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SATELLITE COMPUTING NETWORKS ENABLING INDUSTRIAL USE CASES - A CASE STUDY ACROSS TIME HORIZONS

Abstract

The Industrialization of Space is a rapidly growing field, with new and existing companies seeking to use, operate, build and deploy space-based infrastructure. Satellite Computing Networks (SCNs) could be a key enabler for various industrial use cases, providing information technology / operational technology services globally at scale. This paper presents a comprehensive case study on the application of SCNs in three distinct industrial use cases, each addressing a different timeframe: short-term, mid-term, and long-term.

In the short-term, we examine the use of SCNs for device management and critical infrastructure backup links, focusing on the connectivity and coverage aspects. Our analysis highlights the application scenario of existing and upcoming communication systems and demonstrates how SCNs can provide reliable, high-bandwidth connectivity for industrial applications.

In the mid-term perspective, we explore the use of SCNs for hosting control tasks, making use of computing capabilities, resource orchestration, and digital twin technology to run small industrial computing loads in satellites. This enables the operation of control tasks for terrestrial use cases on the satellite, highlighting the benefits of computation services for real-time data processing and analytics.

Over the long term, we analyze the transfer of industrial infrastructure components to space, creating novel scenarios, for traditional process and automation industry and smart infrastructure for space manufacturing and lunar bases. This goes beyond serving Earth demands, enabling the creation of an innovative, space-enabled ecosystem of industrial infrastructure.

Our case study provides a taxonomy for analyzing industrial use cases benefitting from space infrastructure, identifies technical gaps, and highlights opportunities for future research and development. It also outlines theoretical and practical directions for SCNs advancement in industrial applications.