



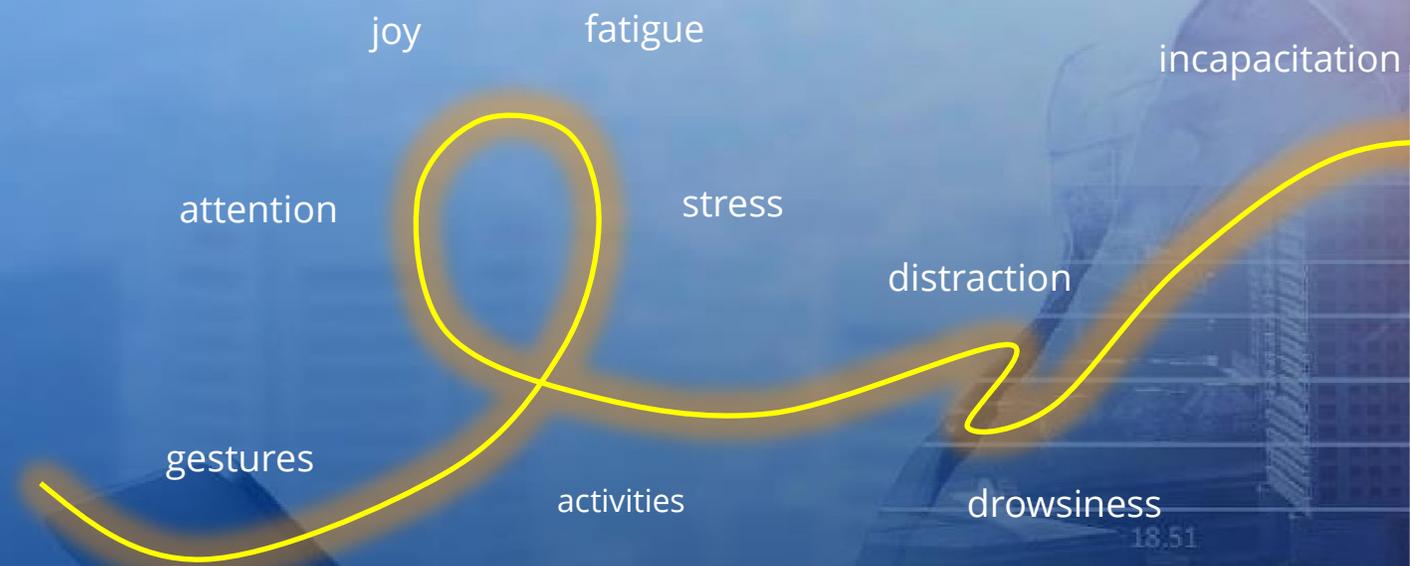
“to understand people and predict their behaviour to advance human potential.”

**NVISO** is a leader in human behaviour artificial intelligence (AI) software for the extreme edge, serving manufacturers of user-centric products and services worldwide.

We combine advanced AI and machine learning with cutting edge science to decipher complex human behavior from multiple sensors using an holistic approach and enable safe, secure, and personalized interactions with autonomous systems

**Confidential and Private**

NVISO SA (**NVISO**)



30<sup>th</sup> November 2022

Company Profile

# Company | Overview

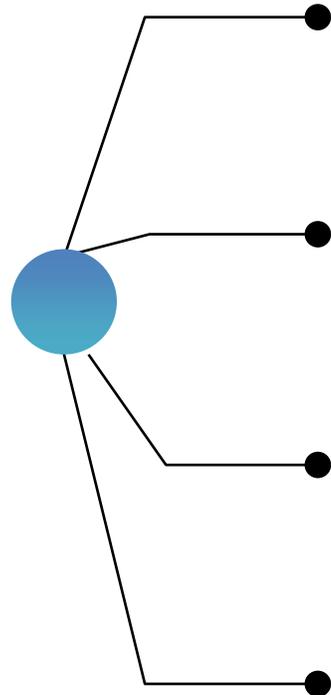
- Core Expertise and Markets
- Product and Market
- Company Overview and Status

# NVISO **CORE EXPERTISE** | **Complex Emotions** and Predicting Behaviour

Decades of Experience in Human Behaviour Artificial Intelligence at the Deep Edge



**Humanizing Autonomous Machines** with Safe, Secure, and Engaging Experiences.



## **DEEP EDGE AI (EMBEDDING AND INTEGRATION)**

Deep Edge AI is a combination of Edge Computing and Artificial Intelligence. AI algorithms are processed locally, directly on the device, without the need for an internet connection or sending or storing any personal data off device. This is critical for applications such as cars, robots, or medical devices.



## **SEMANTIC REASONING (HUMAN FACTORS)**

Semantic Reasoning is the ability of a system “to make logical deductions from the information that is explicitly available”. A human knowledge graph and semantic reasoning engine, derives new data from perception and observational data that it is explicitly given, using ontologies and rules.



## **COMPUTER VISION (PERCEPTION AI)**

Computer Vision is an Artificial Intelligence (AI) field dealing with how computers can obtain high-level understanding from digital images and videos. AI algorithms analyze images to detect objects, categorize images, identify objects, and add metadata.



## **HUMAN BEHAVIOUR RESEARCH AND DATA**

Data is the lifeblood of AI. An AI system needs to learn from data in order to be able to fulfill its function. NVISO has collected over 1Billion data points of human behaviour from large image and video datasets applicable to multiple industries.

# NVISO **CORE PEOPLE** | Experienced Management Team with Global Presence

Well positioned to deliver on the significant growth opportunity

HQ, EPFL,  
Switzerland



Sales Office,  
Yokohama, Japan



**Tim Llewellynn**  
Executive Director,  
CEO & Co-Founder

- Tim is an international entrepreneur with 20+ years experience growing high growth tech ventures from startups to fortune 500 companies working across sales, marketing, and product development. Tim co-founded NVISO in 2011 and holds a Masters and Bachelor Honours from the University of Canterbury, New Zealand in Electrical and Electronic Engineering.



**David Tolub**  
Commercial Strategy

David brings to 20+ years of experience in managing R&D, Marketing and Sales at high tech companies. Prior to joining NVISO, David was CEO at CIPAI, Oversi, and Vice President and General Manager of the Mobile Handset Vendor Division for SanDisk. He managed the divisions' worldwide activities and its fast growth to revenue of over \$200M. Mr. Tolub earned his MBA from Boston University. He also holds an MSc of Electrical Engineering from the Technion University, Haifa, Israel.



**Bogdan Lazar**  
Head of Products

- Bogdan has more than 13+ years of experience in project management (hardware and software, new products, each multi-disciplinary), building and managing engineering teams. Bogdan holds a PhD in Manufacturing Systems and Robotics from the Swiss Federal Institute of Technology (EPFL) / Laboratory of Computer-Aided Design and production (LICP)



**Colin Mason**  
Head of Sales / COO

- Colin is an international technology professional with nearly 40 years management, sales, marketing, engineering and operations experience. Colin holds a Bachelor of Science (Electrical and Electronic Engineering) with Honours from The University of Edinburgh, is a Chartered Engineer and a Member of the Institute of Engineering and Technology.



**Takahiro Nakamura**  
Sales Manager (Japan)

- Takahiro has more than 30 years of sales experience in the Japanese market. Takahiro has held several director level sales positions with major Japanese. Takahiro holds a Bachelors of Physics from the College of Science and Technology, Nihon University



Group Holding,  
Australia

# NVISO **CORE MARKETS** | Where Human Behaviour AI is Mission Critical

From autonomous systems, understanding non-verbal communication, to new human-robot interactions



Pain  
Stress  
Vital Signs

Healthcare /  
Medical Equipment



Avatars / Gaming /  
Communications /  
Consumer Robotics



Automotive and ADAS  
/ Telematics / Mobility-  
as-a-Service

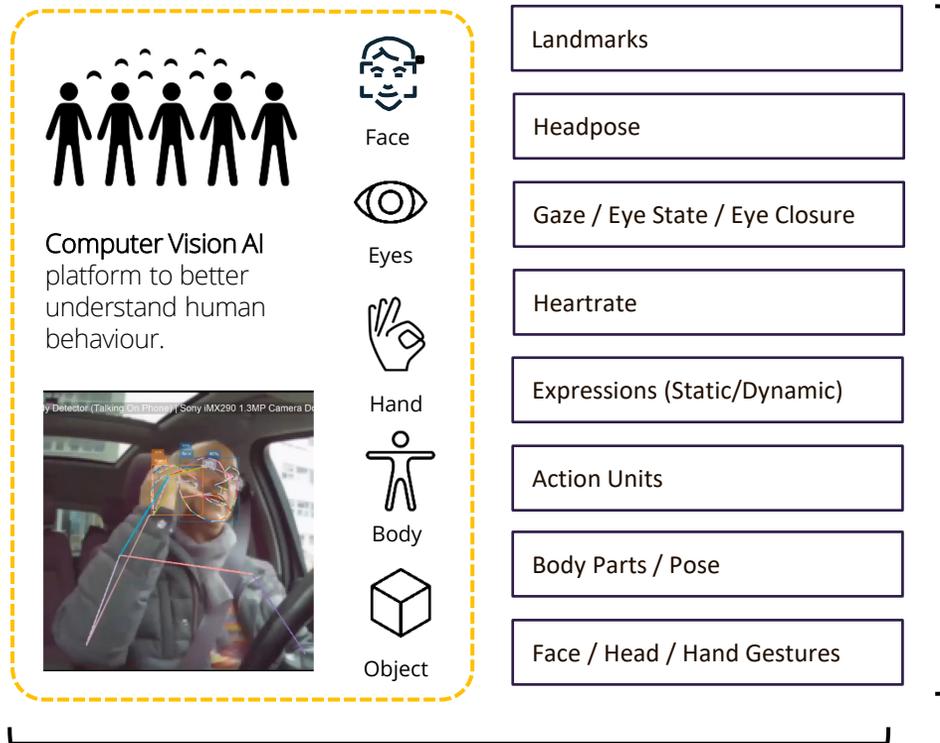
# NVISO's UNIQUE **HOLISTIC PREDICTIVE** APPROACH



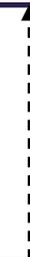
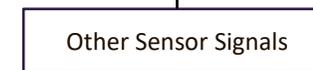
- ✓ Real-time decisions
- ✓ High robustness
- ✓ High accuracy
- ✓ Pre-emptive vs reactive



Any Camera  
Any commodity camera found in devices.



Multiple Signals





**Detections**  
(Core Perception AI)

- RGB/NIR/ToF
- Non-visual



Computer Vision AI platform to better understand human behaviour.



Face



Eyes



Hand



Body



Object

**Hardware**  
(Specialised AI Hardware)

**Observations**  
(Observational AI)

Landmarks

Head Pose

Gaze / Eye Closure

Heart rate

Facial Expressions

Action Units

Body Parts / Pose

Gestures

Observation API

**Partners**  
(Specialist Features)

**Predictions**  
(Advanced Emotions Level)

Your custom signal

**Complex Emotions**  
(Fatigue, (Dis)Comfort/Pain, Stress)

**Advanced Emotions**  
(While Talking, Anxiety, Confusion)

**Health and Vital Signs**  
(Heart, breathing rates)

**Demographics and Biometrics**  
(Face ID, Age, Gender)

**Intention Prediction**  
(Intention, object usage)

**Activity Prediction**  
(Out of position, activities)

**Advanced Gaze (optional)**  
(3D, AOI, distraction, drowsiness)

**Advanced Body Pose (optional)**  
(3D, movement, orientation)

Prediction API

**Applications**  
(Use Cases)

**Robotics**

Emphatic Human-Machine Interaction



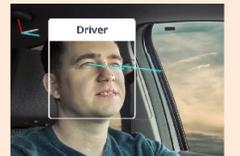
**Health**

Improve diagnostics, remote access to health care and optimized workflows



**Mobility**

Next generation DMS/OMS with Predictive functions and Human-Machine Interactions



**Gaming**

Adaptive gaming features based on advanced emotional states

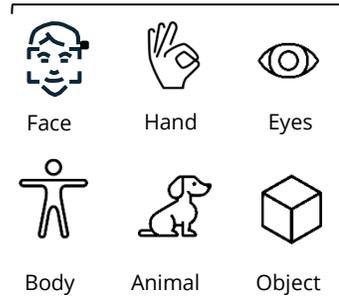


# New Human-Robot INTERACTIONS

## PANASONIC NICOBO: COMPANION ROBOT

NVISO AI Platform is supporting the interaction of companion robots with their owners in their daily lives. It detects presence and identity of the owners, anticipating and reacting to their attention by tracking head pose, gaze. The robot can also appropriately adjust its reactions to the owners mood by understanding their facial expressions. Over-the-air update allows the deployment of new and innovative AI fuelled features.

