Impact of ACTS on the Satellite Communication Field and Role in Paving Future Advancement

The stimulus of the ACTS project is explored below highlighting its contributions to the space programme-

- The technological growth like SB and reuse of frequency has aided in assembly them as benchmarks for the future satellites.
- The improvement in the benchmark for the satellite system will help in developing and managing the performance of space communication systems in terms of reliability, performance, and efficiency (White & Jean, 2011).
- The ACTS project has aided in exploring the potential of frequency reuse in augmenting the efficiency of the spectrum. The role of frequency use in enhancing the frequency of spectrum will aid operators of future satellites and respective regulatory bodies to optimize resources of limited spectrum using a similar approach.

Lesson Learned from ACTS Project

I have learned about the implication of multidisciplinary integration with the support of the ACTS project learning and this has aided in knowing the path for improving the communication system as well as the design of the satellite using informed decisions. I have developed inferences regarding the importance of collaborative teamwork in maximization of efficiency and this trait will be used and prioritized in future projects to make it successful easily (White & Jean, 2011). The accomplishment of the ACTS project has enabled me to learn about the implementation of innovative technologies like S.B. and the reuse of frequency in the improvisation of systems or satellites in space. The learning about satellite performance improvement will assist in validating the overall technique of future projects precisely to make them successful by curbing challenges in advance.

Conclusion

It is summarized that the development and accomplishment of the ACTS project have significantly helped in developing a path for innovation and creative technology in the field of communication systems satellites. The usage of a cost-efficient beam optimization approach within the ACTS project has paved a path for risk-free system designing and communication management in future space programs. It is précised that the usage of S.B and frequency reuse techniques innovated by ACTS project has paved a path to the space researchers in strengthening respective communication system. The role of the technological innovation has

made the communication mode of satellite to work at low frequency as well which eventually augments respective competence in reaching and communicating targeted destination.

References

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