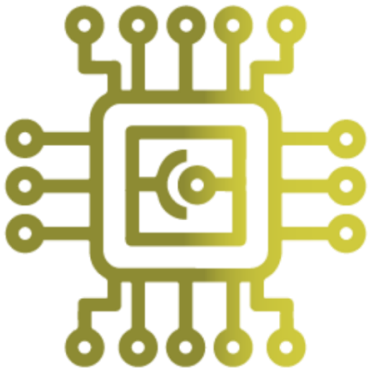
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CONVOLVE

Seamless design of smart edge processors

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Executive Summary

The CONVOLVE Exploitation and Valorization Plan presents a cohesive strategy for maximizing the real-world impact of the project's advanced edge AI technologies. Bringing together 19 leading organizations from industry and academia across Europe, the plan provides a pathway to convert innovative research results into commercially viable products and societal benefits.

Key Dimensions:

Industry Commercialization: Industrial partners drive the transition of project outcomes into market-ready solutions. Each partner outlines specific go-to-market plans in sectors such as automotive safety, space and defense intelligence, healthcare communications, secure edge computing, urban mobility, and AI hardware acceleration. These are backed by robust market analyses, product differentiation, business plans, and alliance-building for large-scale adoption and sustainable growth.

Academic Valorization: Academic partners play a crucial role in ensuring the enduring value and dissemination of CONVOLVE's technological advances. Valorization includes:

- Open Science & Technology Transfer: Release of hardware platforms, software frameworks, and compilers as open source, fostering wide reuse by academia and industry.
- Research Integration: Leveraging project outcomes as foundations for new research lines, securing patents, creating spin-offs, and enabling start-up creation.
- Education & Talent Development: Integrating new technologies into university curricula, master's theses, and research training to cultivate future innovators and highly skilled talent.
- Collaboration with Industry: Partnering with industrial players for deploying prototypes, optimizing technologies for real-world requirements, and facilitating continuous technology transfer.
- Public Dissemination: Publishing high-impact papers, participating in conferences and workshops, and sharing outcomes through open-access repositories to maximize scientific and societal reach.

Intellectual Property (IP) & Sustainability: A combination of patents, industrial secrecy, and strategic open dissemination is used to secure competitive advantage and promote continued innovation, while maintaining compliance with European standards on privacy, security, and data sovereignty.

Projected Impacts:

- Economic & Technological Growth: The plan positions CONVOLVE's outputs to secure leadership in high-value markets, generate new business opportunities, foster European technological sovereignty, and support job creation.
- Societal Benefit: Solutions developed deliver safer transport, energy-efficient infrastructures, advanced healthcare devices, sustainable urban mobility, and secure communications, directly addressing European regulatory, social, and environmental priorities.

- Lasting Legacy: Academic valorization ensures knowledge transfer into new research and education, underpinning ongoing industrial innovation and contributing to Europe's pool of scientific and technological excellence.

In summary, CONVOLVE's exploitation and valorization plan combines targeted industrial commercialization with comprehensive academic dissemination and technology transfer. Through strong academic-industry collaboration, strategic IP management, and a focus on education and open science, the project is set to deliver sustained economic, technological, and societal value—cementing Europe's leadership in edge AI and emerging smart systems.

1. Scope and Purpose

The purpose of this exploitation plan is to define a comprehensive approach for realising the full potential and impact of the project's outputs. This includes detailing the strategies, actions, and mechanisms that will be employed to maximize the commercial, technological, and societal value generated by the project outcomes. By identifying and pursuing the most effective pathways to market, this plan aims to ensure that the results are not only preserved and protected, but transformed into practical solutions, products, or services that deliver measurable benefits.

Furthermore, the plan outlines how these results will be adapted, refined, or scaled to facilitate broad adoption by industry partners, end-users, regulatory bodies, and other key stakeholders.

By proactively addressing potential barriers to uptake—whether technological, commercial, or regulatory—the exploitation plan aims to accelerate deployment and real-world adoption. This will generate economic value through new business opportunities, job creation, and enhanced competitiveness, while also delivering societal benefits such as improved safety, efficiency, and technological leadership.

Ultimately, this exploitation plan provides a structured framework to guide stakeholders through the journey from project completion to broad stakeholder engagement, market entry, and sustainable long-term impact, ensuring that the project delivers a return on investment both for its partners and for society at large.

2. Consortium Recall

The CONVOLVE overall consortium structure includes 19 partners out of 9 countries covering entire European continent and a good mixture of academic partners, large enterprises, and SME:

- Four Large Industry partners working on different segments, such as automotive, IoT, Space, consumer electronics and SW integrated HW for edge-based machine learning platform.
- Three SME acting as technology/solution providers for AI & ML based software solutions, HW security, Novel dynamic networks,...
- Ten universities that provide state-of-the-art knowledge of theory and allow its efficient transfer to applications.
- One association that provides direct outreach to the main stakeholders and potential users of the project results

It includes some of Europe's strongest research groups and industries, covering the entire design and value chain, namely:

- Technische Universiteit Eindhoven (Coordinator) (TUE)
- Thales Alenia Space España, S.A. (TASE)
- Technische Universiteit Delft (TUD)
- Katholieke Universiteit Leuven (KUL)
- Robert Bosch Gmbh (BOSCH)
- NXP Semiconductors Germany GmbH (NXP)
- Gn Store Nord A/S (GNA)
- Ruhr-Universitaet Bochum (RUB)
- Universidad De Murcia (UMA)
- Vinotion Bv (VIN)
- CognitiveIC Bv (CIC)
- Axelera.Ai (AXE)
- Confederation Of Laboratories For Artificial Intelligence Research In Europe (CLAI)
- Universite Internationale De Rabat (UIR)
- Eidgenoessische Technische Hochschule Zuerich (ETHZ)
- Friedrich Miescher Institute For Biomedical Research (FMI)
- The University Of Manchester (MAN)
- The University Court Of The University Of Edinburgh (UED)

3. Industrial Partners

This section provides a market analysis focused on the key technologies developed in CONVOLVE and their commercial applications. Through current data, industry insights, and emerging trends, it explores the growth opportunities available across different sectors, identifying the key drivers behind technology adoption and highlighting the specific challenges that each industry faces.

The analysis are structured around specific use cases or market applications, which serve as practical illustration of how these technologies are already transforming industries. They provide concrete evidence of the technologies' potential to not only enhance productivity but also create new revenue streams, reduce costs, and offer a competitive edge.

By connecting these insights with broader market trends, this section aims to provide a deeper understanding of the evolving market landscape, allowing the CONVOLVE consortium to better position themselves for long-term success. In a rapidly changing environment, this becomes essential for enhancing competitive positioning, capitalizing on new opportunities, and navigating the complexities of modern industry dynamics.

3.1. BOS

3.1.1. Market Analysis and Value Proposition

Target Market

With a revenue of €85 billion in 2024, Bosch stands as one of Germany's largest industrial enterprises, boasting a robust international presence and a workforce of approximately 420,000 employees globally. The Bosch Group dedicates around 35,000 employees to research and development, contributing 9% of its total sales. In 2024, the company filed around 4,500 patents worldwide, showcasing its commitment to innovation and technological advancement.

Bosch's extensive research and development efforts span various fields, including automotive technology, industrial technology, consumer goods, and energy and building technology. This diverse portfolio allows Bosch to remain at the forefront of technological progress and maintain its competitive edge in the global market. The company's dedication to innovation is evident in its continuous investment in new technologies and its proactive approach to addressing the challenges of the future.

Collaborating closely with vehicle manufacturers, Bosch is advancing driver assistance systems to enhance driving comfort and safety, aiming for a future of accident-free driving. Leveraging current technologies, future vehicles will be equipped to anticipate and support drivers more effectively, particularly in critical traffic scenarios. Bosch is developing sophisticated systems featuring high-resolution sensors for environmental detection and powerful control units that analyze sensor data in mere fractions of a second.

These advanced driver assistance systems are designed to provide real-time feedback and support to drivers, helping to prevent accidents and improve overall road safety. By integrating cutting-edge sensor technology with advanced data processing capabilities, Bosch aims to create a seamless driving experience that prioritizes safety and convenience. The company's vision for the future includes the development of fully autonomous vehicles that can navigate complex traffic situations with minimal human intervention, further reducing the risk of accidents and enhancing the overall driving experience.

In addition to its work on driver assistance systems, Bosch is also exploring new areas of innovation, such as connected mobility and smart infrastructure. By leveraging the power of the Internet of Things (IoT), Bosch aims to create a connected ecosystem that enhances the efficiency and safety of transportation systems. This holistic approach to mobility reflects Bosch's commitment to creating sustainable and intelligent solutions for the future.

Competitors Landscape

In the realm of driving assistance systems, Bosch faces competition from several key players who are also advancing their technologies in this space. Companies like Continental, Valeo, and Denso are prominent competitors, each bringing their own strengths to the market. Continental, for instance, has been investing heavily in sensor technology and artificial intelligence to enhance its advanced driver assistance systems (ADAS). Their focus on integrating various sensor modalities, including radar, lidar, and cameras, positions them as a formidable competitor. Valeo, on the other hand, has been pioneering innovations in ultrasonic sensors and has developed a range of products aimed at improving parking assistance and low-speed maneuvering. Denso, with its strong ties to the automotive industry, continues to push the envelope with its comprehensive suite of ADAS solutions, emphasizing safety and reliability.

Acoustic perception, a critical component of modern ADAS, is an area where Bosch is making significant strides. Companies like Aptiv and Harman International are notable

players in this niche. Aptiv has been developing advanced acoustic perception systems that enhance the vehicle's ability to detect and interpret sounds from the environment, such as emergency vehicle sirens or other road users. This technology is crucial for improving situational awareness and enhancing overall safety. Harman International, known for its expertise in audio and infotainment systems, is leveraging its acoustic perception technology to create more immersive and responsive in-cabin experiences. Still, those companies are focusing on infotaintment systems, not automated driving systems. The advancements in acoustic perception are essential for the development of more intuitive and effective driver assistance systems, and Bosch must continue to innovate to maintain its competitive edge in this rapidly evolving landscape.

Product Description and Differentiators

Bosch's harsh microphone systems stand out in the automotive industry due to their exceptional durability and performance in challenging environments. These systems are designed to withstand extreme conditions, including high temperatures, humidity, and vibrations, ensuring reliable operation throughout the vehicle's lifespan. Bosch utilizes advanced materials and innovative engineering techniques to enhance the robustness of their microphones, making them resistant to harsh weather and humidity.

Another key differentiator of Bosch's harsh microphone systems is their integration with the vehicle's overall acoustic architecture. Bosch leverages its expertise in sensor technology and signal processing to create microphones that seamlessly integrate with other in-vehicle systems, such as driver assistance systems. This holistic approach allows for more accurate sound detection and processing, enabling the vehicles to see where other sensor modalities could not provide the proper outputs. Furthermore, Bosch's commitment to innovation is evident in their continuous development of new features and improvements, such as adaptive algorithms that optimize microphone performance based on real-time environmental conditions. These advancements position Bosch as a leader in the automotive microphone market, offering products that deliver unparalleled reliability, clarity, and integration.

Benefits for customers

By integrating acoustic perception with other line-of-sight sensor modalities such as cameras, lidar, and radar, Bosch can bring its vision of highly effective driver assistance systems to fruition. This combination allows for a more comprehensive understanding of the vehicle's surroundings, enhancing safety and driving comfort. Acoustic perception adds an additional layer of environmental awareness, enabling the system to detect sounds that might not be visible to traditional sensors. This holistic approach ensures that the vehicle can respond more accurately to various driving scenarios, ultimately contributing to the goal of accident-free driving.