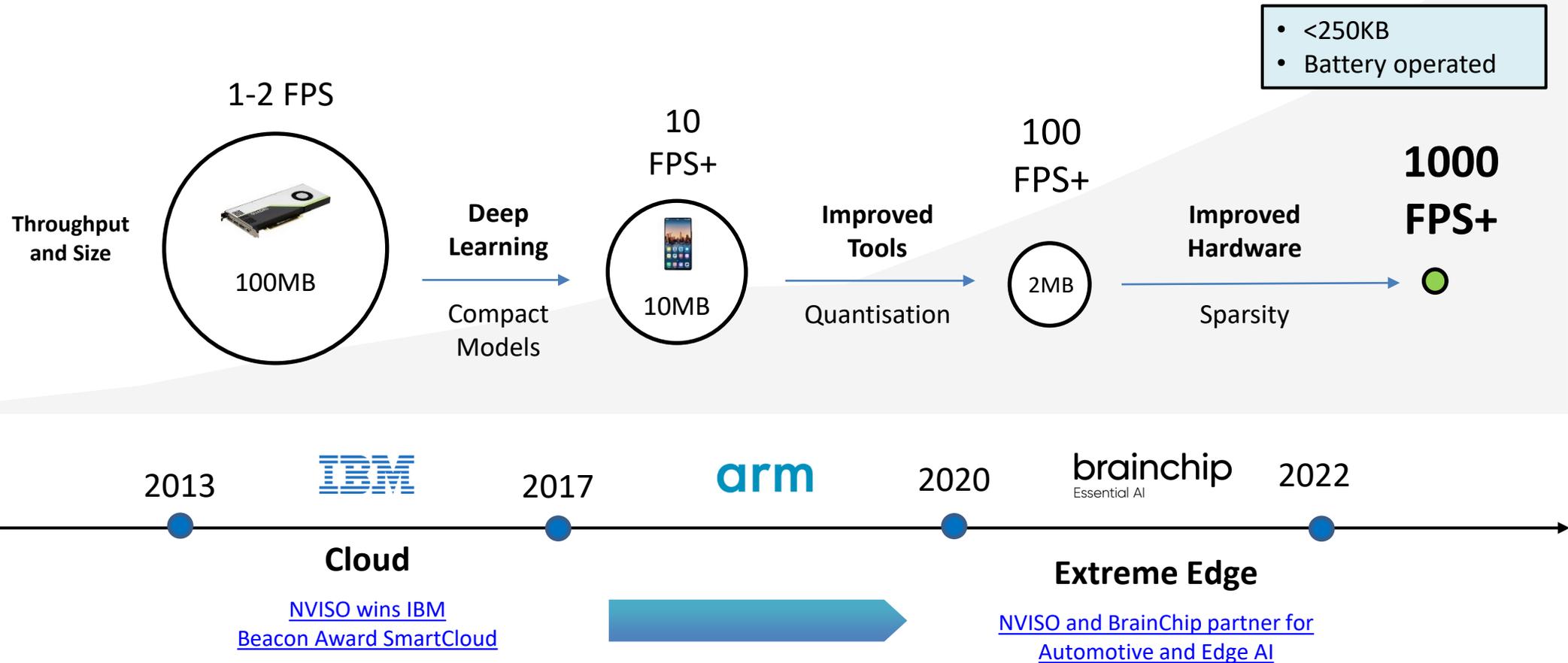
### AI App Catalog



思わず笑顔になるロボット  
**NICOBO** by [Panasonic](#)

**Interactive Systems supporting daily life with safer, personalised, and mood-sensitive experiences**

# Edge AI Transition | AI Apps From Cloud to Battery Operated Solution



# NVISO Present Clients

## COMPANION ROBOTS

Social robots to help reduce loneliness and increase independence in people living at home alone, especially with the elderly.



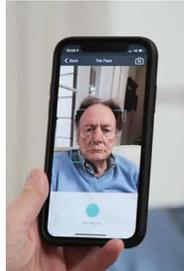
IoT 1 FPS



Low power edge computing platform with camera attached to device.

## HEALTH ASSESSMENT

The aged care sector is in desperate need of technological solutions to support the care of the elderly and particularly those living with dementia.



Mobile 20 FPS



Phone or tablet with embedded camera in screen with restricted placement.

## DRIVER AND OCCUPANT MONITORING

Next generation mobility requires AI for interior sensing for safety, security, and experience.



HPC 30 - 60 FPS

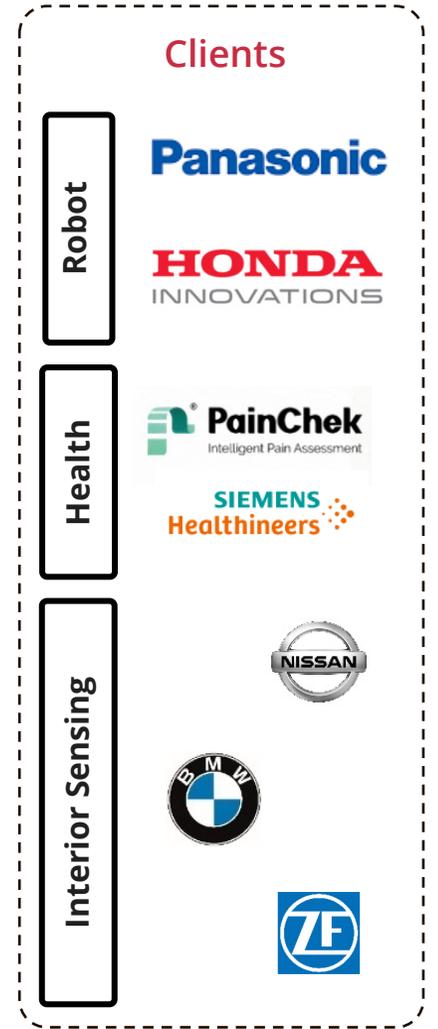


High power edge computing platform supporting attached cameras or non-attached cameras.

Camera or Video Input

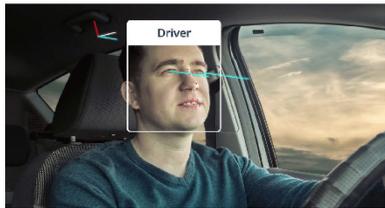


Standard Signal Definitions

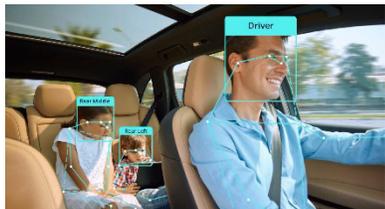


# NVISO Product Demo

## Interior Monitoring Systems for Mobility



**DRIVER MONITORING**  
SAFETY



**OCCUPANT DETECTION**  
SECURITY

- **Test Vehicle** in Switzerland equipped with 20+ AI Apps running on Intel x86, NVIDIA Jetson Xavier AGX, NVIDIA Jetson Nano, and NXP iMX8 QuadMax hardware platforms.
- **NVISO Emotion and Headpose AI Apps** optimized BrainChip Akida hardware
- Designed for DMS/IMS applications for connected and L2+ cars

Watch online - <https://vimeo.com/manage/videos/707615293/0e30484724>

↘ NVISO AI Solution for Mobility

# Intellectual Property | Patent Granted

US Patent for Human Behavioural Profiling from Image Processing using Artificial Intelligence by the US Patent and Trademark Office (patent number US 11,048,921) on 29 June 2021

<https://patents.google.com/patent/US11048921B2/en?q=US+11%2c048%2c921>

Continuation patent application with the Serial No. 16/403,656 filed 26th June 2021

Applications extended to automotive, healthcare, and robotics.



(12) **United States Patent**  
Sorci et al. (10) **Patent No.:** US 11,048,921 B2  
(45) **Date of Patent:** Jun. 29, 2021

(54) **IMAGE PROCESSING SYSTEM FOR EXTRACTING A BEHAVIORAL PROFILE FROM IMAGES OF AN INDIVIDUAL SPECIFIC TO AN EVENT**

(71) Applicant: nViso SA, Lausanne (CH)

(72) Inventors: Matteo Sorci, Morges (CH); Timothy Llewellyn, Saint-Prex (CH)

(73) Assignee: nViso SA, Lausanne (CH)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 72 days.

(21) Appl. No.: 16/403,656

(22) Filed: May 6, 2019

(65) **Prior Publication Data**  
US 2019/0347478 A1 Nov. 14, 2019

**Related U.S. Application Data**  
(60) Provisional application No. 62/668,856, filed on May 9, 2018.

(51) **Int. Cl.**  
G06K 9/00 (2006.01)  
G06N 3/08 (2006.01)  
(Continued)

(52) **U.S. Cl.**  
CPC ..... G06K 9/00335 (2013.01); G06K 9/00671 (2013.01); G06K 9/6267 (2013.01); G06N 3/08 (2013.01); G06Q 40/08 (2013.01)

(58) **Field of Classification Search**  
CPC ..... G06K 9/627; G06K 9/00671; G06K 9/00335; G06K 9/00302; G06K 9/4628;  
(Continued)

(56) **References Cited**

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David C. Howell, "Statistics in Psychology," 8th Edition, University of Vermont, Wadsworth Cengage Learning Publication, 2013, ISBN-13 978-1-111-83548-4—Abstract.

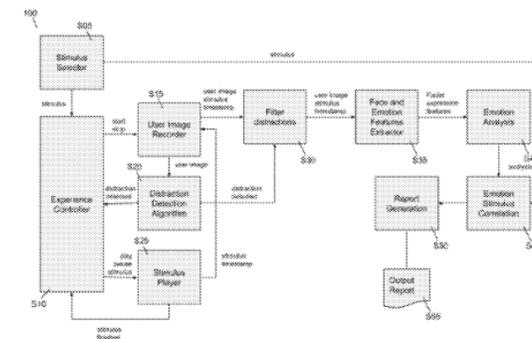
(Continued)

Primary Examiner — Brenda C Bernardi  
(74) Attorney, Agent, or Firm — Andre Roland S.A.; Nikolaus Schibli

(57) **ABSTRACT**

An automated method for assessing a behavioral profile of an individual based on image processing, the behavior profile being specific to a hypothetical or actual event, the method including the steps of detecting non-verbal communication from a physiological expression of the individual based on image data by a first computer algorithm, the image data being created by exposing the individual to a stimulus and obtaining the physiological expression of the individual in response to the stimulus, correlating features of the non-verbal communication to a topical area by a second computer algorithm, and generating a report corresponding to the individual that reflects the correlation between the non-verbal communication and the topical area, the report including the behavior profile of the individual.

19 Claims, 17 Drawing Sheets

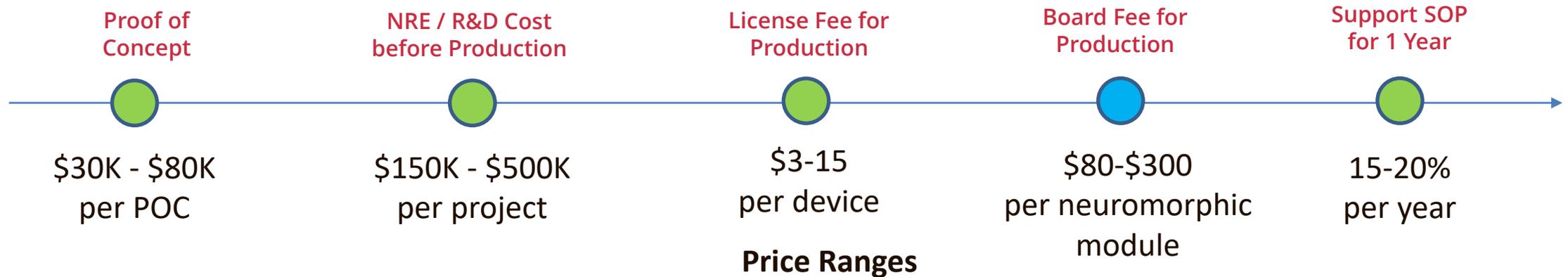


## Business Model | Recurring License Revenues



Manufacturers

- Neuromorphic Module (Available 2023)
- Software (Available Now)



# Competition | From Detection to Prediction

## From Single Sensor to Holistic Approach

### Universal Detection

AI algorithms are processed locally, directly on the device, without the need for an internet connection or sending information to the cloud. They work across the globe and cultures.

### Real-time Prediction

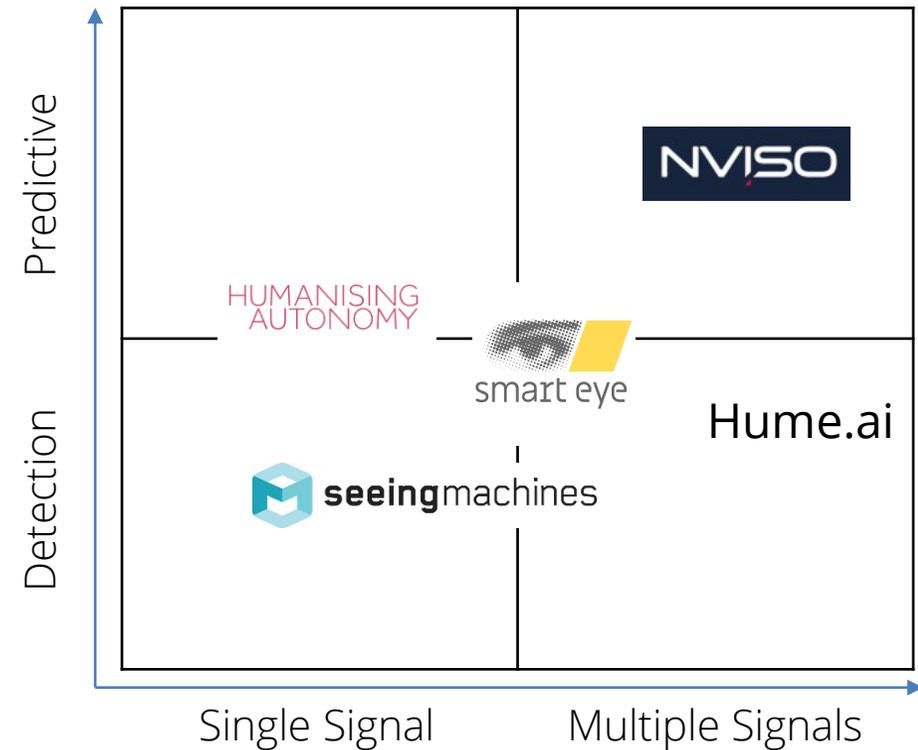
Through analyzing thousands of datapoints per image, complex emotions and human behavioral states can be predicted over short and long durations.

### Multiple Signals Integration

Through the integration of multiple signals, system robustness and confidence can be improved, especially in difficult corner cases.

### Pre-emptive vs Reactive Systems

Systems using NVISO holistic predictions can become pre-emptive opposed to simply reactive. Enable new, intuitive, and engaging user experiences.

