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Author: Dr. Markus Sauer  
Siemens AG, Germany

Dr. Florian Zeiger  
Siemens AG, Germany  
Mr. Hans-Peter Huth  
Siemens AG, Germany

SPACE BASED HYBRID EDGE CLOUD ARCHITECTURES

**Abstract**

The United Nations 2030 Agenda contains as one of its 17 sustainable development goals to “build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”. The key driver is that most of the global population and wide areas around the globe still lack access to state-of-the-art information and communication infrastructure. Besides the humanity aspect a second aspect is that a ubiquitous access to a modern ICT infrastructure is a must for many upcoming commercial and industrial applications. This global problem is challenging also industrialized economies on their path towards digital transformation. Industrial business faces a large demand from its customers for globally available on-demand computational resources and connectivity to its systems. There is no smooth, smart integration of global industrial business assets, available today. In addition, in cases of global or local crisis, high value industrial assets might get out of operation, or face significant performance decrease as critical communication, and on-demand computational resource might not be available anymore. As soon as assets are moving (e.g. ships), or there is high dynamic in the compute demands this gets even more difficult.

With the convergence of space, IT, and OT technology technologies and the development of standardized space systems, a globally accessible space-based edge-cloud infrastructure is of high value in order to address these challenges and business demands. Such a space-based solution tackles with one solution both challenges of accessibility of ICT infrastructure for everyone and the global industrial business use case demands. While the spaceborne applications like scientific missions, earth observations, global connectivity are well covered in literature and research, the topic of setting up a highly accessible edge-cloud infrastructure has only recently started to evolve, and only little concepts exist. Still for terrestrial highly dynamic compute environments, and applications like in the areas of tangible internet, industrial IoT and edge computing, a lot of work has already been performed.

This work provides an analysis of business relevant use cases beyond traditional earth observation and communication – towards fully digitalized industries, which are enabled or can significantly benefit by such space-based edge-cloud infrastructures. A detailed requirement analysis of an industrial grade space-based edge-cloud infrastructure is given along these use cases. A mapping of existing services, concepts, and solutions to these requirements is performed, both for terrestrial and space technology approaches. Finally, a comparative case study of solution concepts or architectures for space-based hybrid edge cloud architectures is presented.