Moreover, implementing energy-efficient monitoring around the vehicle becomes more feasible with Bosch's harsh microphones. These microphones can continuously listen to the surrounding activities, providing real-time audio data. When the system detects significant auditory cues, it can activate more energy-intensive sensors, such as cameras, to capture detailed visual information. This selective activation strategy not only conserves energy but also ensures that critical events are recorded with high precision. By leveraging the strengths of both acoustic and visual sensors, Bosch's system can maintain optimal

performance while minimizing power consumption, making it a smart and sustainable solution for modern vehicles.

3.1.2. Exploitation Strategy and Business Plan

In the CONVOLVE project, Bosch is leading the development of automotive use-cases with a focus on acoustic perception, particularly in detecting the presence of emergency vehicles and tracking their location. This initiative aims to enhance situational awareness and safety by leveraging advanced acoustic sensing technologies. By accurately identifying and locating emergency vehicles, Bosch's systems can provide timely alerts to drivers, enabling them to make informed decisions and respond appropriately in critical situations.

To achieve this, Bosch is developing energy-efficient and low-latency Neural Network based algorithms for detecting and tracking emergency vehicles based on acoustic cues. These algorithms are designed to process audio signals in real-time, ensuring rapid detection and response. The emphasis on energy efficiency ensures that the system can operate continuously without draining the vehicle's power resources, while the low-latency aspect guarantees swift action when needed. This innovative approach not only improves safety but also optimizes the overall performance of the vehicle's sensor systems.

In autonomous driving systems, Bosch integrates these acoustic perception modules into more complex systems to complement other sensor modalities such as cameras, lidar, and radar. This integration is typically carried out in collaboration with vehicle manufacturers, ensuring seamless compatibility and enhanced functionality. Bosch plans to incorporate acoustic sensing as a featured component in its next-generation Advanced Driver Assistance Systems (ADAS) offered to Original Equipment Manufacturers (OEMs). By implementing this unique selling point, Bosch believes that its ADAS systems will stand out in the market, offering a distinct advantage over competing products through superior detection capabilities and enhanced safety features.

3.2. TASE

3.2.1. Market Analysis and Value Proposition

Target market

USE CASE: SURVEILLANCE AND VISUAL IDENTIFICATION

For satellite imagery, four primary target markets have been identified: Defense, Disaster Monitoring, Precision Farming, and Environmental Monitoring. Each of these markets leverages satellite-based technologies to address specific challenges, ranging from national security to the management of natural resources

Among these sectors, our analysis will focus on the Defense market, which not only stands out as the largest in terms of volume but also offers the greatest economic growth potential. The Defense industry's reliance on satellite technology is driven by the need for accurate, real-time data to support critical decision-making processes, national security operations, and global defense strategies. With the ongoing development of advanced imaging and remote sensing technologies, the ability to detect and monitor potential threats, track military assets, and assess battlefield conditions continues to evolve, further reinforcing the sector's heavy investment in satellite systems. Given the Defense market's significant

influence on technological advancements and budget allocations, it represents the most promising area for continued growth, making it a strategic focal point for our analysis.

Geopolitical shifts, emerging threats, and rapid technological advancements are driving a significant transformation in the defense sector. As global tensions rise and defense budgets expand, the demand for cutting-edge solutions is reshaping the industry. Future defense technologies, particularly more intelligent and autonomus systems, are emerging as critical components in national security strategies, placing innovative solutions at the forefront of military operations. The ability to process vast amounts of satellite imagery and sensor data in real-time, coupled with AI-driven analytics, provides military leaders with unprecedented situational awareness, enabling them to make informed decisions with precision and speed.

The market is at the edge of significant growth, driven by real-time monitoring, threat detection, risk mitigation, and proactive decision-making trends. Central to this evolution are advanced sensors, data analytics, artificial intelligence (AI), automation, and visualization tools, all of which significantly enhance situational awareness systems (SAS).

The global aerospace and defense market size was worth around USD 750 billion in 2022 and is predicted to grow to around USD 1388 billion by 2030 with a compound annual growth rate (CAGR) of roughly 8.2% between 2023 and 2030:

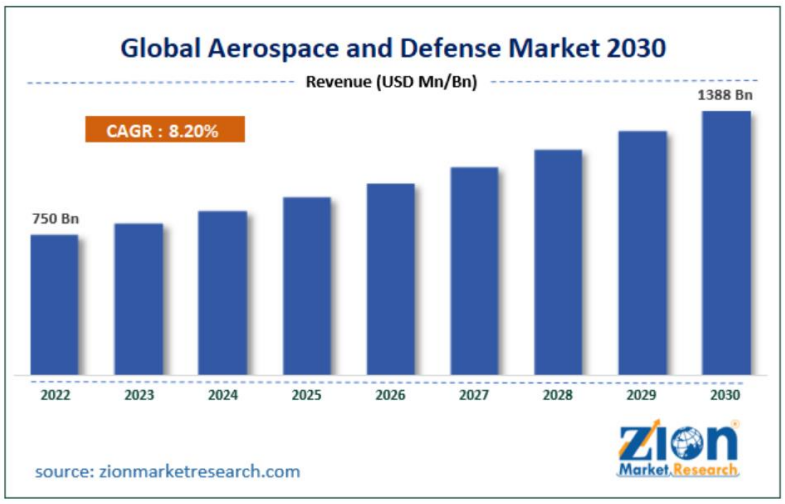


FIGURE 1 GLOBAL AEROSPACE AND DEFENSE MARKET

Based on the same source for market research, we can extract the following key takeaways:

- The growing investment in the aerospace and defense sector is expected to drive the revenue growth of the aerospace and defense industry.

- Based on the operation, the autonomous segment is expected to grow at the fastest rate over the projected period. SAS enhanced by AI represented 3% of total market figures in 2023 and is expected to grow up to 6% by 2030 (source: https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-aerospace-defense-market-report).

- Based on region, North America is expected to dominate the market during the forecast period (40% of market share). Europe represents 22% of the total market figures in 2024 (source: https://www.mordorintelligence.com/industry-reports/europe-aerospace-and-defense-market).

- Based on the type, the space defense segment is expected to hold a 7% market share over the forecast period (source: https://www.marketsandmarkets.com/Market-Reports/space-militarization-market-145370586.html)

Based on above market data and future projections, we derive the following estimations for CONVOLVE outcomes within the space defense segment:

Total Addressable Market (TAM): We define the TAM as the global market for Situational Awareness Systems (SAS) enhanced by Artificial Intelligence (AI) within the broader space defense sector. Based on the market figures and projections referred above, we estimate that the TAM will reach approximately 6Bn by 2030. This figure reflects the growing adoption of AI technologies in space-based defense systems, driven by both geopolitical pressures and technological advancements

Serviceable Addressable Market (SAM): Due to sovereignty concerns and regional constraints, it is important to narrow our focus to the European market. As nations prioritize domestic solutions to maintain control over critical defense infrastructure, the market size will be adjusted accordingly. Under these assumptions, the SAM is expected to reach 1,3Bn by 2030. This figure takes into account the increasing European demand for AI-enhanced SAS within defense applications, while recognizing the limitations imposed by regulatory and geopolitical factors.

Serviceable Obtainable Market (SOM): To estimate the SOM, several factors must be considered. First, the entire value chain involved in delivering AI-enhanced SAS needs to be accounted for. Currently, TAS in Spain contribution to an average SDR (Software Defined Radio) satellite represents approximately 3% of the total system value. This translates into a market share of 39Mn by 2030. However, it is also necessary to assess the competitive landscape. Given Thales group strong global expertise and positioning, we can conservatively estimate capturing around 30% of this market. This would result in a SOM of roughly 12Mn by 2030.

Competitor's landscape

The global aerospace and defense market is currently dominated by players like:

- Northrop Grumman Corp
- General Dynamics

- Raytheon Technologies Corporation
- Airbus Group SE
- The Boeing Company
- Lockheed Martin Corporation
- Raytheon Co
- Bae Systems plc
- General Electric Company
- Safran SA

In Europe, the market is highly dynamic, dominated by established players like Airbus, OHB, and Thales, which hold a significant share. However, they now face growing competition from an emerging "new space" ecosystem. Companies such as Loft Orbital, Iceye, and Satlantis, among others, are rapidly gaining ground, disrupting the traditional market structure. These innovative new entrants are not only challenging the status quo but also carving out their own space by delivering cutting-edge solutions that cater to the evolving demands of the industry. This competitive landscape is fostering innovation and driving growth across the European space sector.

Product description and differentiators

In the specific context of satellite imagery and remote sensing, several challenges must be addressed, all originated from the inherent limitations of capturing data from such great distances. The process of retrieving information and acting on it can be neither swift nor straightforward due to the following factors:

- Limited Communication Windows: The satellite link for transmitting images and data is established only a few times a day, or even weekly, depending on the satellite's orbit, inclination, and the capabilities of contracted ground stations.
- Large Data Volumes: The size of the images and data being transferred is substantial, which can strain communication links and delay processing times.
- Temporal Discrepancies in Analysis: Image and data analysis is conducted on the ground in a different time frame, often resulting in a lag between data collection and actionable insights.

These challenges lead to:

- Delayed Response Times: The ability to react to received images or data is significantly hindered, impacting decision-making processes.
- Inefficient Use of Communication Resources: Valuable bandwidth is wasted when images or data deemed invalid (such as those obstructed by clouds) are only identified after reaching Earth, leading to unnecessary transmission of non-useful information

Addressing these issues is crucial for enhancing the efficiency and effectiveness of satellite-based remote sensing applications.

Our objectives with CONVOLVE are twofold:

- Enhancing Remote Sensing Systems: We aim to integrate on-board AI capabilities into current remote sensing systems to analyze images in real-time. This technology will enable autonomous decision-making, such as filtering out invalid data before transmission or capturing additional high-resolution images of identified targets, ensuring only the most relevant and useful information is sent back to Earth.

- Optimizing Power Consumption: Recognizing that satellite power resources are limited and often inadequate for the energy demands of current ground-based AI algorithms, we focus on significantly reducing the power consumption of on-board AI. This will be achieved by utilizing specialized System on Chips (SoCs) designed for efficiency, as well as by implementing optimized neural networks. These advancements will ensure that the AI can operate effectively within the constraints of satellite power budgets while maintaining high performance.

Benefit for customers

Integrating AI as per CONVOLVE outcomes into remote sensing systems offers clear and substantial benefits for customers across various sectors.

First, the implementation of on-board AI enables real-time image analysis, allowing for faster and more informed decision-making. By autonomously filtering out invalid data and prioritizing the transmission of high-resolution images of identified targets, customers receive only the most relevant information. This efficiency minimizes delays in data retrieval and enhances operational responsiveness, particularly in critical applications like defense and disaster management.

Furthermore, the optimization of power consumption through specialized System on Chips (SoCs) and advanced neural networks ensures that the AI operates effectively within the satellite's limited power resources. This innovation not only extends the lifespan of satellite missions but also reduces operational costs.

Additionally, customers benefit from improved accuracy and reliability in data analysis, leading to enhanced situational awareness and actionable insights. The combination of real-time processing and energy efficiency positions CONVOLVE outcomes as a transformative solution, empowering customers to leverage satellite imagery more effectively.