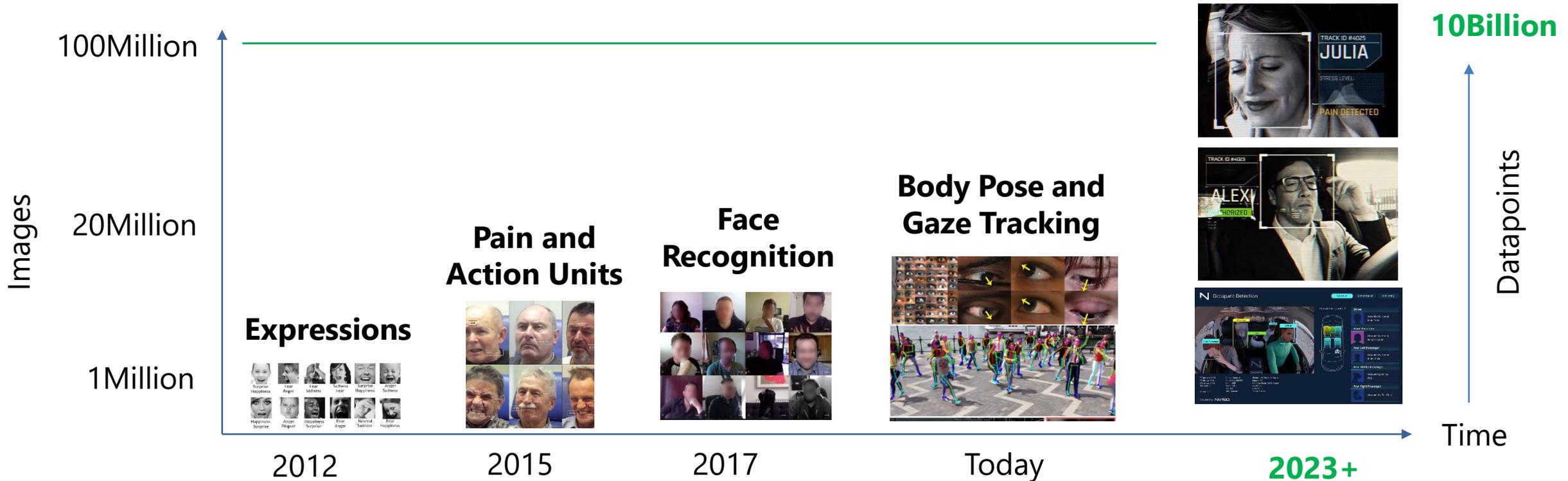


Faster and more robust decisions based on detection process (pre-emptive vs reactive)

# Barriers To Entry | Unique Holistic Multi-Sensor Databases

Proprietary Complex Emotion Datasets

Complex Emotions



Large and diverse multi-sensor Human Behavior AI datasets creates increasing barriers to entry

NVISO Whitepaper | Teaching Machines and IoT Devices to Understand Humans

Company Profile

# AI Solutions | Automotive Interior Monitoring Systems

# Driver Monitoring and Interior Sensing

## Key Technical Challenges for Software



### Frame Rates and Camera Location

Driver-related detection tasks will have a variable framerate from 30 to 60 fps and degradation phases can be expected with a single stream where frames are not equidistant. Camera location can be varied inside cabin.

### Auto-calibration and Mirror Rotation

The angle of the camera changes with each movement of the interior mirror. Therefore, an auto-calibration to estimate the mirror position and rotation must be provided. Relevant CAD data is provided by OEM.

### Requirements for Functional Safety

Parts of the recognition data is used for ASIL-B classified functions. Relevant development guidelines need to be considered including ASIL B error detection.

**Key technical challenges to overcome:** camera, movements, and functional safety

# Driver Monitoring and Interior Sensing | Applications of Tomorrow

Future in-car experience to be centered around the driver-vehicle relationship

AI enables the car to have continuous learning, with the end goal to develop an understanding with the occupants that is both meaningful and human in nature.

Stakeholders including OEMs and Tier 1s are looking at multi-modal interior sensing solutions using an AI based sensor fusion approach to add context to measured data.

Impact on autonomous cars and shared mobility economy includes enhanced user experience via natural interactions, preferences alignment, and ensure controlled access.

Low market maturity with most initiatives still in the pilot phase, with incremental functionalities being constantly enabled, combined with conceiving new use cases

Software development is a key challenge since the creation, training, and validation of AI algorithms come up against many technical and regulatory obstacles

Driver/  
Occupant Safety

AI functions as a key enabler for improving driver and occupant safety, across different levels of autonomous vehicles by acting on real time insights to alert and optimize driving behavior

Life on-Board

With cars becoming an extension of living spaces, the onus is on OEMs to deliver personalized experiences – enabled by AI which can automatically deliver preference-based interactions

Security, Policy  
Adherence &  
Authentication

In this application area, AI shows high potential to minimize security threats and regulate vehicle usage – by making the car safe and accessible only to authorized entities

In-cabin  
Interaction

AI simplifies in-cabin interactions with infotainment and in-car systems by accurately recognizing passengers' voice commands & gestures, with natural language processing being a key enabler

Beyond regulation, Human Behaviour AI to be key enabler for future in-car experience

Graph: Frenus

# Driver Monitoring and Interior Sensing | Key Market Drivers

## Automation Technology and Regulation and Strong Secular Tailwinds



### REGULATION

#### LEVEL 2+ and AUTONOMY

Monitoring of the driver is proposed by NCAP as a requirement from 2022, to mitigate the very significant problems of driver distraction and impairment through alcohol, fatigue, etc.



### EXPERIENCE

#### COCKPIT DESIGN AND EVOLUTION

Vehicle autonomy (L3+) will allow various support systems to be implemented for security, safety and comfort and new UX experiences.



### MOBILITY AS A SERVICE

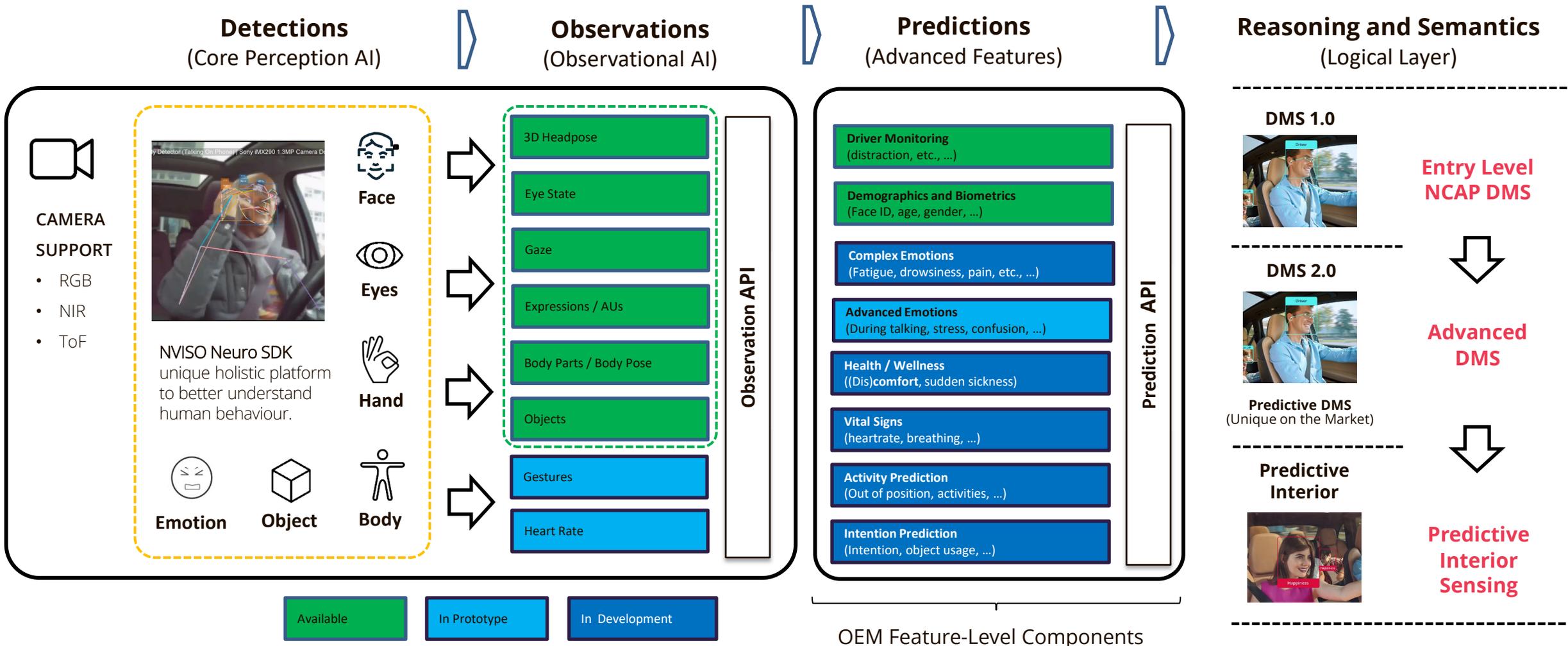
#### CAR AND RIDE SHARING

Car sharing required by societal changes and infrastructure limitations and enabled by vehicle autonomy will shift focus from driving experiences to transportation experiences.

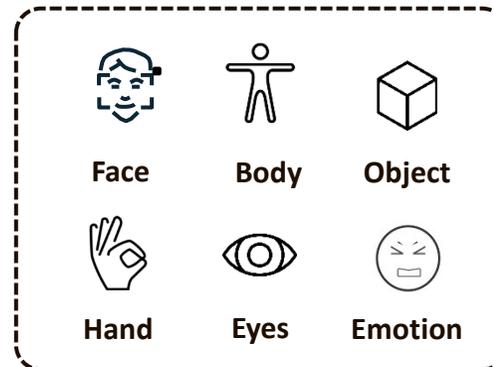
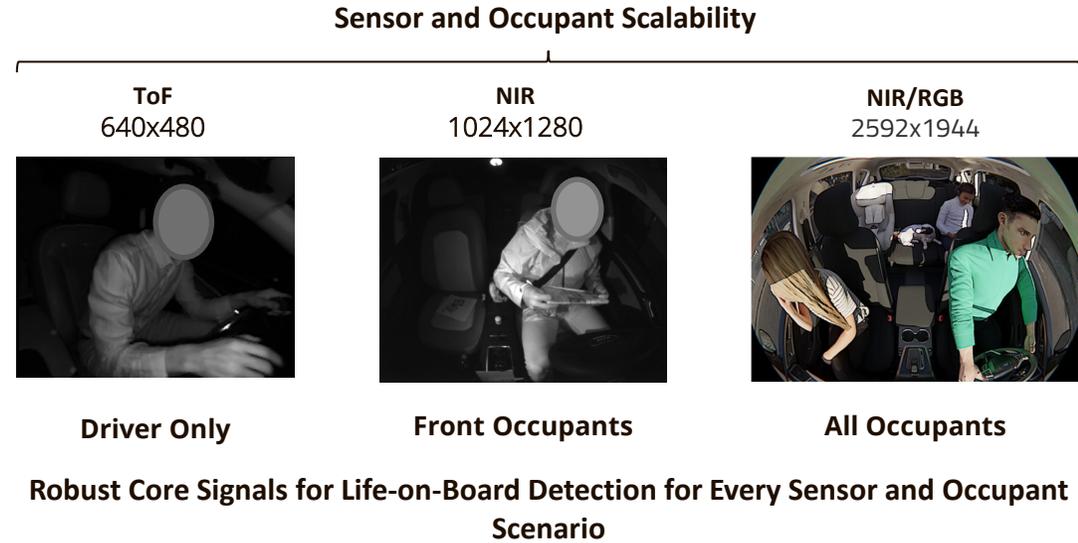
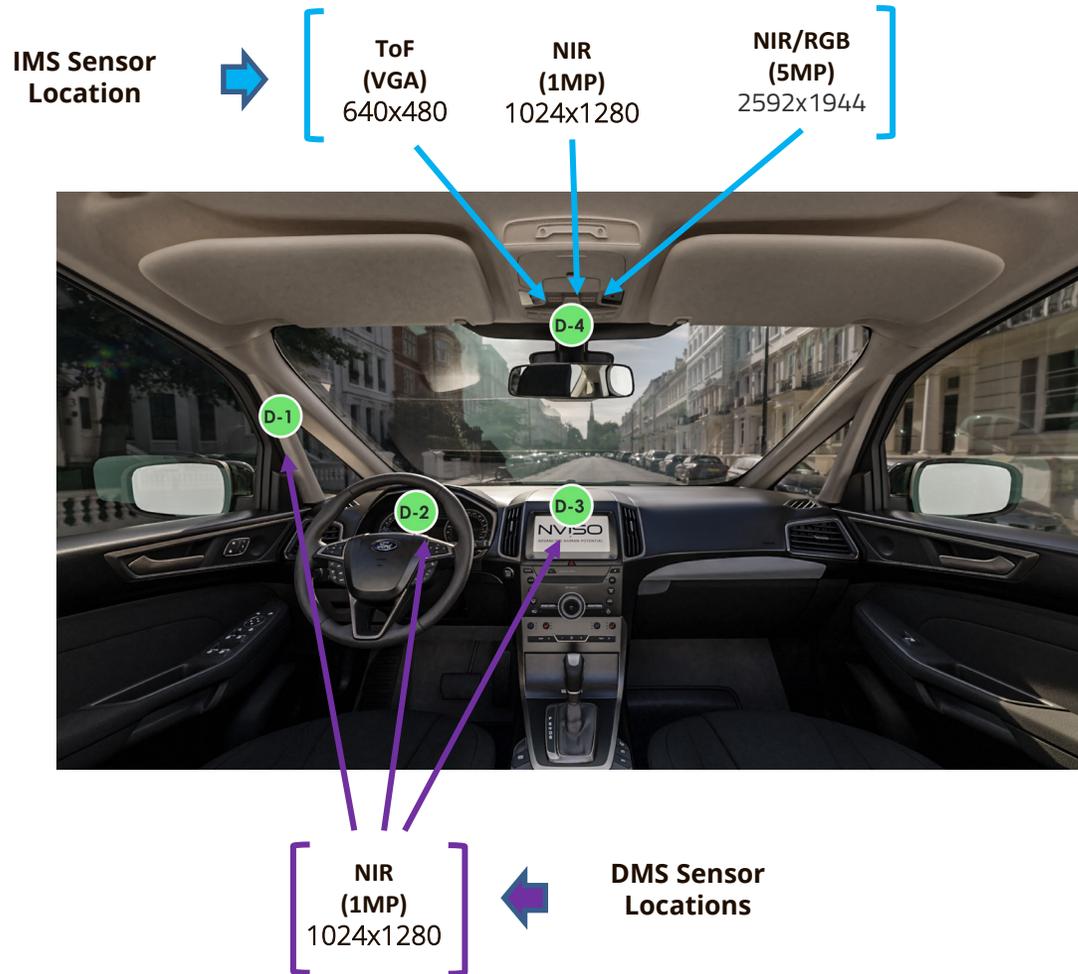
Although regulation is only part of the story, **automation technology is a strong secular tailwind**

