European Core-Chip for Space Applications

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White Paper

COCHISA X-Band and Ka-Band Core Chips for Next-Generation Satellites

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Introduction

The space sector is undergoing rapid transformation. New satellite constellations, the growth of high-throughput communications, and the increasing demand for reliable Earth observation data are reshaping both the technical requirements and the economic landscape. Europe, through initiatives such as Horizon Europe, is investing in technologies that ensure autonomy, competitiveness, and leadership in this domain.

At the centre of this transformation lies a class of highly specialized components: beamforming core chips. These devices are critical to the operation of active phased-array antennas, which are increasingly used in both communications satellites and synthetic aperture radar (SAR) instruments. Unlike traditional reflector-based antennas, phased arrays rely on the precise electronic steering of beams, which requires a large number of integrated circuits capable of controlling phase, amplitude, and signal amplification across hundreds or even thousands of channels.

The COCHISA project is developing two families of such chips for the European space ecosystem: a X-band core chip optimized for Earth observation and radar imaging, and a Ka-band core chip designed for satellite communications and broadband connectivity. Both chips are being implemented in SiGe BiCMOS technology, which offers an excellent combination of RF performance, digital integration, and radiation tolerance. The project also pioneers cost-efficient packaging techniques, ensuring that the chips are not only technically competitive but also economically viable for large-scale deployment.

The X-Band Core Chip – Enabling Synthetic Aperture Radar

Synthetic Aperture Radar (SAR) is one of the fastest-growing segments in Earth observation. It provides imaging capabilities independent of weather and daylight, which is essential for continuous monitoring of Earth's surface. Applications span from climate science to security and from agriculture to disaster response.

The X-band core chip developed within COCHISA is designed to power the next generation of European SAR instruments. Its technical role is central: the chip must deliver precise phase and amplitude control across multiple transmit/receive channels, enabling coherent beamforming and the generation of high-resolution radar images. At the same time, it must meet demanding requirements for linearity, noise figure, power efficiency, and radiation hardness.

The applications of X-band SAR are extensive. In disaster management, it enables near-real-time assessment of damage after earthquakes, floods, or wildfires, providing crucial information to first responders. For climate and environmental monitoring, SAR satellites track ice sheet dynamics, measure sea-level changes, and observe deforestation processes. In agriculture and forestry, SAR supports precision farming by monitoring crop conditions and estimating biomass. Urban planning and infrastructure monitoring benefit from its ability to detect ground subsidence and assess transportation networks. Moreover, maritime surveillance uses X-band SAR for ship detection, illegal fishing monitoring, and oil spill tracking.

From a system perspective, the chip's scalability is vital. Assuming a typical SAR satellite employs 96 X-band core chips both the system-level importance and the large market potential become apparent. By developing a European solution, COCHISA directly addresses the need for ITAR-free, space-qualified beamforming chips, ensuring that Europe maintains sovereignty over this critical technology.

The Ka-Band Core Chip – Powering High-Throughput Communications

If the X-band chip is central to Earth observation, the Ka-band core chip is essential for the communications revolution in space. Operating in the 17–31 GHz range, Ka-band supports broadband internet, high-throughput satellite (HTS) services, mobile backhaul, and secure governmental communications. These missions increasingly employ active electronically steered arrays (AESA) instead of traditional reflector antennas, enabling satellites to generate multiple beams, adjust coverage dynamically, and serve thousands of users simultaneously.

This system architecture places immense demands on beamforming chips. Each antenna element requires precise control, and when scaled across large arrays and multiple beams, the chip counts rise dramatically. A single example illustrates this: an antenna with 256 elements and 16 beams requires 4,096 RF nodes. With a 4-channel beamforming chip, this translates to over 1,000 chips per antenna. For large telecom satellites and constellations such as Starlink, OneWeb, or Amazon Kuiper, which deploy hundreds to thousands of satellites, the global demand quickly reaches into the hundreds of thousands of Ka-band chips annually.

Beyond space, Ka-band beamforming chips have terrestrial potential. They are being explored for 5G and 6G backhaul, high-capacity hotspots, and fixed wireless access where fiber deployment is impractical.

Market Landscape and Competition

The global beamforming market is attracting strong investment and consolidation. A notable example is Qorvo's acquisition of Anokiwave in 2024 for USD 94 million, underscoring the strategic importance of beamforming chips for satellite communications, 5G, and radar. However, despite a variety of commercial analog and digital beamformers, only a handful are qualified for space use.

- Analog Devices offers the ADA3001S, one of the few radiation-qualified analog beamformers.

- Crane Aerospace & Electronics and TTM Technologies provide customized radiation-hardened beamformers.

- SatixFy, an Israeli company, focuses on digital beamformers and in 2024 secured an order exceeding USD 20 million for its Prime2 space-grade digital beamformer.

- Other players such as Teledyne, Renesas, and Qorvo provide RF components, but space-qualified beamformers remain rare.

This gap creates a unique opportunity for COCHISA. By delivering radiation-hardened analog beamformers in both X-band and Ka-band, developed entirely within Europe, the project strengthens regional supply chains and aligns with the EU's broader goals of strategic autonomy in space and semiconductors.

Strategic Impact

The impact of COCHISA extends across several dimensions:

1. Industrial and Commercial

- Equips European satellite manufacturers with ITAR-free beamforming chips.

- Reduces cost through innovative non-hermetic packaging while meeting reliability standards.

- Opens new markets in both space and terrestrial communications.

2. Scientific and Environmental

- Enhances Europe's capacity for climate monitoring, disaster management, and agriculture analytics.

- Directly supports EU flagship programs such as Copernicus NextGen and IRIS².

Conclusion

The COCHISA project is a cornerstone initiative for Europe's space sovereignty. By delivering X-band SAR chips and Ka-band communications chips, it provides enabling technologies for two of the fastest-growing satellite markets: Earth observation and broadband communications. With a design based on SiGe BiCMOS, innovative packaging solutions, and a 100% European supply chain, COCHISA addresses both technical requirements and strategic policy goals.

In doing so, it ensures that Europe is not only a consumer of advanced space technologies but also a global supplier of competitive, ITAR-free beamforming solutions. By the end of the project, the demonstration of TRL 7 X-band chips will mark a major step forward, paving the way for commercial exploitation and long-term industrial impact.

Sources

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- SatixFy, Prime2 Digital Beamformer Order Announcement, 2024