Ultimately, these advancements provide a competitive edge, enabling our customers to respond swiftly to challenges, make strategic decisions based on accurate data, and optimize their resource allocation for better outcomes.

3.2.2. Exploitation Strategy and Business Plan

Our main target market in terms of economic growth potential is Defense. However, Disaster monitoring, Precision farming and Environmental monitoring, even if identified as secondary target markets, are equally important and not to be neglected.

For all of these markets, it is essential that we strengthen our Space Alliance with Telespazio, who is responsible for the downstream services. Telespazio plays a crucial role in maintaining direct relationships with end users, ensuring that they can fully leverage the benefits of our enhanced products. Collaborating closely with them will facilitate a more streamlined communication channel, allowing us to gather feedback and understand user needs better.

Traditional marketing and commercial strategies in the space sector are based on direct engagement with current and potential customers. This approach involves presenting our products and their enhancements through personalized interactions, which we believe is vital for building strong relationships and trust. This strategy is expected to remain effective in the short and medium term, and we will leverage it to showcase the advancements made possible by CONVOLVE outcomes. This proactive approach will ensure that we not only meet the

current needs of our clients but also anticipate future demands in a rapidly changing landscape.

Moreover, our enhanced products will enable us to target more institutional and commercial opportunities, particularly as they address evolving and increasingly demanding requirements for autonomy and efficiency. By responding to these heightened expectations, we can position ourselves as a leading provider in the market, opening doors to new collaborations and projects that further enhance our growth potential.

3.3. GNA

3.3.1. Market Analysis and Value Proposition

Target Market

GN Group is a global leader in intelligent audio solutions, specializing in hearing aids and communication headsets. With a strong presence in Europe, GN operates through its hearing division (GN Hearing) with brands like ReSound, Beltone, and Interton, and its audio division (GN Audio) with brands like Jabra and SteelSeries. This report outlines GN's target markets in Europe, focusing on the hearing aids and communication headsets markets, their sizes, growth drivers, and GN's strategic positioning, particularly in the context of the CONVOLVE project, which aims to advance Europe's position in smart edge-processor design.

The global hearing aids market stands at USD 8.76 billion (2023) and is projected to reach USD 14.67 billion by 2030 (≈5.4% CAGR). Europe alone contributes about USD 2.44 billion of this demand (2023) with a similar mid-single-digit growth, mirroring the continent's aging demographics (an estimated 196 million Europeans have some level of hearing loss).

Likewise, the worldwide unified communication and business headsets market is about USD 3.7 billion in 2024 and on track to double by 2033 (≈7.3% CAGR); the European business headset segment is expected to grow from roughly USD 1.78 billion (2024) to USD 2.67 billion by 2030 (~7% CAGR), fueled by a hybrid work boom (over 12% of EU employees worked remotely in 2024).

The global gaming peripherals market is substantial and growing rapidly, driven by the rise of e-sports and gamers demand. Estimates show this market reaching over USD 15 billion by 2026 with Europe representing roughly a quarter of worldwide demand. European gamers in particular show a strong preference for quality and innovation, investing in high-end accessories and fueling robust regional growth

GN's product portfolio aligns with these trends through smart edge-processing: its latest hearing aids employ on-device AI for real-time speech enhancement and even health monitoring, while its Jabra communication devices deliver high quality speech with AI-driven clarity to support modern workplaces. These innovations directly support EU priorities – enabling healthy aging and inclusive communication (empowering older adults with improved hearing), boosting workplace productivity (via better digital collaboration), and ensuring digital sovereignty (by processing personal data locally on the device) – all while addressing a large and growing addressable market with significant societal and economic benefits for Europe.

Competitors Landscape

Hearing Aids Competitors

GN Group's hearing division, competes in a market led by established players. Research suggests the main competitors are Sonova (Phonak, Unitron), William Demant (Oticon, Bernafon), WS Audiology (Widex, Signia), and Starkey, with Sonova likely holding the largest global market share based on historical data. These companies offer advanced hearing solutions, and GN is noted for gaining market share, particularly with innovations like ReSound Nexia.

Enterprise (Communication Headsets) Competitors

In the enterprise segment, GN's Jabra brand is a market leader in communication headsets. It seems likely that competitors include Poly (formerly Plantronics), Logitech, EPOS (formerly Sennheiser Communications), and Bose, known for their professional audio solutions. GN's annual report indicates Jabra maintains global leadership, with continued gains in video-related products, suggesting strong competition in this space.

Gaming & Consumer (Gaming Headsets) Competitors

For gaming headsets, GN's SteelSeries brand faces a competitive landscape with brands like Razer, HyperX, Logitech G, Turtle Beach, Corsair, and Astro. The evidence leans toward SteelSeries gaining market share in a growing market, as per GN's reports, competing on features like audio quality and comfort, popular among gamers and esports professionals.

Product Description and Differentiators

In the specific context of speech enhancement for hearing aids and professional telecom devices, several challenges arise from everyday acoustic environments and the constraints of wearable technology:

- Unpredictable Background Noise: Users encounter a wide range of competing sounds—cafés, open-plan offices, traffic—that vary rapidly in volume and frequency content.
- Real-Time Processing Constraints: To maintain natural conversation flow, noise suppression and speech clarity algorithms must run on-device with minimal latency, without off-loading to the cloud.
- Battery and Power Limits: Wearable devices demand multi-day operation on a single charge, yet sophisticated AI routines for noise reduction and voice enhancement can be power-hungry.
- Privacy and Data Security: Transmitting raw audio to external servers risks exposing sensitive conversations and personal health data.

These challenges lead to:

- Reduced Speech Intelligibility: Inconsistent noise filtering can make it hard for users to follow dialogue, especially in groups or noisy settings.
- Listening Fatigue: Poorly suppressed background noise forces users to strain to hear, causing fatigue and disengagement.

- Compromised User Trust: Reliance on cloud-based processing can raise concerns over privacy and data ownership.

Our objectives with CONVOLVE are twofold:

- Ultra-Low-Latency, On-Device Speech Enhancement: By integrating smart edge-processor AI into ReSound's hearing aids and Jabra's professional headsets, we enable real-time deep-neural-network filtering that adapts continuously to changing acoustic scenes—so users experience clear, natural speech without perceptible delay.
- Power-Efficient AI Architectures: Leveraging specialized low-power SoCs and optimized neural-network models, we will deliver advanced noise suppression and voice-focus algorithms within the tight energy budgets of wearable devices, extending battery life while preserving high performance.

Together, these innovations differentiate GN products in the market by offering seamless, privacy-preserving speech enhancement that keeps pace with real-world sounds, reduces listener effort, and reinforces GN's reputation as a customer-centric brand driven by cutting-edge edge-AI.

Benefits for customers

By embedding CONVOLVE-driven AI into Jabra headsets and ReSound hearing aids, users enjoy crystal-clear, real-time speech enhancement that adapts instantly to shifting noise environments—so conversations flow naturally without frustrating delays. On-device processing preserves privacy by keeping audio data local, while power-efficient edge-AI extends battery life for all-day use in offices, cafés, or on-the-go. The result is reduced listening fatigue, greater confidence in group settings, and seamless communication for both professionals and those with hearing loss. Ultimately, these advances give customers a distinct advantage: they can engage more fully, react more quickly, and trust their devices to deliver reliable, personalized audio clarity wherever they are.

3.3.2. Exploitation Strategy and Business Plan

Our main target market in terms of economic growth potential is enterprise communications—particularly contact centers and hybrid-work environments. However, hearing healthcare and gaming peripherals, even if identified as secondary segments, are equally important and not to be neglected.

At the heart of our strategy is embedding best-in-class speech-enhancement technology directly into our devices, ensuring world-class voice pickup that cements GN's reputation as the industry leader. By leveraging CONVOLVE-driven edge-AI, our hearing aids, professional headsets, and gaming peripherals deliver ultra-clear, natural speech in any environment—outperforming lower-end alternatives that lack real-time adaptability. This advanced on-device AI also opens up novel use cases—such as live language translation in meetings, adaptive audio profiles for gamers, and real-time hearing diagnostics—that further differentiate our products and expand market reach.

Traditional marketing and commercial strategies in the audio sector rely on direct engagement with current and potential customers—via personalized demos, pilot trials, and clinical consultations—which we believe is vital for building strong relationships and trust.

This approach is expected to remain effective in the short and medium term, and we will leverage it to showcase the ultra-low-latency, on-device AI that differentiates our speech enhancement solutions. This proactive stance will ensure that we not only meet the current needs of professionals, audiology patients, and gamers but also anticipate future demands in a rapidly changing landscape where compute costs are rising and Moore's Law is slowing.

Moreover, our CONVOLVE-driven enhancements—optimized neural architectures, event-based processing, and power-efficient SoCs—will enable us to pursue more institutional and commercial opportunities, particularly as customers demand greater autonomy, privacy, and efficiency. By responding to these heightened expectations, we can position GN as a leading provider of AI-powered audio solutions, opening doors to new collaborations and projects that further enhance our growth potential.

3.4. NXP

3.4.1. Market Analysis and Value Proposition

Target Market

NXP Semiconductors builds products for a smarter connected world. NXP is a leader in secure smart connected solutions for edge-based applications, innovating in the automotive, industrial, IoT, mobile, and communication domains. The company aims to position itself as a HW platform partner for secure Edge Computing & communication with its extensive portfolio of ultra-low-power microcontrollers to AI enabled high-performance processors. Convolve offers the unique opportunity to advance the basis for the development of future products on the basis of the desired research results, in order to meet the corresponding requirements with an ideally tailored portfolio and to make the best possible use of the market potential for the competencies in Europe.

This project empowers the creation of technological innovations to have a more self-dependent and sustainable automation in Europe. The market potential for AI on edge and security for electronic components and systems is enormous as it addresses numerous fields of application. According to Grand View Research [1]the edge AI market size was estimated at ~ USD 21 billion in 2024 and projected to be USD 66,5 billion by 2030, with a 21.7% CAGAR from 2025 to 2030, Figure 1. Similar market research such as Market.us [2]forecast a CAGAR of 24% reaching a market size by 2030 of USD 85 billion.

[1] Edge AI Market Size, Share & Growth | Industry Report, 2030
[2] Edge AI Market Size, Share, Trends | CAGR of 24.1%

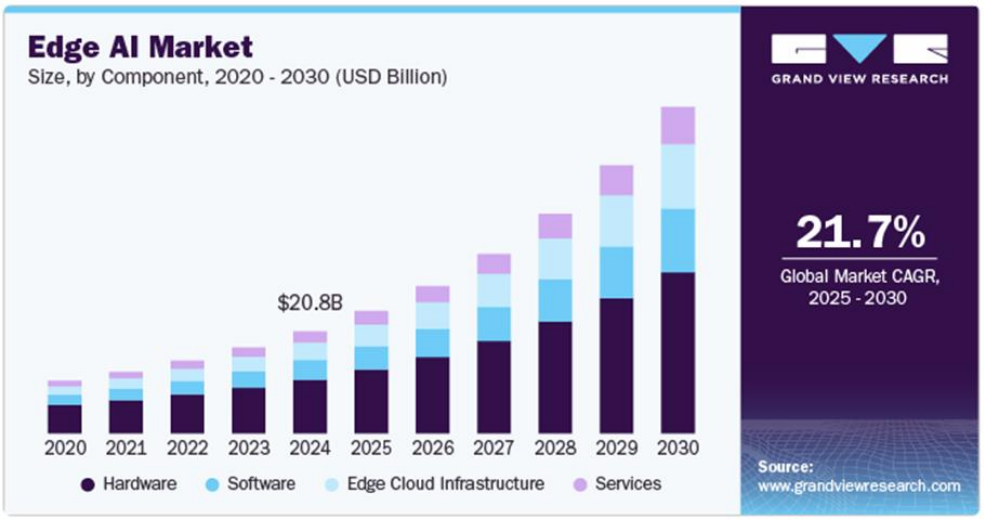


FIGURE 2 EDGE AI MARKET SIZE 2020-2030

Furthermore, the market share of Europe was 27,8% vs the 39,1% of North America and 23% of Asia Pacific. These numbers are significant, as they highlight the importance of projects like Convolve to drive innovation and technological sovereignty to compete in the global market.