Source (Source: Automotive Interior - From Lighting to Sensing and Display Technologies 2020 report, Yole Développement, 2020)

# Driver Monitoring and Interior Sensing | NVISO LoB Platform Approach



# Driver Monitoring and Interior Sensing | NVISO Life-on-Board (LoB) Sensors



**DMS/OMS/CPD for Every OEM Situation**  
 Scalable -> Cost Effective

# Driver Monitoring and Interior Sensing | Integration Demo



**DRIVER MONITORING**  
SAFETY

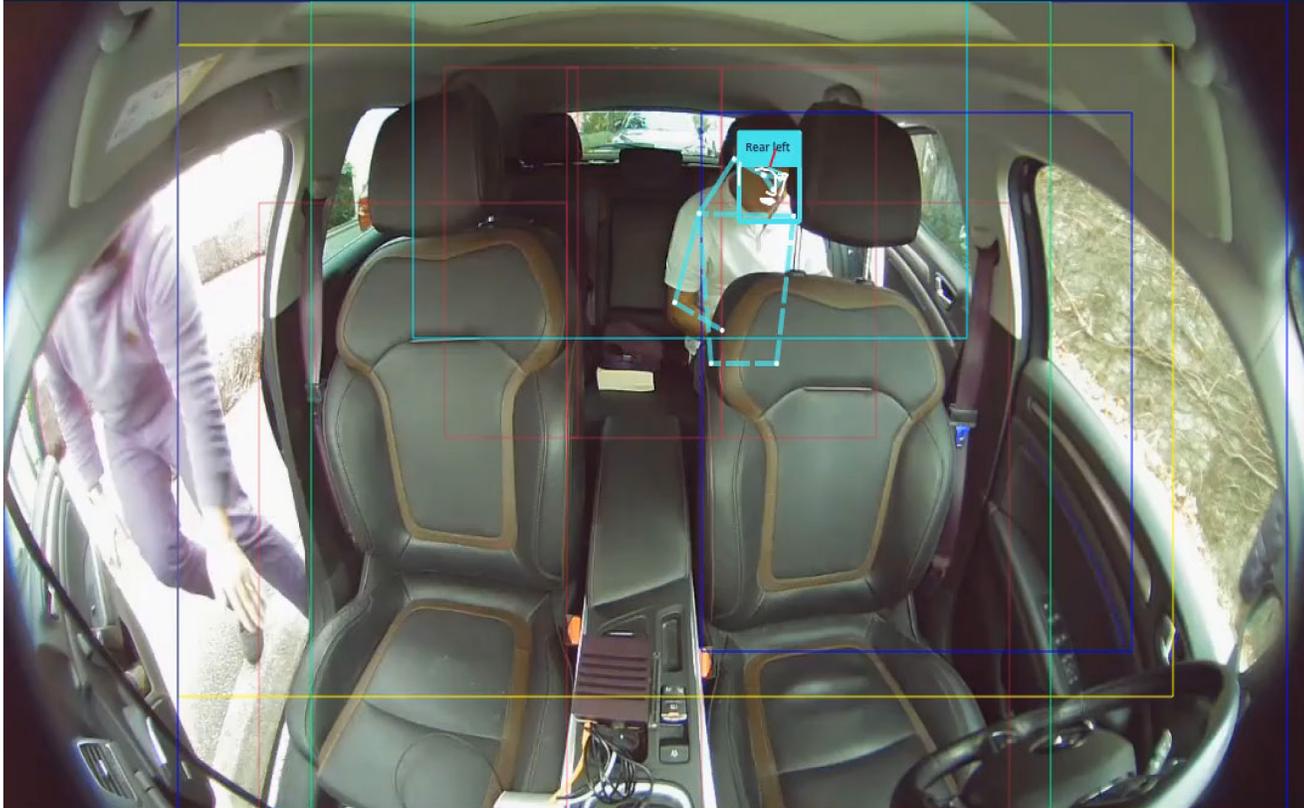


**OCCUPANT DETECTION**  
SECURITY



- **Test Vehicle** in Switzerland equipped with 20+ AI Apps running on Intel x86, NVIDIA Jetson Xavier AGX, NVIDIA Jetson Nano, and NXP iMX8 QuadMax hardware platforms.
- **NVISO Emotion and Headpose AI Apps** optimized BrainChip Akida hardware
- Designed for DMS/IMS applications for connected and L2+ cars

Interior monitoring systems <https://vimeo.com/manage/videos/707615293/0e30484724>



Occupant Count: 1



Cabin Mood

Signal not available

- Happiness
- Surprise
- Sadness
- Disgust
- Anger
- Fear
- Neutrality

Display FPS:  
RAM usage: 1.2% (3079.2 MB)  
CPU load: 4.0%  
GPU load: -

### Driver



Empty

### Front passenger



Empty

### Rear left passenger



Occupied by  
Human  
Unknown / Adult

### Rear middle passenger



Empty

### Rear right passenger



Empty

### Driver State

Eyes State (open/closed)

Attention:

0 bpm

Vital Signs

Signal not available

0 bpm



Hands on wheel  
No hands



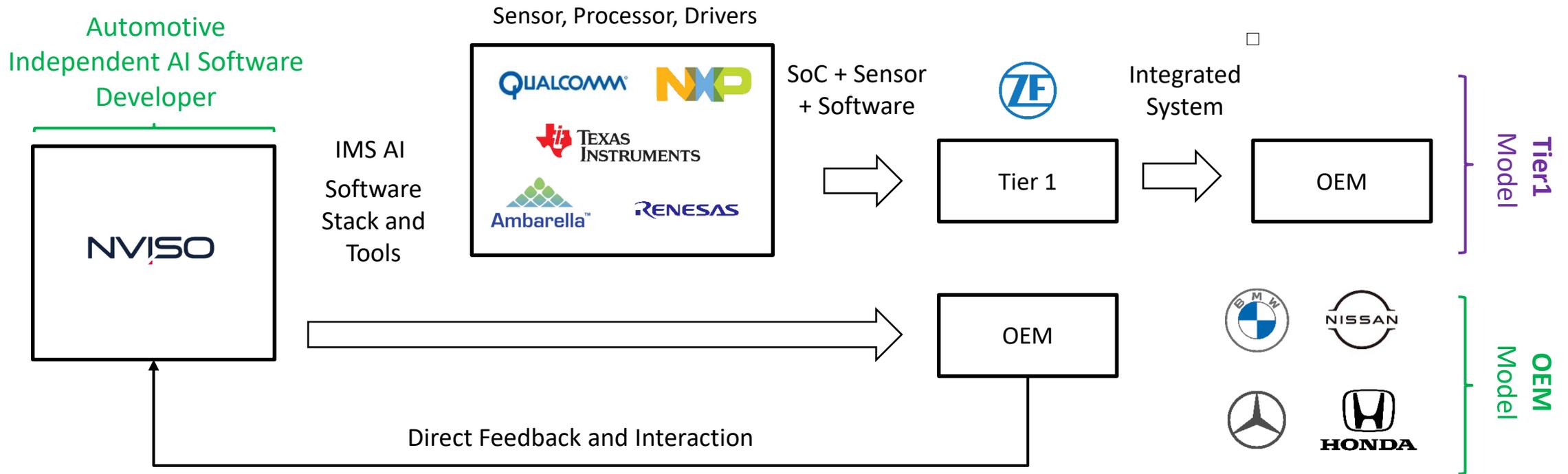
Activity



Gesture

# Accelerated Market Opportunity via Platform Approach

Technology direct to OEM or via System Integrator



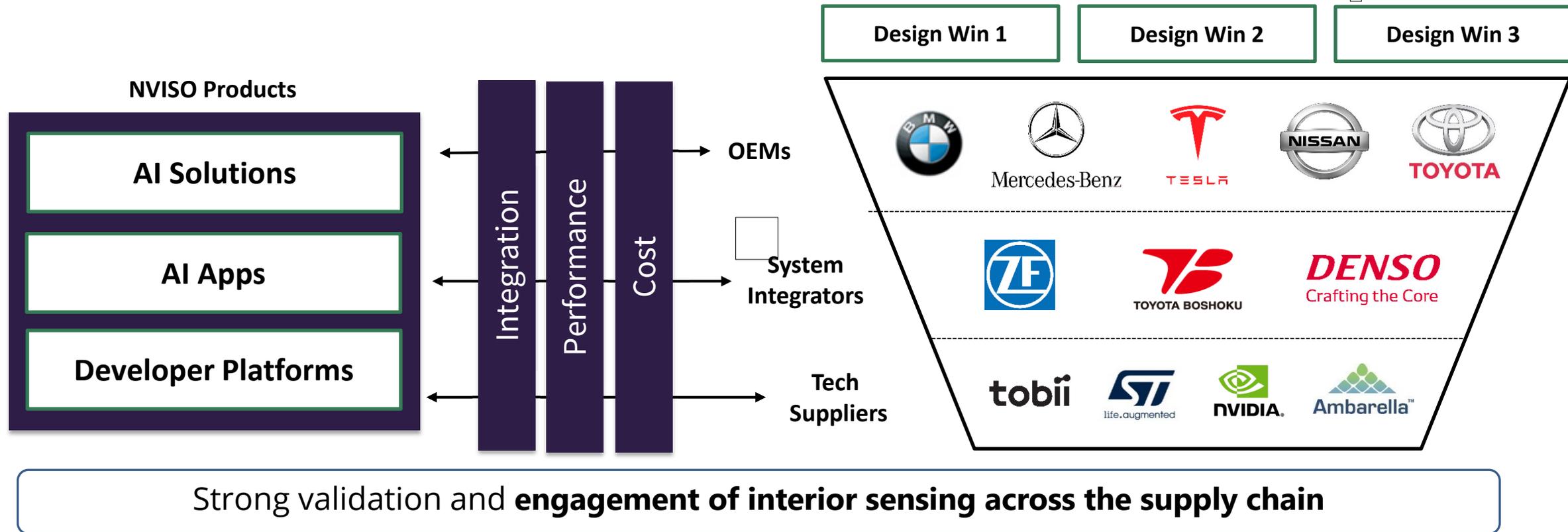
Technology joint/venture shorten integration time and lowers costs for OEMs

Graph: NVISO Business Plan

# Validation and Engagement

Engagement and validation across entire Automotive supply chain

Target to secure 3 design wins in next 3 years



Strong validation and **engagement of interior sensing across the supply chain**

Graph: NVISO Business Plan

Company Profile

# AI Solutions | Neuromorphic Computing Enhanced

# NVISO Neuro SDK | BrainChip Partnership

## AI App interoperability with world's first fully-digital neuromorphic processor

### Who is BrainChip?

- BrainChip's first-to-market silicon-proven, event-based AI processor IP, Akida™, is based on neuromorphic principles - mimicking the human brain. BrainChip enables effective edge compute to be universally deployable across real-world applications such as connected cars, consumer electronics, and industrial IoT.
- BrainChip Akida benefits for NVISO edge applications
  - Power Efficient** - extreme energy efficiency for always-on devices
  - High Throughput** – runs many networks simultaneously
  - Ultra-Low Latency** – execute in milliseconds not seconds
  - One-Shot Learning** - on-device learning from little data

### NVISO Achievements

- Porting four (4) NVISO AI Apps to BrainChip Akida in 3 months
- Fully qualification and characterisation and benchmarking versus CPU / GPU
- Release of EVK for demonstration and customer engagement