The European AI innovation environment differentiates for the focus on privacy and security, relying on the EU AI act and GDPR. The principles of these policies are leveraged and pursued by the innate characteristics of edge computing. Features like low latency, energy efficiency and on-device inference with sensitive data are added values for a smarter connected world.

CONVOLVE also focuses on securing edge computing to drive user adoption and support market expansion. One of the transformative technologies on the horizon is quantum computing, which, despite its immense potential, poses a significant cybersecurity threat. Quantum systems could theoretically compromise widely used encryption methods such as RSA and ECC making current security irrelevant. In response to these risks, the **post-quantum cryptology (PQC)** market has emerged rapidly and is projected to have significant growth. According to Global Market Statistics, [3]the PQC market was valued at USD 504 million in 2024 and is expected to reach USD 70.8 billion by 2033, reflecting a com CAGR of 41.5%.

The RISC-V market is undergoing rapid expansion, driven by growing demand for open-source, customizable processor and accelerators architectures across sectors such as AI, automotive, IoT, and data centres. According to RISC-V International, the market for RISC-V IP and software is projected to reach USD 1.07 billion by 2025. Additionally, SHD Group forecasts a CAGR of approximately 40% for RISC-V IP between 2022 and 2030.

Competitors Landscape

NXP Semiconductors is an integrated Device Manufacturer (IDM), meaning the company design chips and produces inhouse part of their supply. The main competitors on edge AI chips are part of the IDMS and Fabless Chips segments from the semiconductor industry, Figure 2.

[3] Post Quantum Cryptography Market Size, Trends and Forecast | 2025-2033

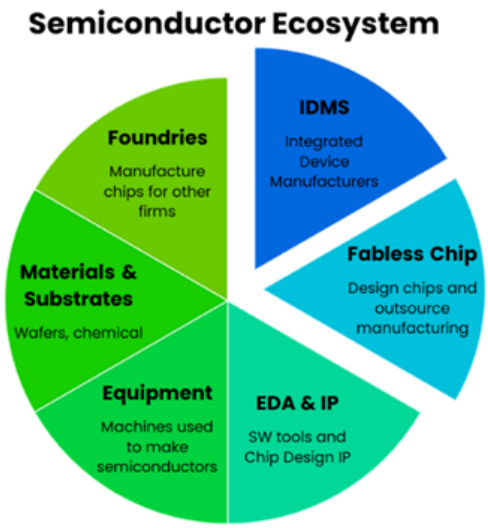


FIGURE 3 TYPES OF COMPANIES IN THE SEMICONDUCTOR INDUSTRY

- Intel Corporation
- Qualcomm
- Texas Instruments
- Infineon Technologies
- Renesas Electronics
- STMicroelectronics
- NVIDIA

Product Description and Differentiators

NXP Semiconductors delivers a comprehensive portfolio of edge computing solutions through its EdgeVerse™ platform, designed to provide secure, scalable, and energy-efficient intelligence across industrial, automotive, and IoT domains. This includes industrial-grade microcontrollers and microprocessors equipped with end-to-end security and integrated ML/AI acceleration capabilities.

As a leading automotive supplier, NXP also offers advanced computing platforms tailored for software-defined vehicles (SDVs) and autonomous driving systems, supporting real-time processing and functional safety. Furthermore, NXP continues to evolve its ecosystem by enabling developers with tools to deploy AI workloads directly on its hardware platforms.

NXP has recently introduced products based on the RISC-V architecture, such as secure authenticators and digital product passports, reflecting its commitment to innovation and flexibility in processor design. However, widespread industry adoption of RISC-V remains in its early stages, as the ecosystem continues to mature and gain traction across various application domains. NXP has also been developing in-house scalable accelerator architectures designed to deliver efficient machine learning (ML) performance at the edge. Integrating this across the portfolio of microcontrollers and application processors, to offer optimized power and performance for a wide range of edge AI applications.

The Convolve initiative, where NXP collaborates with partners to explore real-world use cases and define the evolving requirements of edge AI allows to steer better the development of these products. This approach ensures that the hardware platforms are not only technically advanced but also aligned with the practical needs of developers deploying AI in industrial environments.

Benefits for customers

During CONVOLVE a constant has been the use of the open-source RISC-V architecture. A significant advantage of this Instruction Set Architecture is that it can be used and shared from universities and startups to large corporations such as NXP. This alternative to licensed architectures such as ARM or X86 allows countries and entities to innovate without IP licensing costs and barriers.

These characteristics drive a better technology transfer from research to industry and consequently improving the time to market. The research, technical achievements, and interaction with the different sectors and academia during this project will be leveraged by NXP to grow its portfolio and thus continue to provide innovative solutions after the project. For security technology and AI at the edge, NXP wants to position itself to gain the necessary experience at this early stage and to analyse and integrate user requirements. Here, a pioneering role is to be taken at an early stage.

3.4.2. Exploitation Strategy and Business Plan

During the project we have been able to observe different flavors of AI and security accelerators that can be incorporated into commercial solutions. This configurability offered by RISC-V makes it possible to address hardware needs that support rapid innovation in emerging AI algorithms, models, and use cases.

Integrating RISC-V and the learning outcomes into our future chip development roadmap presents significant strategic benefits, including greater flexibility, scalability, cost efficiency. By capitalizing on RISC-V's open architecture, we can strengthen our position as a technology leader and maintain long-term competitiveness in the semiconductor landscape.

The security technologies explored during CONVOLVE have deepened our expertise in implementing post-quantum security at the edge. Concurrently, the research conducted by our partners on composability and side-channel protection for AI accelerators positions us at the forefront of emerging security trends.

3.5. VIN

3.5.1. Market Analysis and Value Proposition

Target market

Urban mobility plays a fundamental role in meeting the EU objectives of economic competitiveness, social cohesion and sustainable growth. The constant interaction between unprotected or vulnerable road users and powered vehicles creates situations where people are regularly put at risk. Annually, there are more than 120,000 fatalities and 2.4 million injuries in traffic accidents in the EU, where 37% of the total occur in urban areas and with vulnerable road users (pedestrians and two-wheelers) accounting for almost 70%

of the victims[4]. European cities also need to find ways and means to sustainably reduce the environmental impact of urban traffic which is responsible for 40% of the total CO2 emissions. In addition, the higher expose in urban areas to NOx gasses and fine particulate (ø < 2.5 µm) have devastating effects on heart disease, asthma and lung cancer, causing more than 500,000 premature deaths in Europe every year[5],

Improved urban mobility will also have far-reaching impacts on the EU economy, affecting its competitiveness and technological leadership, its growth potential and labour markets. The cost to the economy of congestion and delays is an increasing trend and there is real pressure to improve road-based travel. Congestions in the EU are often located in and around urban areas and costs +110 B€ (1 % of the EU's GDP) annually[6].

With the advances in communication technologies, Transportation Management Systems (TMS) now help users in a wider array of applications by building a whole traffic applications ecosystem. The global TMS market was valued at 14.99 million$ in 2014 and is expected to reach 43.82 million$ in 2034, growing at a CAGR of 11.46% between 2019 and 2024[7].

TMS market size is primarily driven by the global rise in cities' population, oncoming self-driving vehicles and the rising awareness regarding the social and economic losses that economies incur due to urban traffic jams. Additionally, there is an increasing need for more robust data for bicycle, e-scooters and pedestrian transportation modes through expert algorithms that complete the urban mobility view and place the safety of vulnerable users as a priority task. Europe is estimated to be the leading region in TMS deployment owing to supportive government initiatives for developing smart cities and smart transportation projects. Furthermore, high adoption of cutting-edge technologies, such as route guidance software and smart signaling, are also estimated to foster the growth of the TMS market. However, the lack of standards and uniform technology and security-related issues are projected to be the major constraints.

Addressable and Obtainable market. It is estimated that there are around 4,000 cities in the world have over 100,000 inhabitants[8], of which 325 are in Europe. Taking into account these figures, and considering a targeted market share for permanent projects with 5 to 10 cross-sections (over 40 sensors) of 15%, we forecast a total of around 48 European cities fitted-out with our technology after the first 3 years of commercialization.

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[4] https://ec.europa.eu/commission/presscorner/detail/en/memo_19_1990

[5] https://www.eea.europa.eu/publications/europes-air-quality-status-2023

[6] https://www.eca.europa.eu/lists/ecadocuments/ap19_07/ap_urban_mobility_en.pdf

[7] https://www.precedenceresearch.com/transportation-management-systems-market

[8] https://brilliantmaps.com/4037-100000-person-cities/



FIGURE 4 ADDRESSABLE AND OBTAINABLE MARKET

Competitor's landscape

To the best of our knowledge, there is no solution in the market offering a smart integrated solution that can communicate with traffic control systems and can simultaneously monitor and manage traffic data of motorized vehicles, cyclists and pedestrians, as ViSense does. Indirect competition may come from "Traffic Control Integration Providers" offering integrated mobility services and related control systems. This market is dominated by a few big companies such as Siemens, Indra and Swarco. Compared to them, we offer a more specific solution and with a much more competitive price. Applied TMS are distinctively diverse, offering highly customizable solutions on a project-by-project basis. Table 1 shows the main market players operating in EU that may compete with ViSense and compares some of their operational features.

Company Product	Real time	All traffic participants	Accuracy	Data analysis					Deep-Machine-learning
				Counting Classific. Velocity Direction	Traffic behaviours	License Plate Recogn.	Peak times Near-miss	Environ. zones.	
Dufec (NL)	✓	NO	<80%	✓	NO	✓	NO	NO	NO

Scapeye (NL)	✓	NO	98%	✓	NO	✓	NO	NO	NO
DataFromSky (CZ)	NO	NO	>95%	✓	✓	✓	✓	NO	✓
Citylog (FR) **SmartTraffic-td**	✓	NO	>95%	✓	NO	NO	NO	NO	NO
Eco-counter (FR) **Urban Multi**	NO	NO	-	✓	NO	NO	NO	NO	NO
FLIR Teledyne (USA)	✓	NO	-	✓	✓	NO	NO	NO	NO
MioVision (CAN)	NO	✓	95%	✓	NO	NO	NO	NO	✓
ViNotion (NL) ***ViSense***	✓	✓	99%	✓	✓	✓	✓	✓	✓

TABLE 1 MAIN MARKET PLAYERS OPERATIN IN EU

USE CASE: TRAFFIC MANAGEMENT

Product description and differentiators

ViSense is an outstanding TMS that collects and processes traffic data in real-time (24/7 measurements) using high-grade camera sensors (pre-installed or new ones) in combination with our in-house developed video analysis units. By means of Artificial Intelligence (AI) algorithms such as deep-learning (for object recognition) and machine learning (for vehicle tracking and data analysis), we can evaluate the behaviour of all traffic participants (including pedestrians and cyclists) for mobility analysis and traffic control. ViSense offers a comprehensive approach through our own firmware architecture and AI-based Video Content Analysis (VCA) using edge-computing (high privacy protection). Our competitive advantages rely on the high accuracy (detection>99%), wide range (up to 30-meter width lanes) and varied stream of valuable dynamic insights: counting, classification, direction, speed, distances, lane specific data, traffic behaviour, near-collision detection, queue length, densities, environmental zones (i.e. traffic restriction zones), etc.