PRESS RELEASE

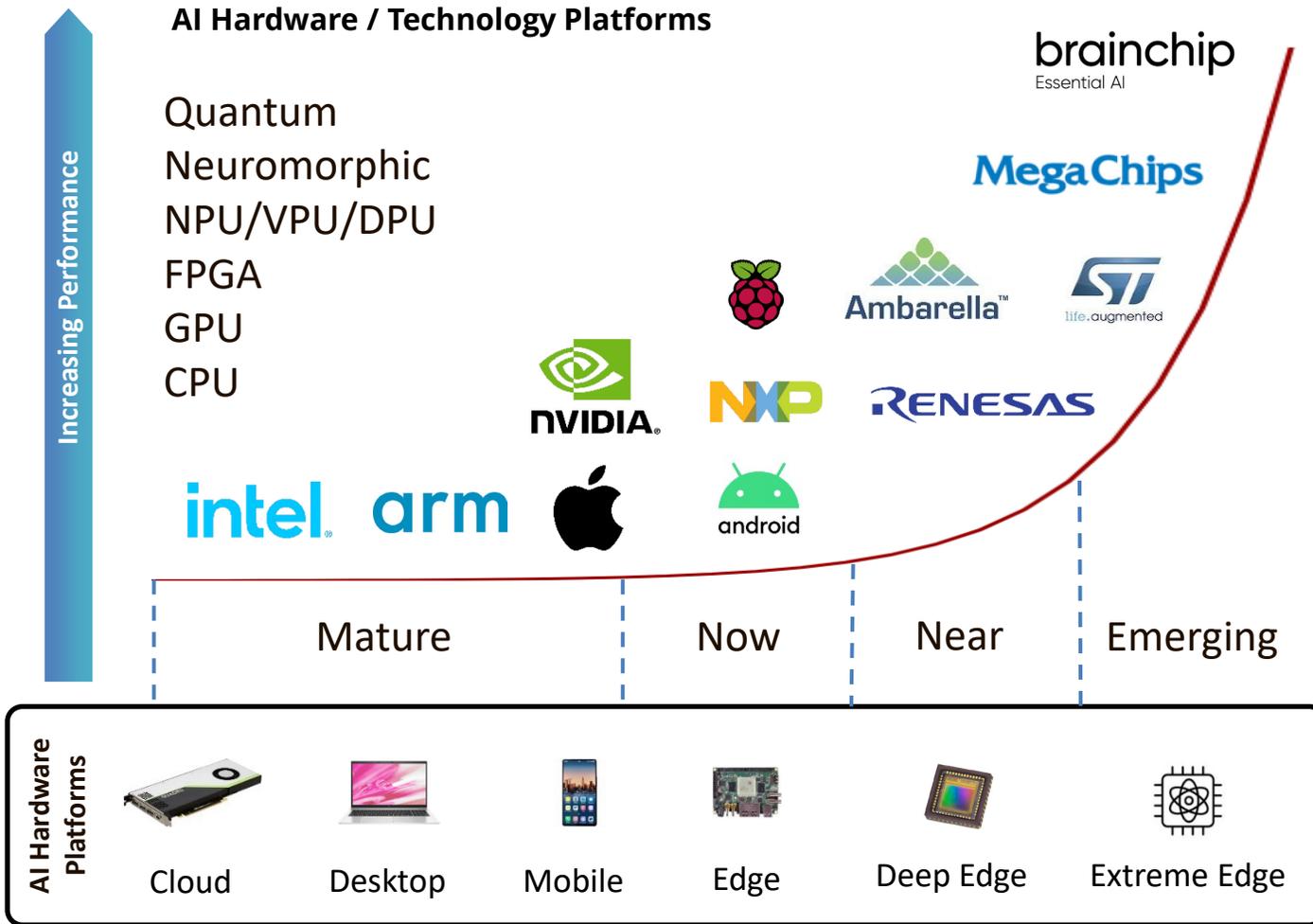
NVISO advances its Human Behaviour AI SDK for neuromorphic computing using the BrainChip Akida platform

<https://www.nviso.ai/en/events/ai-expo-2022>

Four (4) **NVISO AI Apps are interoperable** with world's first fully-digital neuromorphic processor

Image: NVISO – AI Expo Japan April 2022

# Accelerated Adoption | AI IoT + Neuromorphic Computing + AI Apps



## Example NVISO Industry Verticals

# AI Solutions for Industry

**CONSUMER**

AI enabled smart devices in the home can transform entertainment, work, education, and healthy living spaces.

**HEALTHCARE**

Modern AI can transform the healthcare industry by analyzing vast amounts of data with incredible accuracy.

**AUTOMOTIVE**

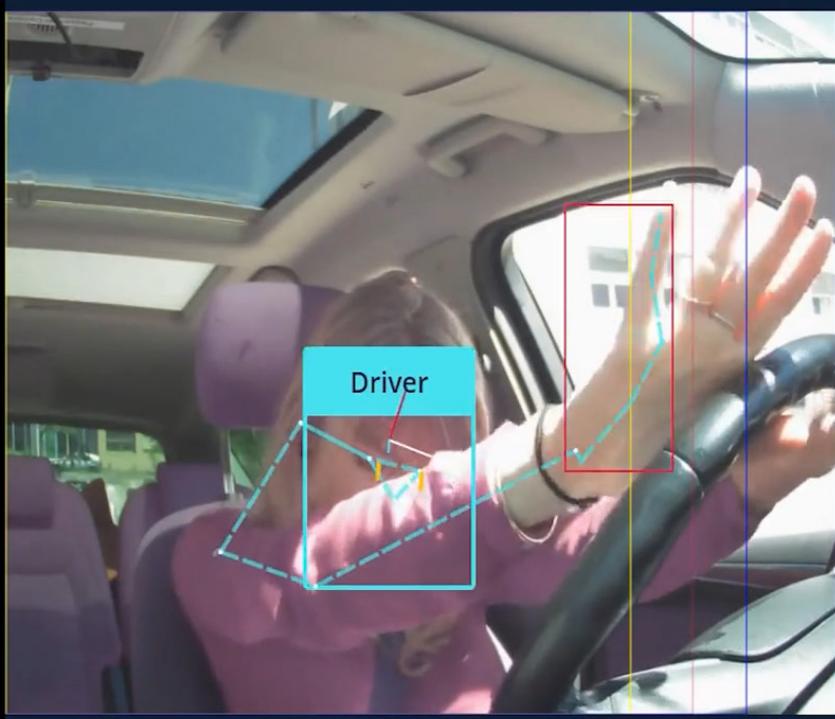
Next generation mobility requires AI, from self-driving cars to new ways to engage customers.

# AI Apps

Face Hand Eyes Body Animal Object

# Accelerated Adoption | Robust in Real-World Environments

**NVIDIA GPU**  
Precision 32 to 8-bit



**BrainChip Akida (Headpose Only)**  
Precision 4-bit



Edge

100  
FPS+



Extreme  
Edge

1000  
FPS+

# NVISO Neuro SDK | BrainChip Performance Evaluation

- Software and Hardware**

- NVISO Neuro EVK incorporating five (5) CNN based models for Human Behaviour AI
- NVIDIA Jetson Nano 4GB Developer Kit
- BrainChip Akida 1000 PCI Express Card

- Benchmark**

- Five (5) NVISO Neuro Models with identical
  - #params / architecture
  - input size / outputs
  - batch size = 1
- Three (3) inference runtimes
- Two (2) hardware platforms



PHOTOGRAPH  
NVISO advances its Human Behaviour AI SDK for neuromorphic computing using the BrainChip Akida platform.

NVIDIA Jetson Nano (4GB)

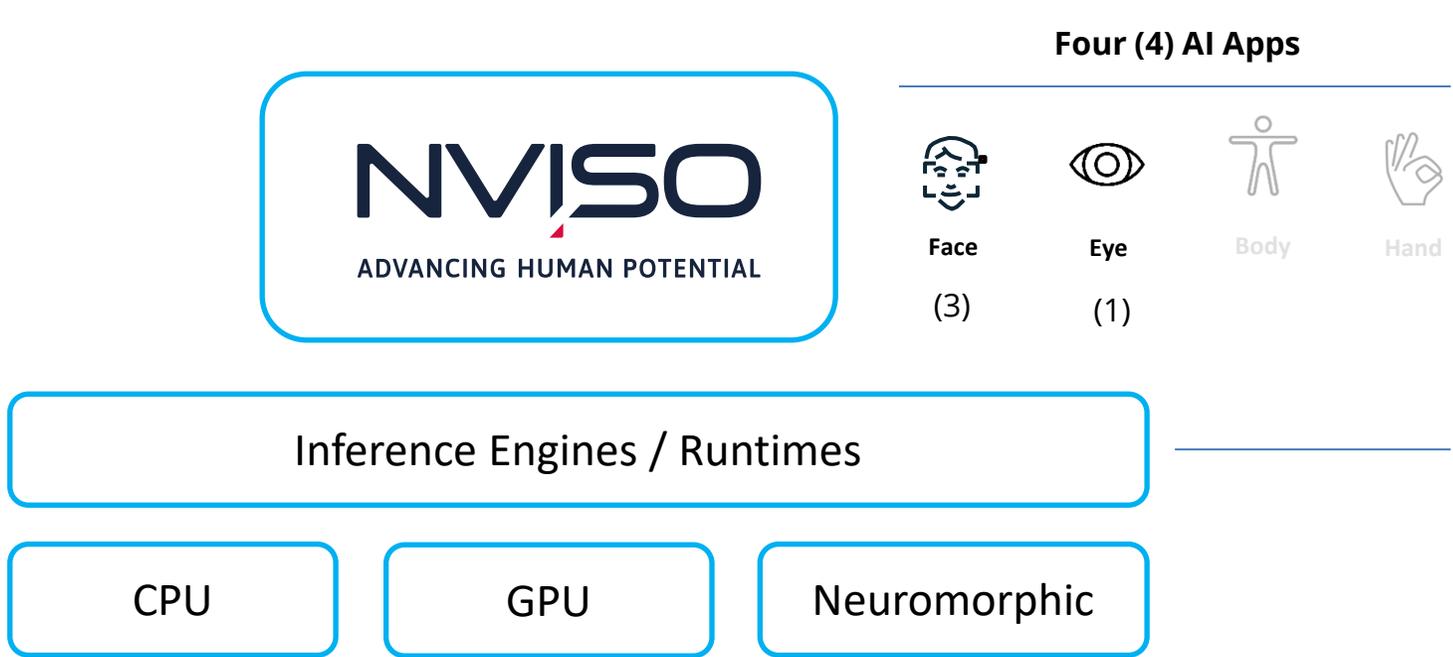


**brainchip**  
Essential AI



	<b>NVIDIA Jetson Nano</b>	<b>BrainChip</b>
CPU	ARM A57 (Camel V8.2)	ARM M4
Neural Acceleration	CUDA based GPU	Akida
Frequency (MHz)	921 (GPU) / 1479 (CPU)	300

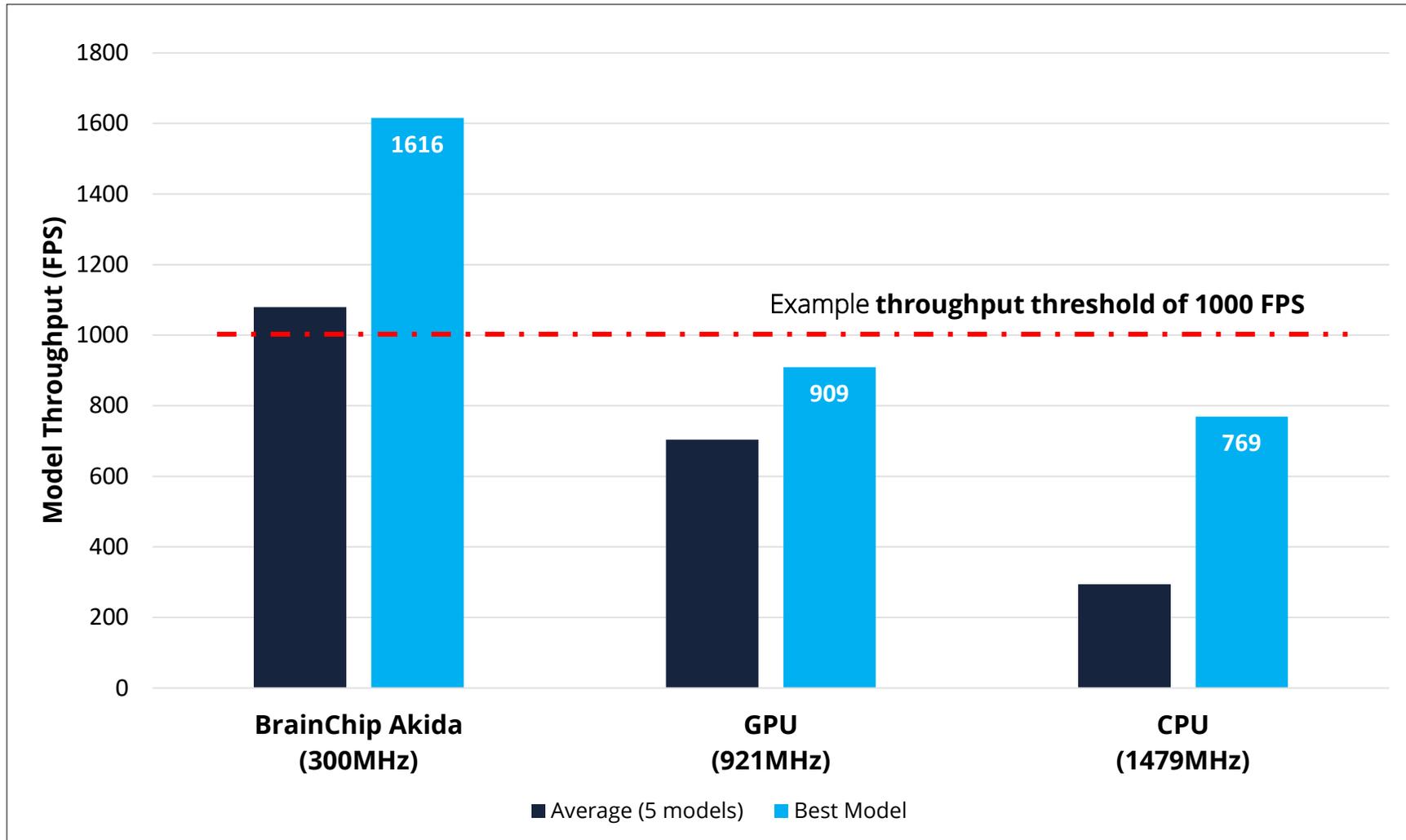
# NVISO Neuro SDK | BrainChip Performance Evaluation



- **Five (5) NVISO Neuro Models Under Test**
  - Input Sizes (48x48 to 112x112)
  - Headpose / Gaze
  - Facial Expressions
- **Inference Engines / Runtimes**
  - TensorRT 8.0.1
  - BrainChip Akida Runtime 2.2.2
  - LPDNN v0.4
  - ONNX Runtime 1.10
- **Hardware Platforms**
  - NVIDIA Jetson Nano (4GB)
  - BrainChip Akida



## NVISO Neuro SDK | Throughput exceeding 1000 FPS



### Model Throughput (FPS) vs Platform

NVISO Neuro Model performance can be accelerated by an average of 3.67x using neuromorphic computing over a single core ARM Cortex A57 as found in a NVIDIA Jetson Nano (4GB). On a clock frequency normalization basis, this represents an acceleration of 18.1x.

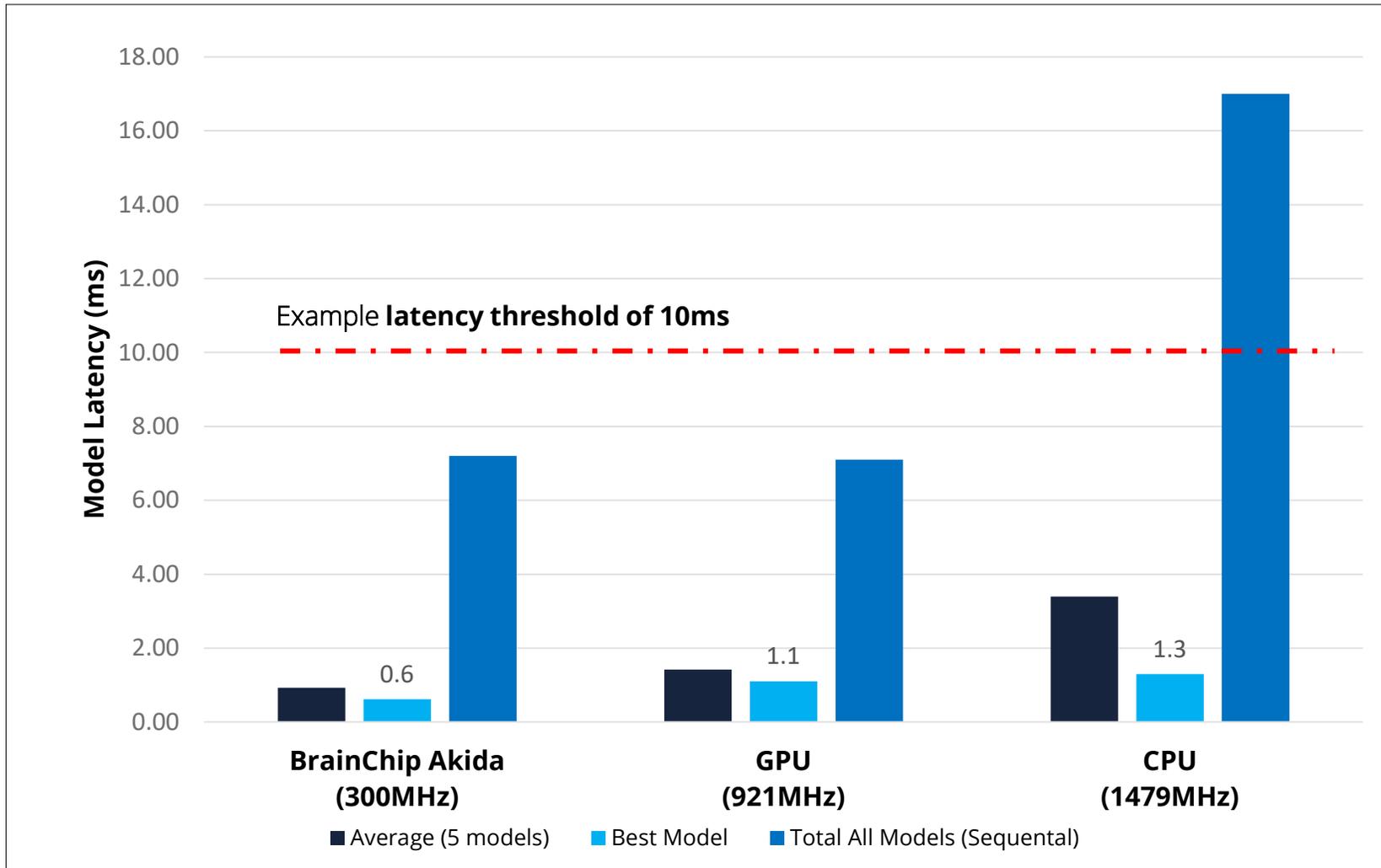
When compared to the GPU, this acceleration represents 1.53x and 4.69x respectively.

CPU = Single ARM Cortex A57

GPU = Single NVIDIA Tegra X1

Batch size = 1

# NVISO Neuro SDK | Latency less than 1ms



## Model Latency (ms) vs Platform

NVISO Neuro Model latency (ms) can be summarized in the following table.

Latency (ms)	BrainChip Akida	Jetson Nano 4GB GPU	Jetson Nano 4GB CPU
Emotion Front	2.5	1.4	4.7
Emotion Rear	0.7	1.1	1.3
HeadPose	2.8	1.6	7.9
Eye Gaze Right	<b>0.6</b>	1.5	1.6
Eye Gaze Left	<b>0.6</b>	1.5	1.5
Total	7.2	7.1	17.0

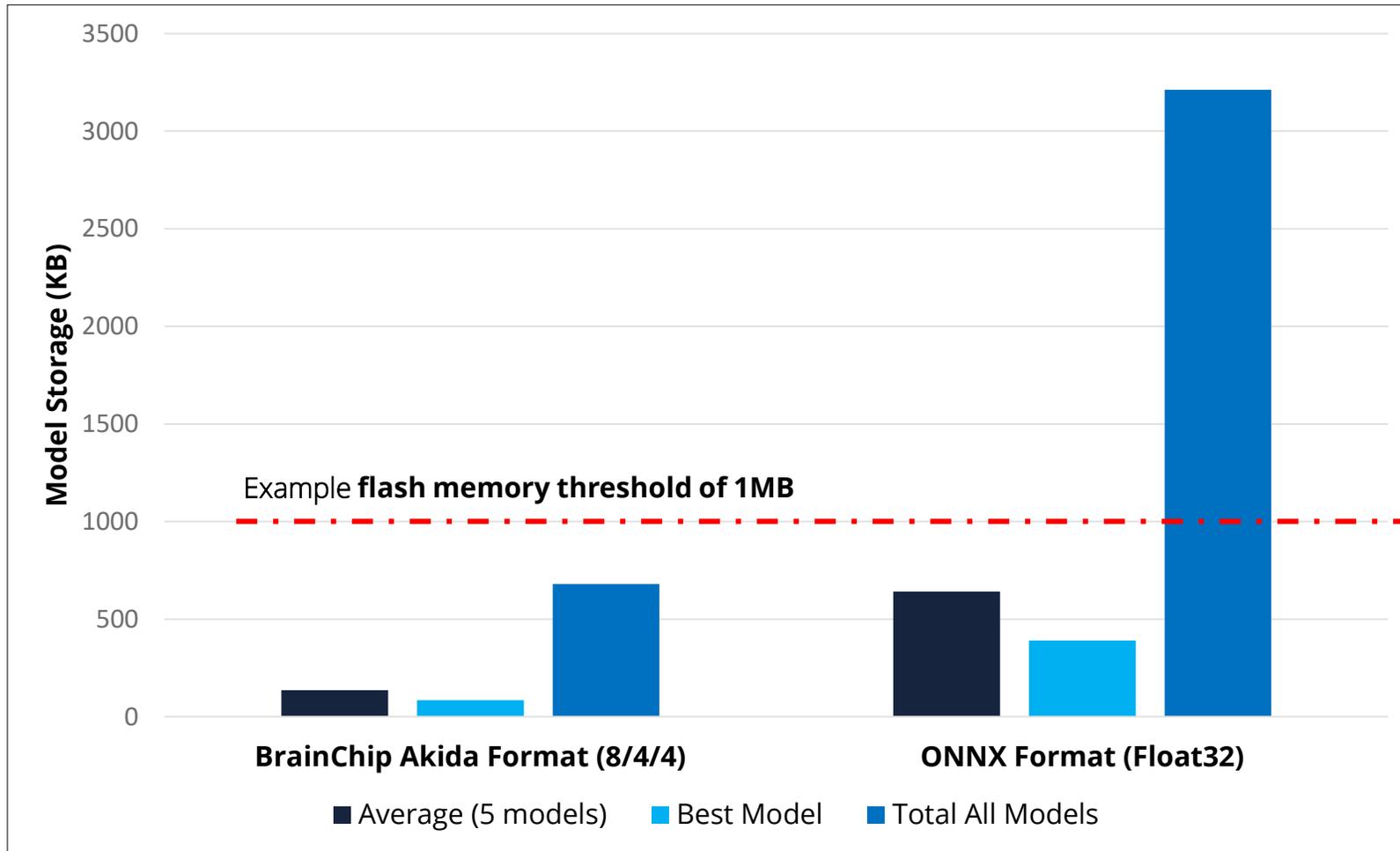
Total model latency is similar for GPU and BrainChip Akida, however CPU latency is approximately 2.4x slower. All models on all platforms can achieve <10ms latency and the best model can achieve 0.6ms.

CPU = Single ARM Cortex A57

GPU = Single NVIDIA Tegra X1

Batch size = 1

## NVISO Neuro SDK | Storage under 1MB



### Model Storage (KB) vs Platform

NVISO Neuro Models can achieve a model storage size under 1 MB targeting ultra-low power MCU system where onboard flash memory is limited. Removing the need for external flash memory saves cost and power.

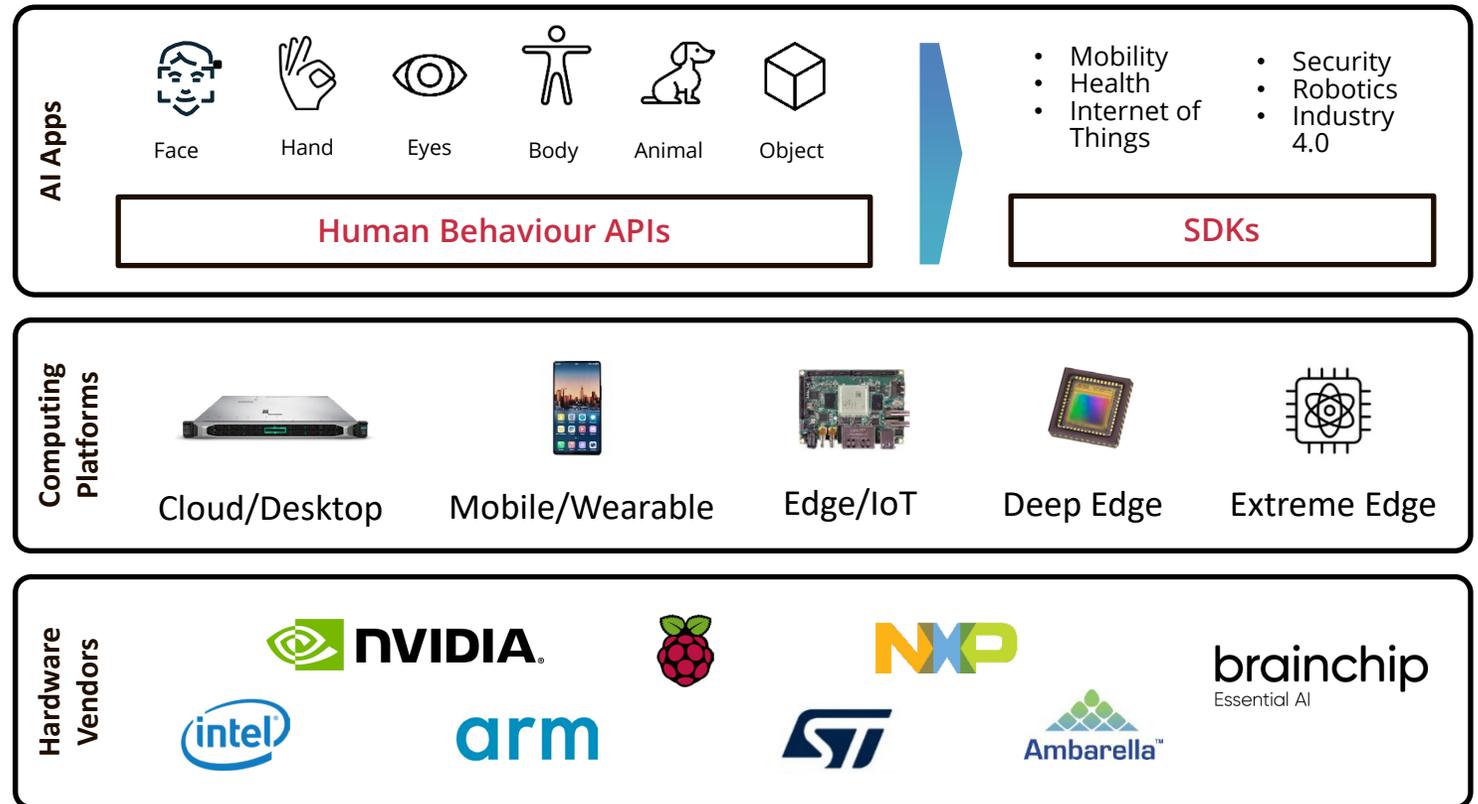
AKIDA (8/4/4) = 680 KB

ONNX (Float) = 3213 KB

# Monetising the Data | AI Applications solving Industry Problems

**AI Apps and Solutions** for edge device is far more demanding due to the limitations in terms of computation and storage abilities when compared to cloud-based systems.