FIGURE 5 PRODUCT DIFFERENTIATORS

The novelties of our approach can be divided into HW and SW innovative features:

HARDWARE COMPONENTS

Our solution consists of two HW elements:

- **The camera.** We can work with pre-installed cameras or install new ones. In case of using pre-existing traffic cameras we have to perform a previous calibration and adaptation to ensure the highest quality input data and adapt their viewpoints since most of the cameras already installed in cities are used for surveillance and thus their viewpoints are not optimized for traffic insights. Off-the-shelf cameras are coupled to the video processing unit, where using a RTSP protocol their image streams are read and analyzed by the SW.
- **The video analysis unit** incorporates the future CONVOLVE neural network for deep-

learning and provides high-performance with low-power requirements. This feature allows for a couple of years of counting history data, and up to a month of trajectory and speed analysis. We can also offer an on-site/local data recorder that extends the storage history to practically infinite. The different components are off-the-shelf, but the assembling and the incorporation of our firmware is carried out in-house. The video analysis unit runs completely on top of a Linux kernel and is programmed in a C++ environment.

SOFTWARE

The core of ViSense technology is our unique in-house design Video Content Analysis (VCA) SW which is powered by deep-learning algorithms for object recognition and tracking for domain-specific applications, i.e.; motorized vehicles, bicycles, e-scooters and pedestrians with data about speed, density, trajectory, driving lane classification, bicycle-to-car distances, etc.

We have developed a modular SW architecture so that upcoming dedicated HW platforms for deep-learning can be easily integrated. The figure below shows the ViSense data flow

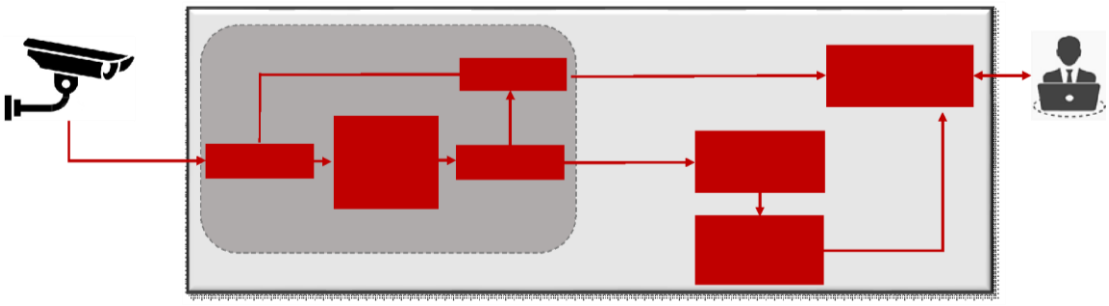


FIGURE 6 DATA FLOW

Overall, ViSense overcomes the limited range of information offered by current TMS by providing detailed urban mobility data and analysis, on the basis of which traffic authorities and companies can take efficient measures to manage urban traffic and/or directly control it by for example integrating ViSense with traffic lights. Thus, it is expected that urban mobility action plans based on the statistics delivered by ViSense analysis will have a direct impact on the major issues that presently concern European cities.

Benefit for customers

In an age of co-modality, when the car is getting smarter and smarter, and the types and sources of data larger and larger, new economic models combining different transport modes and services emerge with ITS as a core element (e.g.; travel information, planning services, smart ticketing, traffic status, cooperative systems, etc.). Advanced computer vision technologies are merging with AI to create applications with increasingly human-like decision-making using visual data.

By 2040, there will be more than 33 million autonomous cars in the EU. Although these vehicles are equipped with several sensors, they miss crucial information about the dynamics in a city such as moving pedestrians, bicycles and objects out of the line of sight of the vehicles. Likewise, the growing relevance of soft transport modes (cycling and walking) has put city authorities into high pressure for guaranteeing their safety. Since perceived crash risk and lack of safety are found to be the most relevant discouraging

factors for using urban bicycles, the enhanced urban traffic security derived from ViSense will surely impact positively in bike adoption. Helping cities' authorities to deal with the forthcoming challenges associated with traffic safety and sustainability in cities cannot wait any longer. The deep-learning capability of AI-based TMS will significantly reduce the effort required for analyzing traffic data and will empower traffic authorities with actionable insights thanks to sophisticated and efficient traffic analysis.

ViSense base-technology has already been validated by early users (see Stage of Development below) and received the active interest of several entities. Our experience in this sector suggests a rapid implementation for our technology, which from the conceptual point of view is ready-for-market and whose feasibility has been completely confirmed. We have absolute certainty that there is a strong demand for advanced TMS that allow increasing urban traffic safety, sustainability and mobility, complying at the same time with the progressively stringent GDPR regulations.

In the following table we summarize the main benefits derived from the implementation of ViSense and examples of economic returns for each customer niche.

Customer	**Municipalities** **Traffic Authorities**	**Road Infrastructure Tenders Applicants**	**Traffic Consultancy Agencies**
Need	***Improve traffic flow, ensure safety and reduce emissions.***	***Cost-efficient planning and maintenance operations.***	***Accurate and useful data.***
Value	• Identification of hotspot areas. • Reduction of traffic fatalities. • Safe integration of vulnerable road users. • Reduction of congestions. • Improve urban freight flows. • Air quality, public health. • Easily deployed on existing smart cameras. • Privacy by design: Images are analysed and deleted, not stored.	• Analysis of the behaviour of all traffic participants. • Valuable insights in complex urban traffic scenarios. • Post-intervention data. • Best accuracy in the market. • Deep insight into traffic dynamics. • Analysis of wide areas per camera. • Improving bike infrastructure. • Easily deployed on existing cameras. • Data-driven decisions on interventions, thus reducing costs.	• Real-time traffic monitoring. • Analysis of the behaviour of all traffic participants. • Valuable insights in complex urban traffic scenarios. • Wide variety of data analysis. • Suited for crowded situations. • Best accuracy in the market. • Range up to 18 m (four lanes). • Work in- and outdoor under varying weather and lighting conditions.

TABLE 2 MAIN BENEFITS AND ECONOMIC RETURNS

Key innovations

Camera video is the best way to collect traffic data because it is easy to install and can support a wide variety of applications. However, until a few years ago, video detection and analytics solutions were not good enough.

State-of-the-Art technologies offer deep-learning and machine-learning models that employ AI techniques for video analysis for traffic purposes. These systems can "truly understand" the traffic environment, providing more robust and reliable insights (false detections shrink below 2-3%). Nevertheless, the need of cloud- or server-based implementation implies serious concerns about privacy protection data, and to date, most of the AI-based solutions are not able to recognize cyclists, e-scooters and pedestrians with the efficiency required by TMS. Moreover, server-based processing demands a high bandwidth capacity for streaming the video and causes additional latency.

ViSense goes one step ahead, detecting the presence and movement of vehicles, pedestrians and cyclists in real-time (24/7 measurements) and using edge-computing (high-privacy protection). Taking pedestrians and bicycles into account, our throughput increases by 20% compared to conventional solutions. Deep- and machine-learning algorithms require a large data set in order to properly train AI. In this sense, ViNotion has accumulated a large video traffic data repository over the past 5 years. Our technology has already been validated in different projects, showing the highest accuracies in the market (<1% false detections) for the recognition of all traffic participants under real conditions of shadows/reflections, darkness/tunnels, rain/snow/fog, etc.

To allow large scale deployment, it is important to make the sensor solution more cost efficient, in a smaller form factor and consuming a fraction of the power consumption. Hence, these are the innovations that are addressed by CONVOLVE.

3.5.2. Exploitation Strategy and Business Plan

USE CASE: TRAFFIC MANAGEMENT

Intellectual Property Exploitation

Our IPR assets include the completely developed in-house SW of the video processing unit. This overall architecture connecting the different components is our unique know-how subjected to protection via patents. However, since patenting SW solutions is hardly addressable in Europe, our main IP protection strategy will be based on industrial secrecy and Non-Disclosure Agreements (NDAs) with any other party and/or employees involved in ViSense development.

Up to now we have not registered our IP rights, but we distribute our HW devices with secured firmware. Nonetheless, our IP falls directly under the EU Computer Programs Directive 2009/24/EC, which gives us protection within Europe. Likewise, our value proposition is also protected by the extensive R&D knowledge, the time & resources required to copy our approach, and the high brand reputation achieved as a pioneering SW provider. Several actions will be taken to further protect the IPR related to code protection and intangible knowledge such as the synchronization logic and the encryption of NN networks in embedded forms. These knowledge protection measures will be used to develop our solution, shield its distinctive technology and achieve the described competitive advantages.

Commercialization plan and strategic partnerships

We plan to use temporary projects as a launch platform to penetrate new markets (flagship projects), bringing visibility and then switch to permanent deployments. In this line, we also schedule to commercialize low-priced demo systems with a support service to engage potential customers by validating our product and generating credibility. Equally, we would need to position ViSense in the market by a rapid communication & dissemination campaign. Our go-to-market planned roadmap is based on the following criteria: (i) Countries/regions receptive to adopting innovative TMS, (ii) EU cities with a significant share of bicycles as urban transportation mode, (iii) our existing network of customers and partners.

The first five years of commercialization have been divided into 4 stages, considering market research studies and our commercial prospects.

1. Year 1 – Expansion into our home market: The BENELUX Region. As a company established in Eindhoven, the BENELUX region is our natural market, where we have already created a strong and close network of partners. We have executed temporary projects with Dutch and Belgian municipalities, which have shown interest in turning those temporary campaigns into permanent ones. The precise knowledge of industry standards and regulations will ease the rapid expansion of our solution.
2. Year 2 – Scandinavian countries, Germany and Austria. We will expand into leading regions investing in sustainable mobility. Cities like Copenhagen, Stockholm, Vienna and Berlin are among the most bicycle-friendly cities in Europe. Thereby, we can maximize our unique competitive advantage of being the first company offering a holistic approach that includes the monitoring of bicycles and pedestrians. Nordic countries are the most digital economy in the EU, and initiatives like Digital Growth Strategy, will stimulate companies to use data technologies for urban mobility improvements.
3. Year 3 – France, Spain and European Eastern countries. In the 3rd stage we will target European regions where authorities have already launched campaigns to promote the use of bicycles in urban areas. With the aim of halving injury and fatality rates for cyclists, these countries plan important investments in cycling transport infrastructure. In France, Urban Planning Law (ALUR) promotes the implementation of sustainable urban mobility plans across the territory. In Spain, new urban transport plans are emerging in the big cities for their public transport infrastructure, park and ride and bicycle schemes. Eastern countries such as Czech Republic and Hungary, have become involved in awareness raising workshops and are promoting sustainable transport planning where urban mobility improvement is tackled as a main priority.
4. Year 4 and 5 - Expansion outside the EU. We will initiate our expansion overseas in North America, a region that holds 21% of the total TMS market, and the south-east Asian region which anticipates a smart mobility applications market as large as ≈70 billion$. We will focus on the largest cities where mobility is a big issue and where TMS are well-accepted. Examples of operational smart traffic projects in North America are: Toronto (currently testing innovative technologies), Miami (a total of 300 new smart traffic sensors) and Virginia (on-demand traffic and transportation intelligence plans). Regions in South-east Asia are spending heavily on new smart solutions to respond to the dense growth in their urban areas[9].