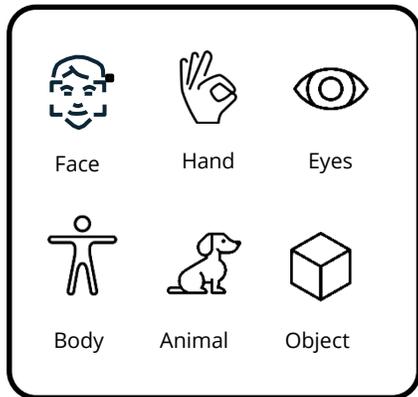
**Developer Platforms** for ultra-low power, always-on, battery powered devices require porting of the trained model from the training environment to the target device, e.g., a low-power microcontroller, including the implementation of all necessary pre and post-processing steps of the AI App. This is a complex step as it involves several data and code conversions as well as low-level optimisations for a given hardware vendor.



10 years of R&D developing state-of-the AI Apps for **detecting human behavior on edge devices**

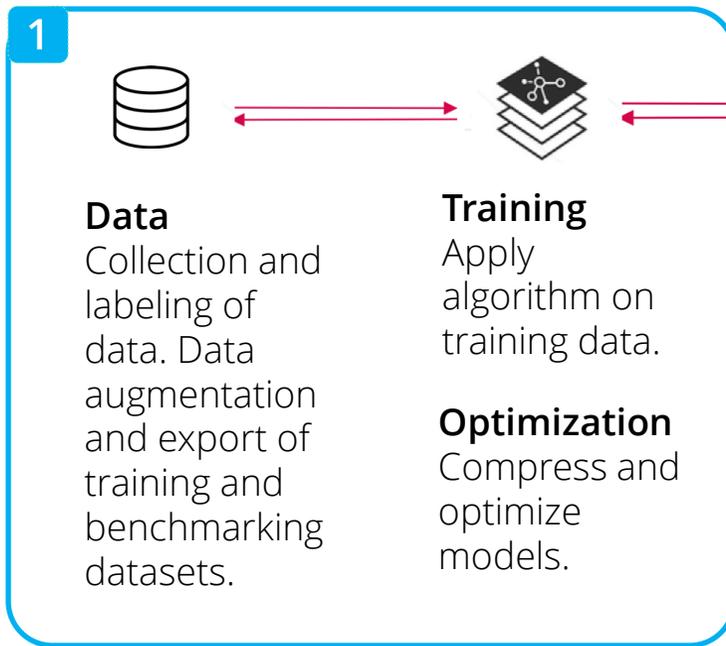
# The Magic | Data-Centric AI App Automation

## Existing Datasets



## Datasets, Training, and Optimisation

Collect/Annotate/Train/Optimise



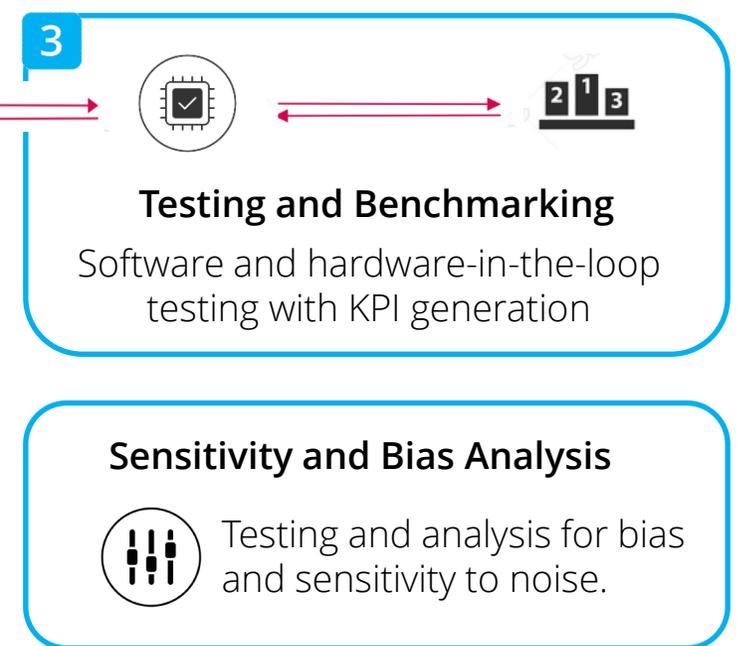
## Deployment

Code/Compile

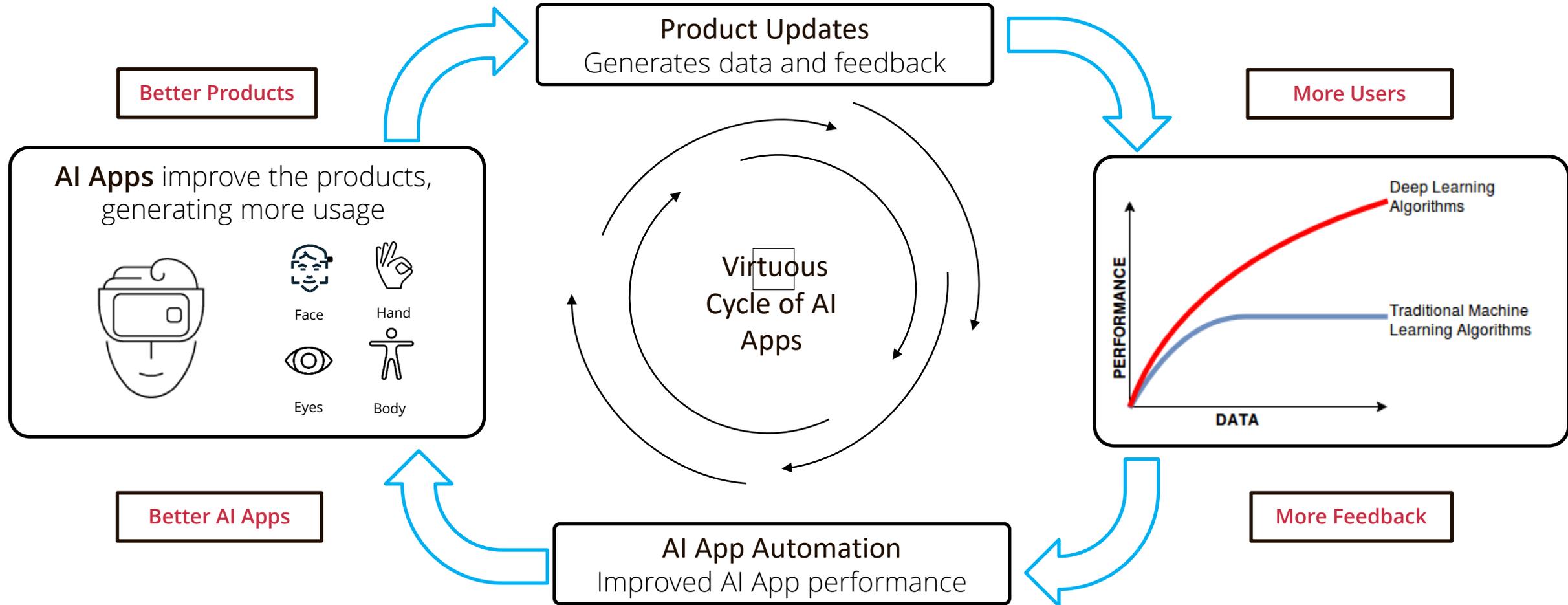


## Testing and Benchmarking

SIL/HIL Tests and Benchmark



# The Unfair Advantage | AI "Flywheel" Network Effect



# Lower Power and Latency | ~2x Performance Gains on ARM CPUs Alone

Average of THROUGHPUT	Column Labels		
Row Labels	Ine	onnxruntime	tensorrt
<b>imx8m-nano</b>	<b>4.5</b>	<b>1.9</b>	
128x96	8.0	3.2	
192x144	3.5	1.6	
256x192	2.1	1.0	
<b>jetson-nano2</b>	<b>7.7</b>	<b>3.2</b>	<b>20.3</b>
128x96	13.3	5.4	26.4
192x144	6.0	2.6	19.4
256x192	3.7	1.7	15.3
<b>jetson-xav-agx</b>	<b>16.3</b>	<b>7.0</b>	<b>51.3</b>
128x96	28.4	11.9	79.6
192x144	12.7	5.6	44.8
256x192	7.9	3.7	29.6
<b>rpi3</b>	<b>3.4</b>	<b>1.5</b>	
128x96	5.9	2.5	
192x144	2.6	1.3	
256x192	1.6	0.8	
<b>rpi4</b>	<b>7.1</b>	<b>3.2</b>	
128x96	12.9	5.3	
192x144	5.2	2.7	
256x192	3.1	1.7	
<b>Grand Total</b>	<b>7.8</b>	<b>3.9</b>	<b>38.9</b>

- Automated toolchain explores multiple inference engines. LPDNN (LNE), ONNX Runtime, and TensorRT at runtime to find best configuration for a given platform. Currently supports MCUs, CPUs, GPUs, and NPUs. Neuromorphic computing currently under development.
- Benchmarks of AI Apps include pre-processing, model inference, and post-processing on multiple platforms e.g. example shown on NXP iMX8m-Nano, NVIDIA Jetson Nano, NVIDIA Jetson AGX, and RaspberryPi3/4, however over 20 platforms currently supported.
- Different input sizes are included in benchmarks.
- LPDNN (LNE) Inference Engine ~2x Faster** for ARM CPUs than ONNX Runtime. AI App performance (latency and power) heavily depends on:
  - Hardware selected
  - Software based inference engine (including pre and post-processing)
- For AI Apps requiring lowest latency or lowest power consumption both **software and hardware must be carefully selected together.**

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## Future Matters

This presentation contains reference to certain intentions, expectations, future plans, strategy and prospects of NVISO. Those intentions, expectations, future plans, strategy and prospects may or may not be achieved. They are based on certain assumptions, which may not be met or on which views may differ and may be affected by known and unknown risks.

The performance and operations of NVISO may be influenced by a number of factors, many of which are outside the control of NVISO. No representation or warranty, express or implied, is made by NVISO, or any of their directors, officers, employees, advisors or agents that any intentions, expectations or plans will be achieved either totally or partially or that any particular rate of return will be achieved. Given the risks and uncertainties that may cause NVISO's actual future results, performance or achievements to be materially different from those expected, planned or intended, recipients should not place undue reliance on these intentions, expectations, future plans, strategy and prospects. NVISO does not warrant or represent that the actual results, performance or achievements will be as expected, planned or intended.

# NVISO Risks

Risk Description	
<b>Transactional Risk</b>	
<b>Lack of Market</b>	There is currently no public market for NVISO's fully paid ordinary shares ( <b>Shares</b> ), the price of Shares is subject to uncertainty and there can be no assurance that an active market for the Shares will develop or continue in the future. While NVISO may ultimately list on ASX, there is no certainty that this will occur.
<b>Financing and Dilutionary Risk</b>	The success of reaching an IPO is subject to many risk factors including the success of interim capital raising, market conditions and/or business opportunities. Even if NVISO is successful in closing future financing there is no guarantee that an IPO will take place. If the company can not attract future financing, it could stop to be a going concern if it can not secure customers for its products and services. NVISO reserves the right to explore any alternative structures/solutions in the future. The Company may elect to restructure its corporate organisation in the future which may dilute and affect investors and shareholders interests. Currently issued ordinary shares are 130.9 million, \$3.37m of convertible debt, and additionally there are 20 million performance shares, 20 million unlisted options, and 10 million management/advisor/lender options.
<b>General Risks</b>	
<b>General risks</b>	There are a range of general risks that are relevant to a potential investment in NVISO, including but not limited to, economic, the fact that NVISO may have additional requirements for capital, regulatory risks, and taxation, amongst others.
<b>Future Liquidity</b>	There is no guarantee that NVISO will be admitted to the ASX or that there will be an ongoing liquid market for NVISO's securities. Accordingly, there is a risk that should an ASX listing not be achieved or should the market for NVISO's securities become illiquid, shareholders will be unable to realise their investment in NVISO.
<b>Economic</b>	General economic conditions, introduction of tax reform, new legislation, movements in interest and inflation rates and currency exchange rates may have an adverse effect on NVISO or NVISO's activities, as well as on its ability to fund those activities.
<b>Regulatory</b>	Changes in relevant taxes, legal and administration regimes, accounting practice and government policies may adversely affect the financial performance, financial position and activities of NVISO or NVISO.
<b>Investment speculative</b>	The list of risk factors ought not to be taken as exhaustive of the risks faced by NVISO or by investors in NVISO. The risk factors, and others not specifically referred to in this list, may in the future materially affect the financial performance of NVISO and the value of the Shares. Therefore, any Shares to be issued carry no guarantee with respect to the payment of dividends, returns of capital or the market value of those Shares. Potential investors should consider that the investment in NVISO is highly speculative and should consult their professional advisers before deciding whether to apply for Shares in NVISO.
<b>Operational Risks relating to NVISO</b>	
<b>Patent application risk</b>	As discussed below (Technology risks), NVISO intends to offer its products and services internationally. NVISO has applied for a patent, which is still pending. There is no guarantee that this patent application will be granted or that NVISO will receive enforceable patent rights. There is a risk that NVISO will not be entitled to practice the inventions claimed in the patent, and that the working of its patented invention may be prevented by another patent or patent application which has an earlier priority date to the patent applications licensed to NVISO. Even if NVISO succeeds in obtaining patent protection for its products, its patent could be partially or wholly invalidated following challenges by third parties. The grant of a patent does not guarantee validity of that patent since it may be revoked on the grounds of invalidity at any time during its life. If none of the claims of a granted patent are valid, the patent is unenforceable.
<b>Protection of intellectual property rights</b>	NVISO has trade secrets and other intellectual property rights that are important assets. NVISO may therefore rely on a combination of confidentiality and license agreements with its consultants, employees, and third parties with whom it has relationships, as well as patents, domain names, trade secrets and copyright, to protect its brand and other intellectual property rights. There is a risk that NVISO may be unable to detect the unauthorised use of its intellectual property in all instances. Further, actions taken by NVISO to protect its intellectual property may not be adequate or enforceable and therefore may not prevent the misappropriation of intellectual property and proprietary information.  NVISO's failure to protect its intellectual property rights could have an adverse impact on NVISO's operations and financial performance. NVISO may be required to incur significant expenses in monitoring and protecting its intellectual property rights. NVISO may initiate or otherwise be involved in litigation against third parties for infringement, or to establish the validity, of its rights. Any litigation, whether or not it is successful, could result in significant expense to NVISO and cause a distraction to Management. In addition, unauthorised use of NVISO's brand or intellectual property by third party products or services may not only result in potential revenue loss, but also have an adverse impact on NVISO's brand value and the market perception of the quality of its products.