ViSense is a component of a broader solution, so we need to closely cooperate with partners that complement our skills and satisfy the end-user´s needs. We are completely aware of

[9] https://www.mckinsey.com/capabilities/operations/our-insights/smart-cities-in-southeast-asia

the need to internationalize our sales to become more resilient to market fluctuations and plan a high-level expansion of commercial partners. We understand that it is essential to carry out a bottom-up approach to the new markets, engaging our stakeholders through a consistent and rationalized growth. We will approach all partners personally, by regular face-to-face meeting in order to discuss/update our collaboration agreements and provide valuable insights of our business model. During the last years and through the collaboration in different projects, we have created a strong network of renowned stakeholders along the whole value chain, who have stated our game-changing approach and supported us in the last stages of development. We plan to update our partnership landscape in order to strengthen the international commercialization strategy.

Business Plan

Roadmap

The ViSense product is already being developed. The R&D aims to enhance the performance of the current solution by re-defining our in-house design and incorporating new tools. By integrating with other platforms and improving data collection and processing (multi-camera and database), we will achieve strong tools that ensure continuous development through a continuous data feedback cycle. Dissemination and exploitation, with pre-commercial purposes, is also necessary to maximize awareness among potential users and partners. Testing and validation is an essential step to assure the robustness of the technology at the desired TRL8.

Financial projections

Considering different revenue streams, a financial forecast for the first five years of commercialisation after ViSense has reached TRL 8 estimates the following impact on ViNotion accounting. It has been moderately estimated to install 4 Traffic Control Systems in year 1, steadily increasing up to 160 (≈6,400 sensor units) in the fifth year. Likewise, 4-years DaaS Projects (cumulative) and temporary Mobility Research Services has been forecasted to increase from 4 projects and 10 monitoring points, respectively, in the first years to 40 projects and 150 monitoring points in the fifth. Considering these revenue streams, we estimate an accumulated gross income of 33,6 M€ along the forecasted period. Seeking a continuing development in line with our R&D strategy, we plan to invest a total of 1,47 M€ (420 k€ in the first year) in the upgrade of the product (software, hardware, communications, etc.). For the commercialization costs an increase from 300,000 € to 800,000 € has been projected as the target market area grows.

Viability analysis (ROI)

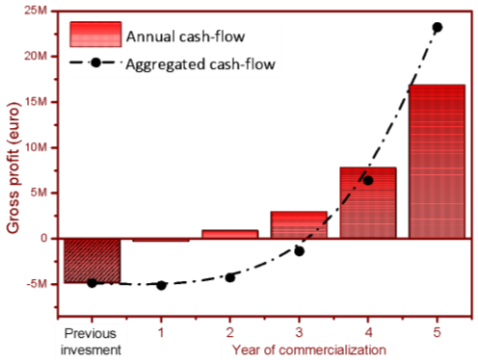


FIGURE 6 VIABILITY ANALYSIS

Accordingly, the total gross profits will increase from losses (minus 265,000 € in the 1st year) to benefits of 16.8 M€ in the 5th, accumulating a total profit of 28 M€. Considering a total investment of 5.55 M€ and an expected 5-year accumulated profit of 28 M€, the calculated Return of Investment (ROI) is 5.0. Calculated break-even point will be achieved on the first quarter of the 4h year of commercialisation when the accumulated cash-flow will turn into earnings

Funding strategy

We estimate the funding requirements for ViSense development to TRL8 for the next two years at 500 k€. This finance requirement will be resourced from the reserves of ViNotion.

In parallel to the completion of TRL6-TRL8 activities, we will also perform the required works and tasks that bring our technology to TRL9. These activities will focus on evaluating and establishing the requirements and procedures to widen the installation of ViSense to an industrial scale-up approach, including quality assurance procedures, supply chain optimization, procurance of certifications, service level agreements, etc. To this end, we have reckoned an additional budget of 300,000 € that will also come from our own funds.

Risk analysis

The ViSense implementation project is a complex mission that can benefit from a risk assessment approach that helps ensure its correct functioning under the expected levels of efficiency and highlight weak links in the value chain. The table below shows a detailed risk assessment by classifying those into **technical, commercial, financial and legal,** describing also specific contingency measures.

Risk assessment and contingency plan.

	Description of risk	Likelihood	Impact	Contingency measures
Technical	**Exclude the part of market that has pre-installed cameras**	Medium	Medium	-Prevention: Offer two HW solutions with (i) integrated and (ii) separate processing unit. -Mitigation: Offer the same processing unit in order to avoid doubling SW development costs.
	Solution is too heavy or bulky for installation	Low	Medium	-Prevention: Keep our current two-element HW design until the upgrades enable a lightweight integrated solution.
	Poor compatibility between new components	Low	Medium	-Mitigation/Contingency: Revise specifications and work with a wide range of suppliers.
	Product cannot meet the required accuracy	Low	High	-Mitigation: Create a feedback loop from early-customers to response on shortcomings. Train system integrators and resellers for optimal configuration.
	Lack of experience to develop the central data store as backbone	Low	High	-Prevention: Hire additional personnel to develop/maintain the central data store. Use external SW developers to accommodate

				development and transfer knowledge.
	High complexity to support all existing platforms	Medium	High	-Mitigation: Suitable market research. Priority to platforms with large communities/supports.
	High dependence on partners with closed source platforms	Medium	Medium	-Prevention: Negotiate contracts that eliminate exclusivity, or only allow exclusivity for strong niches/partners.
	High prices	Medium	Medium	-Mitigation: Negotiate deals with several suppliers. Allow flexibility to change HW components. Re-sell the data to consultancy services, urban planners, *etc.*
Commercial	**Low budget available in cities for TMS solutions**	High	Medium	Mitigation: Provide clear benefits schemes to cities. Offer DaaS model to reduce high pre-investment. Partners like *HIG, Sweco, Connection Systems* can offer DaaS and act as financial buffers.
	Already adopted TMS by cities	Low	Medium	Mitigation: Create credibility about our outstanding advantages by disseminating flag-ship projects results. Continuous updating of competitors to strong the commercialization strategy.
	Privacy/security risks with internet connection	Medium	Medium	Mitigation: Offer two solutions; (i) cloud-based access and (ii) access within closed networks. Get the ISO 27001 certification to guarantee information security. Only transmit data (never video) securely over the air.
Legal	**Changing regulatory framework**	High	Low	Mitigation: Continuous analysis of regulations and fine-tuning of the product accordingly (continuous upgraded). Contracting legal services for advisory.
	No stable cash flow due to temporary contracts/project	Low	Low	Mitigation/Prevention: Focus on 24/7 solutions with clear business proposals. Offer flexible payroll to cope with changing market demands.
Financial	**Delays in development have significant impact on sales and revenues**	Medium	Medium	Mitigation/Prevention: We start developing Minimal Marketable Functions (MMF) so that we can start sales for specific markets that have limited needs. That will allow us to generate more capital for further development and integration.

TABLE 3 RISK ASSESSMENT AND CONTINGENCY PLAN

3.6. CIC

3.6.1. Market Analysis and Value Proposition

Target Market

The convergence of AI and edge computing is creating a rapidly expanding global market, projected to exceed €65 billion by 2030, with sustained annual growth rates above 21%. Within this space, secure edge AI addresses the protection of models and intellectual property; it is a high-value and underserved segment. The project targets a clearly defined market in Europe, focusing on early adopters in industrial IoT, automotive, healthcare, and critical infrastructure, where the protection of AI models is mission critical.

AI models deployed at the edge increasingly raise core business value, yet remain highly exposed to theft, reverse engineering, and tampering. This vulnerability is emerging as a major bottleneck for large-scale adoption, particularly among SMEs and technology providers. At the same time, policy initiatives led by the European Commission are accelerating demand for trustworthy and secure AI, creating a strong regulatory pull for solutions that ensure IP protection and system integrity.

Current market offerings fail to address this need completely. Leading platform providers such as NVIDIA and Intel dominate deployment infrastructure but offer no solutions to protect neural network weights. AI security vendors such as Protect AI focus on cloud-based risks, leaving a critical gap at the edge. No existing solutions deliver end-to-end, lightweight protection of AI models in real-world edge environments.

We position ourselves to fill this gap and define a new market category by delivering integrated, AI-native protection mechanisms tailored to constrained devices. Our initial targets are:

- Edge hardware and platform vendors seeking embedded security differentiation
- AI solution providers and system integrators managing high-value models
- Operators of critical systems where trust, resilience, and IP protection are essential

In line with Horizon Europe, it contributes to establishing European leadership in secure, sovereign AI while unlocking significant commercial value in a market ready for exponential growth.

Competitors Landscape

The AI edge computing landscape is shaped by a mix of large technology providers, specialized AI security companies, and research-driven initiatives. Major industrial players such as NVIDIA, Intel, Google, and Microsoft provide mature platforms for deploying AI models at the edge, focusing on performance, scalability, and ease of integration. Although these solutions include baseline security features, they do not adequately address the power requirements and the protection of neural network weights against extraction, tampering, or reverse engineering, particularly in untrusted and resource-constrained environments.

In parallel, emerging AI security companies such as HiddenLayer and Protect AI focus on adversarial robustness and ML supply chain security. However, their approaches are largely cloud-centric and do not provide end-to-end protection of models during deployment and inference at the edge. Hardware-based solutions from providers like ARM offer trusted execution environments, but these remain general-purpose security mechanisms with limited integration into AI workflows and insufficient coverage of AI-specific threats. Consequently, the current landscape remains fragmented, lacking integrated, lightweight, and AI-native mechanisms for securing model weights across the full lifecycle.

The proposed project goes beyond the state of the art by delivering a holistic framework including hardware-assisted security, specifically tailored to edge environments. In alignment with this proposal, this approach strengthens European technological sovereignty while enabling secure, trustworthy, and IP-preserving deployment of AI solutions across critical sectors. By addressing a fast-growing, high-risk problem with no direct end-to-end competitors, the project has the potential to achieve rapid market traction and scalability across multiple sectors.

Product Description, Differentiators and Benefits for customers

The proposed solution provides a security framework for edge AI based on in-memory computing architectures, enabling direct protection of neural network weights at the point of computation. By embedding security within the memory-compute layer, it ensures confidentiality and integrity of models during storage and execution, with minimal performance and energy overhead.

The product provides runtime protection against model extraction, tampering, and side-channel attacks, while remaining compatible with existing edge AI stacks and emerging hardware platforms.

Unlike existing solutions from NVIDIA, Intel, or Protect AI, which focus on performance, the proposed approach delivers intrinsic, in-memory protection of AI models. This results in ultra-low overhead, stronger resilience to advanced attacks, and a fundamentally new paradigm for secure edge AI, positioning the solution beyond the current state of the art.

3.6.2. Exploitation Strategy and Business Plan

Commercialization plan, roadmap, and strategic partnerships

The commercialization strategy follows a phased roadmap from validation to scale-up. In the short term (years 1–2), the focus is on technology validation for different use cases. This will allow initiating some partnerships with potential users/ adopters in the following two years; the idea is to demonstrate the value proposition of our solutions for edge AI.

Mid-term (years 3–5), the solution will be automated and productised as an embedded security module, supported by partnerships with hardware vendors, system integrators, and semiconductor players (e.g., ARM) to enable broad market access. The ultimate goal is to develop fully automated electronic design automation tools will we be integrated in the design flow to enable the security of the designs; therefore, the business model will be based on licensing software.

3.7. AXE

3.7.1. Market Analysis and Value Proposition

Target Market

The products of Axelera AI address the edge computing space, targeting computer-vision applications in manufacturing, retail, healthcare and other domains. The edge AI hardware market, currently valued at $20-24 billion, is experiencing rapid growth with projections reaching $54-269 billion by 2030-2032. The edge AI market addresses by Axelera AI consists out of the following target domains:

Industrial & Manufacturing: Manufacturing facilities represent a core market for Axelera's technology, with applications ranging from quality inspection on high-speed production lines to predictive maintenance of critical equipment. Edge AI enables immediate detection of product defects, real-time process optimization, and early warning of equipment failures, directly impacting productivity and operational costs. Emerging sectors like precision agriculture utilize edge AI for crop monitoring, irrigation optimization, and yield prediction in connectivity-challenged rural areas. The rise of collaborative robotics and automated

guided vehicles further expands the need for low-latency, reliable AI processing at the industrial edge.

Security: Security applications demand robust edge processing for real-time threat detection, access control, and perimeter monitoring across airports, government facilities, and critical infrastructure. Privacy regulations and the need for continuous operation even during network outages make Axelera AI's edge AI accelerators essential for modern security systems.

Retail: Retail environments leverage edge AI for customer analytics, inventory management, and loss prevention while maintaining shopper privacy through on-device processing. Smart building applications extend beyond retail to include occupancy-based climate control, energy optimization, and integrated security systems in commercial properties. The ability to process data locally addresses both privacy concerns and the need for immediate operational insights.

Automotive: The automotive sector drives significant demand for edge AI accelerators, particularly in advanced driver assistance systems (ADAS) and autonomous vehicle applications. These safety-critical systems require real-time processing of multiple sensor inputs for functions like emergency braking, lane keeping, and pedestrian detection, where millisecond latency can mean the difference between collision and avoidance.

Smart Cities: Urban infrastructure increasingly relies on distributed intelligence for traffic optimization, environmental monitoring, and public services. Edge AI accelerators enable adaptive traffic control systems, real-time air quality monitoring, and smart utility management that must function reliably regardless of network conditions. These applications directly impact citizens' quality of life while helping cities operate more efficiently.

Healthcare & Life Sciences Healthcare applications require edge processing for patient privacy compliance and real-time clinical decision support. Point-of-care diagnostic devices with AI-powered image analysis, continuous patient monitoring systems, and surgical guidance tools all benefit from low-latency edge processing. The ability to deploy sophisticated AI in remote clinics or privacy-sensitive environments opens new possibilities for accessible healthcare.

Competitors Landscape

The major competitors of the Axelera AIPU are other low-power accelerators in M.2 form factor, targeting the edge market. The following graph shows that the peak performance of Metis is superior to the major competitors:

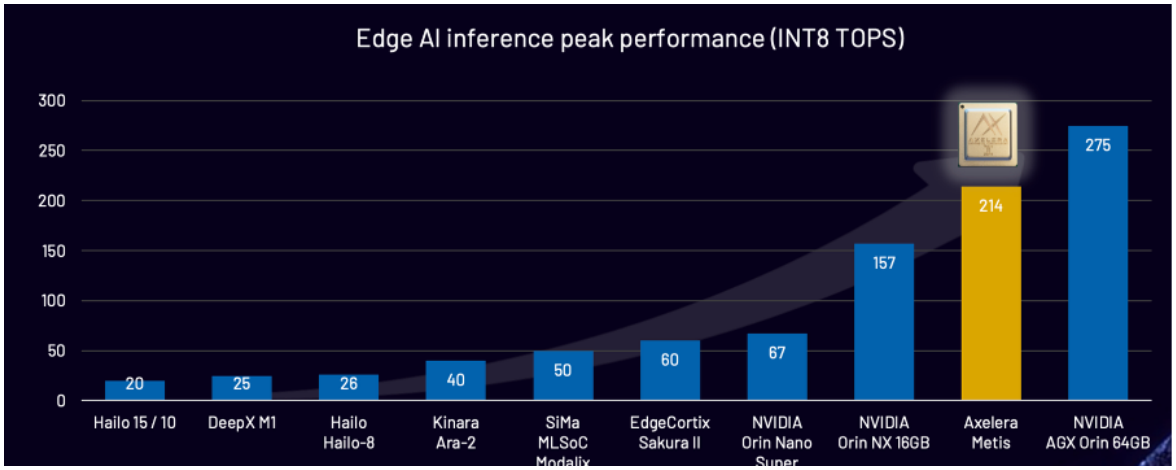


FIGURE 7 PEAK PERFORMANCE ANALYSIS

Product Description and Differentiators

Axelera AI has developed a custom Digital In-Memory Computing (D-IMC) dataflow architecture that delivers 214 TOPS at 15 TOPS/W efficiency, positioning it among the higher-performance solutions in this market segment. This allows to run advanced AI applications using deep neural networks for tasks such as object detection, semantic segmentation, human pose estimation algorithms in fast and power-efficient manner.

The power-efficient Compute-In-Memory architecture of Axelera AI's hardware in combination with software optimizations allows to build AI into new form factors and applications. The power efficiency (15 TOPS/W) not only benefits power consumption but the lower heat dissipation allows for passive cooling by not requiring fans for air cooling, which is beneficial in industrial scenarios, where reliability and maintenance are a significant consideration. This also allows deployment in thermally constrained environments and battery-powered applications.

AI innovation is made accessible for all developers by providing an end-to-end hardware and software stack that allows to easily deploy the latest AI algorithms. Customers use the SDK to bring their applications into the Metis AI platform and run it on Axelera's powerful Metis AI Processing Unit (AIPU), whether the application is developed using proprietary or standard industry models. This ensures that developers can get the most out of our performance-leading hardware and can start with AI development without requiring low-level knowledge.

The SDK supports standard PyTorch and ONNX models without requiring retraining or manual optimization, reducing deployment time from weeks to days. Our toolkit automatically analyses the neural network structure and applies multiple optimizations such as post-training quantization.

Benefits for customers

The edge computing platform provides practical advantages for organizations deploying AI in real-world environments. The Digital In-Memory Computing architecture enables passive cooling in most deployments, reducing maintenance requirements and failure points in industrial settings while opening possibilities for battery-powered and space-constrained applications.

Software integration is simplified through direct support for PyTorch and ONNX models, eliminating the need for specialized optimization or retraining. This reduces deployment timelines and allows organizations to utilize existing AI development resources effectively.

Key operational benefits include:

- Local processing eliminates cloud dependencies and associated latency
- Data remains on-premises, addressing privacy and regulatory requirements
- Reduced bandwidth costs for video and sensor data

Scalable architecture supports growth from pilot to production deployments

3.7.2. Exploitation Strategy and Business Plan

Intellectual Property Exploitation

Our intellectual property framework drives our competitive advantage by strategically protecting, advancing, and leveraging cutting-edge AI and semiconductor technologies. Through centralized ownership under Axelera AI B.V. in the Netherlands, we maintain regulatory alignment with EU requirements while consolidating our most valuable technological assets. We pursue patent protection for critical innovations while strategically managing other developments through confidential retention or targeted publication to enhance our market position.

In terms of CONVOLVE's intellectual property exploitation, the pruning algorithm developed for CONVOLVE, published on the top-tier International Conference on Computer Vision, is an essential part of the strategy to bring AI applications to the edge. Pruning allows to distill large state-of-the-art networks to smaller variants, making them more power-efficient and suitable for deployment on Axelera's Metis AIPU with minimal impact on the accuracy. For CONVOLVE, Axelera AI has developed a dynamic-resolution algorithm that automatically switches the resolution of video streams for object detection to the optimal resolution from a performance-power-accuracy perspective.

Commercialization plan, roadmap, and strategic partnerships

Axelera AI has a strategic partnership with Arduino, a well-known developer of low-power general-purposes edge computing devices. For deployment of computing systems in industrial settings, Axelera has partnerships with Advantech and SECO to provide off-the-shelf computing systems. The next generation of Axelera's product will extend its computer vision capabilities by providing full on-device pipelines. New applications including large language models and vision-language models.

4. Academic Partners Valorization Plan

4.1. TUE

Within the CONVOLVE project, TUE has made key scientific and technological contributions in three strategic areas: energy-efficient hardware acceleration for AI workloads, design methodologies for predictable multicore systems, and composable execution platforms for heterogeneous computing. These results provide a strong foundation for future research, technology transfer, and industrial exploitation in edge-AI and embedded computing systems.

The hardware accelerator developments include both compute-in-memory (CiM) architectures and spiking neural network (SNN)-based accelerators targeting vision applications. These technologies address the growing demand for energy-efficient AI processing at the edge by reducing data movement and enabling low-power inference. TUE will continue to mature these technologies through follow-up national and European research projects, open-source dissemination where appropriate, and collaborations with semiconductor, automotive, robotics, and edge-computing industries. The long-term objective is to facilitate the adoption of CiM and neuromorphic processing techniques in future low-power AI platforms.

In parallel, TUE has developed methodologies for predictable multicore scheduling and resource management, enabling efficient execution of mixed-criticality and real-time workloads on heterogeneous platforms. These methodologies have potential applications in automotive, industrial automation, and cyber-physical systems where timing guarantees are essential. The results will be further exploited through scientific publications, integration into educational activities, and collaboration with industrial partners interested in predictable embedded computing.

4.2. ETHZ

At ETH Zurich, the outcomes of CONVOLVE are disseminated through open-source releases, research integration, and education. All hardware platforms, software frameworks, and compiler flows developed during the project are released under permissive licenses on the PULP platform repositories (https://github.com/pulp-platform/), ensuring transparent access and fostering reuse by both industry and academia.

CONVOLVE outcomes enable new research directions at the Digital Circuits and Systems Group of ETH Zurich by providing a robust foundation of architectures, energy-efficient accelerators, and RISC-V based heterogeneous computing platforms. These results form the basis for advancing design methodologies, developing more efficient design flows, and exploring innovative approaches to scalable system integration. This ensures that the technical contributions of CONVOLVE continue to shape future research well beyond the project's duration.

The technologies developed are also integrated into ETH Zurich's graduate education. Platforms and case studies from CONVOLVE are used in courses such as *System-on-Chip for Data Analytics and Machine Learning*, where students gain hands-on experience through labs, semester projects, and theses.

4.3. FMI

The FMI has, in collaboration with GNA, developed two neural network models for efficient speech quality prediction as part of GNA's speech enhancement use-case. Following the FMI's valorization plan, the models and associated code are or will be made publicly available in open access venues and repositories. The first model was published in the Interspeech 2024 proceedings and the associated code is publicly available on the FMI's official GitHub repository at https://github.com/fmi-basel/binary-activation-maps-sqp. Similarly, the second model has been accepted for publication at Interspeech 2025 and the code will be made publicly available. This work provides algorithmic developments within GNA's business plan of evaluating the use of ultra-low power processors in their products.