Risk Description	
Operational Risks relating to NVISO	
<b>International Operations</b>	NVISO intends to do business internationally. NVISO's operations will therefore be subject to a number of risks inherent in international operations, including: (i) political and economic instability in foreign markets; (ii) inconsistent product regulation by foreign agencies or governments; (iii) imposition of product tariffs and burdens; (iv) costs of complying with a wide variety of international laws; (v) risks stemming from NVISO's lack of local business experience in specific foreign countries; (vi) foreign currency fluctuations; (vii) difficulty enforcing intellectual property rights; (viii) foreign taxes; and (ix) language and other cultural barriers.
<b>Technology risks</b>	<p>The market for emotion analytics and AI and associated products and services is characterised by rapid technological change and advancement, audio and visual advances, medical advances, changing consumer and user requirements, short device lifecycles and evolving industry standards. Any one of these factors could reduce demand for our products and/or services and require substantial resources and expenditures for research, design and development to avoid technological or market obsolescence.</p> <p>NVISO's success will depend upon its ability to enhance current technology, services and systems to develop or acquire and market new technologies to keep pace with technological developments and evolving industry standards, while responding to customer and user needs. A failure to adequately develop or acquire new technologies or product enhancements that will address changing technologies and customer or user requirements adequately, or to introduce such technology on a timely basis, may have a material adverse effect on NVISO's business, financial condition and results of operations.</p> <p>NVISO might have insufficient financial resources to improve existing technologies, advance technologies and develop new technologies at competitive prices. Technological advances by one or more competitors or future entrants into the artificial intelligence space may result in NVISO's present services or technology offerings becoming non-competitive or obsolete, which may decrease revenues and profits and adversely affect NVISO's business and results of operations.</p>
<b>Changes in strategy</b>	NVISO's strategy may evolve over time due to a review and assessment of, among other things, market trends, technical challenges, changes in regulations, the level of market acceptance in particular jurisdictions or markets and the emergence of new or improved technology. As a result, the future strategies, approaches, markets, products and plans of NVISO may not reflect the strategies, approaches, markets, products and plans set out in this presentation.
<b>Access to data</b>	Improvements to NVISO's products and services rely on access to data. The data is currently acquired from the usage of the NVISO's products and various collaborative R&D projects. The data, such as pictures and videos of human faces with the knowledge of the emotion presented in the given picture or video, is used to improve NVISO's existing products and to build new AI based products. If for any reason, regulatory or other, NVISO's ability to obtain data is limited, this may result in increased costs in order to develop or acquire required datasets.
<b>Intellectual Property</b>	<p>NVISO's prospects will depend on its ability to develop and protect technology that meets changing market needs and addresses the technological advances and competitiveness of other companies operating in the markets targeted by NVISO.</p> <p>NVISO's interest in its technologies is protected by a pending patent application. Whilst this provides NVISO with protection, there is no guarantee that other companies will not legally challenge the patent or that they might knowingly or unknowingly infringe NVISO's patent. Any such action may adversely affect the business, operating results and financial condition of NVISO.</p> <p>NVISO SA could also be subject to claims by employees and service providers under Swiss law with respect to intellectual property developed by them.</p> <p>NVISO's considers that moving forward it will be important that NVISO maintains and obtains patents and that trade secrets and other proprietary know how is sufficiently protected to ensure the viability of NVISO's technologies.</p>
<b>Reliance on Key Management Personnel</b>	<p>The responsibility of overseeing the day-to-day operations and the strategic management of NVISO depends substantially on its senior management and its key personnel. No assurance can be given that there will be no detrimental impact on NVISO if one or more of these employees cease(s) their employment or if one or more of the Directors cease to be directors of NVISO.</p> <p>Success of the business will depend on the Directors and the officers of NVISO to develop the business and manage operations, and on the ability to attract and retain key quality staff and consultants.</p> <p>The management team is currently comprised of a team of personnel who the Directors consider can cover on a temporary basis for any other member of the team who may leave NVISO, until such time as NVISO engages a replacement. However, the loss of multiple key persons or the inability to find new key persons (or delays in finding such key persons) could have a material adverse effect on the business.</p>
<b>Changes to Regulations affecting NVISO</b>	The regulatory requirements for NVISO's technologies are currently minimal. If the regulatory framework was to change requiring necessary approvals to operate or use the NVISO technology, NVISO may not be able to obtain such necessary approvals or clearances in a timely fashion or may not be able to obtain the necessary approvals and clearances at all.

Risk Description	
<b>Foreign Exchange Risk</b>	While NVISO transacts business internationally, the operations of NVISO are primarily in Switzerland and NVISO intends to raise capital in Australian dollars. Accordingly, a foreign exchange risk exists in relation to any significant fluctuations in currency exchange rates.
<b>New Technology and Competition</b>	While NVISO has technology that is at the forefront of its market, this does not preclude other alternative ideas or technologies being developed and overtaking the performance or utility of the NVISO technology. This is a risk as there is significant investment by large technology businesses in the areas of machine learning and AI. Such an investment may promote the development of improved technologies that could provide a significant commercial threat to NVISO.
<b>Competitive environments in the industry applications</b>	<p>In respect of the application of NVISO's technology to the financial services industry, there is a risk that large technology businesses would enter the market and due to relevant scale would have the ability to offer relevant services to the market at very low costs. This would allow data to be collected faster and therefore enhance other products that would compete with NVISO.</p> <p>In respect of the application of NVISO's technology healthcare industry there is a risk that an established healthcare services provider would enter the market. Such provider would likely have large existing datasets enabling them to build and validate new AI based products more efficiently than NVISO. This risk is mitigated by close collaboration with such businesses making NVISO a relevant partner to them, providing innovation quicker than their internal processes.</p> <p>If the capabilities offered by NVISO to automotive industry become standard features in vehicles, there is a risk that the automotive OEMs and Tier1 suppliers develop AI features individually rather than relying on existing developers such as NVISO. NVISO mitigates these risks by providing competitive and flexible business models and pricing in the given industry.</p>
<b>New Technology with Limited Testing and Feedback</b>	<p>NVISO's prospects will depend on its ability to develop technology that meets changing market needs and addresses the technological advances and competitiveness of other companies operating in the AI solution market.</p> <p>The NVISO technology and its products are relatively new and may require lengthy testing and development before they are commercially viable for application and sale in relevant industries. Ongoing testing and trials may delay NVISO achieving immediate sales in the short to midterm following admission to the ASX.</p>
<b>Limited Commercial Application to Date</b>	<p>The technologies for emotional AI are still an immature market in a commercial sense. Due to the early stage nature of the market, there is no single paradigm on what the best method is for achieving commercial success.</p> <p>NVISO's sales have been limited due to restrictions in working capital and NVISO's focus on products and R&amp;D.</p> <p>Investors should be aware that past performance should not be relied upon as being indicative of future performance.</p> <p>NVISO may have to expend a great deal of funds in advertising and marketing in order to reach its intended clients and customers. NVISO's technologies may require substantial upfront capital investment that has not yet been identified, and there can be no assurance that subsequent operational objectives will be achieved. Failure to achieve objectives/ milestones may have a material adverse impact on the financial performance of NVISO.</p>
<b>Future profitability or dividends are not assured</b>	No assurance as to future profitability or dividends can be given and these are dependent on future earnings and working capital requirements of NVISO. Potential investors should note that there can be no guarantees with respect to the payment of dividends and return of capital.
<b>Cost of technology</b>	Although NVISO will eventually seek to market its technology into mid and low-income countries, the costs of implementing the technologies may prove too expensive for consumers in those countries. Should this prove to be the case this could result in reduced gross margins and loss of potential market share, either of which could materially adversely affect NVISO's future business, operating results and financial position.
<b>Restricted Securities</b>	NVISO anticipates that certain Shares and Options and will be classified as restricted securities by ASX upon Admission. Shares held by the Founders, Timothy Llewellyn and Matteo Sorci, will be subject to a voluntary escrow period and these Shares will only be released upon the satisfaction or achievement of certain performance milestones. These securities will be subject to an escrow period of up to 24 months from the date of Official Quotation. This could be considered to be an increased liquidity risk as a portion of NVISO's issued capital will not be able to be traded freely for a period of time.
<b>Research &amp; Development Risk</b>	Robotics and artificial intelligence companies typically engage in significant amounts of spending on research and development, and there is no guarantee that the products or services produced by these companies will be successful. Further, rapid changes to the field could have a material adverse effect on NVISO's operating results Robotics and artificial intelligence companies, especially smaller companies, tend to be more volatile than companies that do not rely heavily on technology.

Risk Description	
<b>Hacking and security breaches</b>	<p>NVISO may be adversely affected by malicious third party actions that seek to breach security of the platform. Any such 'hacking' of the platform could, among other things, jeopardise the security of customer information stored by NVISO. If NVISO's efforts to combat such malicious actions are unsuccessful, or if their data storage or platform has actual or perceived vulnerabilities, NVISO's business reputation and brand name may be harmed, which may result in a loss of customers from the platform (and reduced prospects of securing new customers).</p> <p>NVISO currently uses cloud services such as IBM SoftLayer and Amazon S3. IT security and the protection of customer data is critical to NVISO's success. To this end, NVISO has installed 'state-of-the-art' firewalls and data encryption, and undertakes due diligence on security policy compliance when using third party infrastructure. To further improve its data security, NVISO has initiated its ISO 27001 certification. This established a management system that is intended to ensure that information security is under management control and meets specific requirements. Organizations that meet the requirements may be certified by an accredited certification body following successful completion of an audit. NVISO has set a target of passing the audit and obtaining the ISO 27001 standard in Q2, 2019. NVISO has also adopted a number of internal information management and security policies which regulate the use of the NVISO's IP.</p>
<b>Service Interruptions/ technology outages</b>	<p>NVISO relies on its technology to provide its customers with reliable service. There may be a failure to deliver this level of service due to factors such as:</p> <ul style="list-style-type: none"> <li>(i) Human error;</li> <li>(ii) Power loss;</li> <li>(iii) Improper building/ storage maintenance;</li> <li>(iv) Physical or electronic security breach;</li> <li>(v) Natural disaster/ damage;</li> <li>(vi) War, terrorism and any related conflicts worldwide; and</li> <li>(vii) Sabotage and vandalism.</li> </ul> <p>Service interruptions may trigger clauses in contracts which could result in terminations, award of compensation and other potential expenses to NVISO. Service interruptions may further expose NVISO to additional legal liability or erosion of reputation.</p>
<b>Ethics</b>	<p>Ethical concerns surrounding artificial intelligence are becoming more and more important as its prevalence grows. Decisions made by AI agents can be faster, more accurate and more suitable to complex and dynamic contexts than decisions made by humans. However, in some situations there is no objective view on what the optimal decision should be, because that depends on the ethical principles adopted to draw conclusions. Studies suggest training technology to decide based on interpretation of situations and the stakeholder and stakes involved is helpful. Such interpretative effort is complicated for AI systems unable to comprehend abstract concepts such as human emotion or values. The consequence is that depending on its design or the information upon which it is trained, an AI agent may act against human interests.</p>
<b>Bias and Accountability</b>	<p>Beyond responsible testing and development of software, accountability is an important factor of companies making transparent and auditable decisions. Accountability is important in precluding unintended consequences from applications due to input algorithms being human-generated. Consequently, training data can contain prejudice and bias, which may lead to unfair decision-making by nVISO technologies. Transparency of the decision-making process and the underlying training data may assist in achieving an unbiased and impartial outcome regardless of a consumer's characteristics such as race, gender or religion. Such transparency can be enabled by setting up appropriate scrutiny requirements for the artificial intelligence development process.</p>
<b>No representation or warranty as to the accuracy or completeness of the information</b>	<p>The information in this document may not be complete and may be changed, modified or amended at any time by NVISO, and is not intended to, and does not, constitute representations and warranties of NVISO. Neither NVISO, nor any other advisor of NVISO intends to update this document or accepts any obligation to provide the recipient with access to information or to correct any additional information or to correct any inaccuracies that may become apparent in this document or in any other information that may be made available concerning NVISO. Investors should conduct their own due diligence investigations regarding NVISO and the prospects of NVISO's proposed activities.</p>
<b>Additional Capital Requirements</b>	<p>NVISO's capital requirements depend on numerous factors. Additional funding will likely be required by NVISO in the future to effectively implement its business and operations plans, to take advantage of opportunities for acquisitions, or other business opportunities, to keep up with competition, and to meet any unanticipated liabilities or expenses which NVISO may incur. Any additional equity financing will dilute shareholdings, and debt financing, if available, may involve restrictions on financing and operating activities.</p> <p>If NVISO is unable to obtain additional financing as needed, it may be required to reduce the scope of its proposed operations and scale back its expansion programmes as the case may be. There is however no guarantee that NVISO will be able to secure any additional funding or be able to secure funding on terms favourable to NVISO.</p>
<b>Litigation risks</b>	<p>NVISO may be subject to litigation and other claims and disputes in the course of its business, including contractual disputes with customers, suppliers or channel partners, employment disputes, indemnity claims, and occupational and other claims. There is a risk that such litigation, claims and disputes could materially adversely affect NVISO's operating and financial performance due to the costs of defending and/or settling such claims, and affect NVISO's reputation and credibility in the marketplace.</p>

**NVISO**  
ADVANCING HUMAN POTENTIAL

[nviso.ai](https://nviso.ai)