4.4. TUD

TUD is actively exploring and leveraging the obtained results in multiple ways to ensure the technical contributions continue to shape future research well beyond CONVOLVE duration. Examples include:

- DREAM-CIM microarchitecture is currently in the process of being patented. Building on this innovation, TUD aims to develop a full AI chip optimized for energy-efficient applications. A specialized AI chip based on DREAM-CIM is already under development. If the additional ongoing activities progress successfully, TUD may consider launching a new spin-off company.
- X-SIM Simulator (Accurate and Scalable Simulator for Memristive Computing-in-Memory Accelerators) is being disseminated through open-source releases, integration into ongoing research, and incorporation into academic curricula.
- The project's advances in the use of RRAMs are being commercialized through a start-up initiative. An EIC Transition Grant of €2.5 million has already been secured, and the start-up is currently under development.
- The CONVOLVE outcomes are enabling new research directions within the Computer Engineering group at TUD, particularly in the development of reliable and energy-efficient AI accelerators. These results provide a strong foundation for future work on scalable system integration, particularly with the RISC-V platform.

4.5. KUL

At KU Leuven, the results of the CONVOLVE project are being valorized in several directions. One important path is the exploration of starting a new spin-off company of KU Leuven-MICAS. This company will be based on the SNAX and ZigZag/Stream tools developed during and before the project. These tools are now being further developed to support commercial use, and their value is discussed with a few industrial partners. The spin-off will offer accelerator IP and supporting toolchains, with a focus on efficient hardware for AI at the edge. The MICAS research group at KU Leuven has a long history of starting spin-offs, with no less than 7 started in the last decades.

Furthermore, ZigZag and Stream are also in use in several bilateral research activities with companies. Companies exploring the usage of these tools are AMD, Meta, Nokia, Vivo and Sony.

Besides this, KU Leuven is also using the project results as a basis in other ongoing and newly funded research projects. The CONVOLVE hardware and software technologies developed by KU Leuven are being used as a starting point to explore new types of accelerators. In particular, KU Leuven is investigating SNAX as a basis for solutions for hyperdimensional computing and neurosymbolic AI, which require innovative hardware-software co-design.

Of course, beyond the above valorizations in the commercial and research domain, the CONVOLVE results are also exploited in the master level education, in the form of examples used in the theoretical lectures, as well as a starting point for master theses. Research. In this way, we make sure that the impact of the CONVOLVE project continues after and beyond the project itself.

4.6. RUB

RUB is an academic partner of CONVOLVE and its primary valorisation is the education of next-generation engineers. To this end, we integrate students into the CONVOLVE project using theses and engineering projects. By doing so, students are introduced to academic research and practical real-world applications. This consolidation often poses interesting challenges and is vital for a holistic education.

In addition, RUB also leverages the insights gained in CONVOLVE as guidelines towards interesting future research directions. By focusing on research on problems with industry demands, future results can be valorised better and opportunities for potential start-ups can be identified. One prominent example of the is the energy efficiency of post-quantum cryptography: while highly demanded in practice, very little research has been done in this area.

4.7. MAN

The strategy for the group at The University of Manchester has been to develop technology that moves neural networks away from power-hungry massively-parallel datacentres and more towards ubiquitous portable applications with very tight energy constraints. Our focus has been on the design of flexible hardware accelerators (under the name ***FlexMan***) in support of both ANNs and SNNs, principally applications proposed by our industrial CONVOLVE partners in GNA, Bosch and Thales. A consistent design approach has enabled significant re-use of components from our original ANN pipeline in the spiking variant. The remaining subsections consider our proposed exploitation plans with each partner:

With Bosch, Germany

The automotive group at Bosch, Stuttgart, are interested in adding value to vehicles through the provision of information processing systems to improve safety and provide a richer driving experience. This philosophy is part of a wider research effort to find value in smart edge devices. The Manchester team have worked with Bosch to validate their spiking neural networks solution for siren detection as a test case of the approach.

From the perspective of Bosch the benefits are:

- An FPGA-based solution is the first step to validate the application.
- Bosch will use these results and exploit for other applications such as Bosch connected and smart home systems
- To enable smart sensors with longer lifetime or even energy harvesting.
- Enables evaluation of the environment's dynamics and incorporates such information to minimize energy footprint.

The FPGA-based FlexMan accelerator will act as a flexible evaluation platform for Bosch to identify optimal uses of neuromorphic technology in products.

With JABRA (GNA), Denmark

The speech de-noising application supplied by Jabra to the CONVOLVE project has been the target for several of the research sub-projects within WP4 as well as hardware development in WP2. Their network is based on the standard NsNet2 ANN, which incorporates several Gated Recurrent Units (GRUs). For the Manchester team, supporting this NsNet2 in hardware has been a major focus in WP2.

The Manchester team are in discussion with the team in Jabra to continue the optimisation of our FlexMan hardware on FPGA, aiming for a follow-on project funded by UKRI, the United Kingdom's R&D funding agency. The ultimate aim is to deploy FlexMan in real hardware from Jabra for speech denoising.

Within the forthcoming International Neuromorphic Systems Design Centre, University of Manchester, UK

A new professor in the APT group in Manchester, André van Shaik, is establishing a cross-departmental *International Center for Neuromorphic Systems (UK)*, intended to progress the application of both ANNs and SNNs and to form strong industrial links. He brings with him the near-complete *Deep South neurocomputer* (Deep South) an FPGA-based platform capable of simulating massive neural networks. The neurons are implemented as hardware on the FPGAs, and there is scope to add new neuron models, which will include our *FlexMan* ANN and SNN accelerators developed under CONVOLVE. Our ANN and SNN accelerators will therefore be available as a ***service,*** open to researchers across Europe and beyond. This will require an integration step that is not covered by the Convolve project and so will necessitate additional funding.

4.8. UMU

University of Murcia's role under Convolve is the development of an end-to-end compilation chain from frontends dedicated to AI (such as PyTorch, ONNX) to RISC-V and building dedicated

optimizations for Neural Networks and Transformers.We aim to further build on the outcome of Convolve as described below:

1. Research and Development Steering

- Compiler Framework Enhancements: Leverage insights from the Convolve project to refine compiler extensions for neural networks (NNs) and transformers, optimizing them for RISC-V platforms and accelerators. At UMU, we prioritize features such as automatic instruction reordering that enables a variety of optimizations, from fusion to vectorization, etc. We also build cost models to drive the memory and computation allocation on the available CPUs and accelerators. We aim to extend the new compilation chain built under Convolve for the Convolve use-cases and accelerators to target new applications (transformers) and efficiently map them to emerging hardware.
- Partnerships with Spanish Industry: Building on the know-how on compiling and optimizing NNs, we collaborate with local Spanish companies to align compiler optimizations with emerging architectures (e.g., RISC-V with vectorization support for AI), ensuring low-latency execution for edge AI applications. Such collaboration has led to secure a joint R&D grant from the Spanish government.

2. Talent Development and Training

- Curriculum Integration: Embed Convolve compiler frameworks into master's courses (i.e., UMU's Advanced Programming for Parallel Architectures course part of the Master in New Technologies), emphasizing NN optimization for heterogeneous hardware.
- Internship Pipeline: Host international students as interns (e.g. ENS France) that get exposed to the Convolve technologies in the view of disseminating our results, train new young talents, and potentially start new collaborations with their home universities and research groups.

3. Dissemination and Visibility

- Open-Source Knowledge Transfer: Release modular compiler tools and compilation chains (e.g., our end-to-end NN to RISC-V compiler, instruction reordering and fusion optimizer, reduction detection compiler pass) via GitHub.
- Conference Track Record: Publish results at venues like HiPEAC (Europe's premier compilers/architecture conference), and flagship conferences such as MICRO.

4.9. UIR

UIR plans to continue advancing dynamic neural networks and edge AI beyond the CONVOLVE project. The outcomes of the project provide a solid foundation for future work and will serve as a starting point for deeper theoretical investigations into adaptive and efficient AI models. UIR also maintains a strong interest in hardware-software co-design, using the technologies developed during CONVOLVE to explore optimized solutions for edge deployment.

In addition, the models and tools resulting from the project are being extended to new application domains, including communications and healthcare, where intelligent, low-power solutions are

increasingly in demand. The knowledge and technologies developed are also being actively integrated into education through master's theses and final year engineering projects, offering students hands-on experience with state-of-the-art research and reinforcing the long-term impact of CONVOLVE within both academic and practical contexts.

5. Conclusion

CONVOLVE's exploitation efforts are founded on a targeted approach: identifying high-impact pathways for each technological innovation, securing intellectual property through patents and trade secrets, and tailoring commercialization strategies to address unique market demands in automotive, space, communication, healthcare, and urban mobility sectors. The plan not only facilitates maturation and protection of project results but actively supports transformation into market-ready, scalable solutions.

Market Opportunity and Impact

The project strategically addresses several fast-growing markets:

- **Automotive:** Leveraging Bosch's leadership, CONVOLVE's innovations in acoustic perception and sensor integration underpin next-generation ADAS, with strong growth prospects driven by increasing demands for safety, autonomy, and energy efficiency in vehicles.
- **Space/Defense:** Thales Alenia Space España targets AI-empowered situational awareness systems in the defense satellite sector, capitalizing on ballooning demand for real-time analytics and European technology sovereignty amid global market expansion.
- **Audio and Communication:** GN Group's integration of on-device AI in hearing aids and professional headsets addresses a booming and evolving European market, meeting the needs of an aging population and a hybrid workforce.
- **Semiconductors and Edge AI:** NXP drives adoption of secure, low-power edge-AI platforms for a connected world, harnessing open architectures like RISC-V and focusing on post-quantum security.
- **Urban Mobility:** ViNotion's ViSense system capitalizes on the rising demand for real-time, privacy-preserving traffic monitoring to enhance safety and efficiency in European cities.
- **Edge AI Acceleration:** Axelera AI delivers industry-leading performance-per-watt through its Metis platform and foster partnerships that position it to disrupt markets like manufacturing, security, retail, and smart cities.

Furthermore, the academic partners in CONVOLVE are deeply committed to ensuring that the project's scientific advancements transcend the boundaries of research publication and bring tangible value to society, industry, and future scientific endeavours. Through strategic knowledge transfer, collaborative innovation with industry, and the development of highly skilled graduates, the universities and research institutes in the consortium serve as pivotal bridges between fundamental research and practical impact.

By actively disseminating results via high-impact publications, conferences, workshops, lectures/courses and open-access repositories, the academic partners promote the widespread adoption and adaptation of new knowledge. Engagement in standardization activities, contribution to curricula, and the creation of training materials further extend the project's legacy beyond its official duration.

Moreover, the academic partners are dedicated to fostering long-term collaborations with industrial stakeholders, supporting technology transfer, and enabling the commercialization of research outcomes where appropriate. These efforts ensure that innovations generated within CONVOLVE not only advance the academic state-of-the-art but also provide measurable benefits to the broader ecosystem—driving European competitiveness, societal well-being, and technological sovereignty.

In conclusion, CONVOLVE's comprehensive exploitation and business plan establishes a clear framework for transitioning innovative research into real-world commercial solutions, with significant economic, technological, and social benefits for Europe. The consortium's collective capabilities and strategies strongly position its members to capture high-value market segments, drive sustainable growth, and maintain Europe's leadership in the rapidly evolving landscape of edge AI and smart systems.