NEXYAD deck

SafetyNex: a game changer embedded AI software for automotive

. Autonomous Vehicle

. ADAS ‘Advanced Driver Assistance Systems)

. Connected Vehicle and telematics

INNOVATION CONCEPTS

a game changer

20 years of boostrapping R&D

20 years of public funded collaborative research led NEXYAD to develop a hybrid physics-informed AI called SafetyNex, that calculates in real time during driving the **PRUDENCE** OF VEHICLE MOVEMENTS IN ITS SURROUNDING ENVIRONMENT (scale 0-100%). We couldn't find any other company with such a calculation.

What is PRUDENCE ? (dictionnary)

Prudence is **taking into account in your acts** that:
. You do not know everything about surrounding environment
. You cannot predict every consequences of your acts

Effect of PRUDENCE on human driver: anticipation

. 60 years old drivers have poor eyes performance and slow reflexes compared to 18 drivers
. 18 drivers cost 4 to 12 times more to insurers than 60 drivers (per km)
. PRUDENCE of 60 drivers **compensates for a lack of performance on the perception stage** and for the relative slowness of execution

REVOLUTION : **for the 1st time ever** we can endow an autonomous vehicle with a **sense of PRUDENCE**

Problem : State of the Art in Autonomous Vehicles

Classic approach of robot vehicle development:

. Cut road situations into N use-cases (e.g. N=100, or N = 1000)

. Define a **desired behavior** of vehicle in every use-case

. Develop a control law for every use case = **N control laws**

N calculation modules (complexity) and « by hand » tuning of numerous parameters (e.g. 6 parameters per control law)

A control law is a mathematical calculation program that imposes a **desired behavior** to the vehicle (e.g. slow down)

. **Not easy and even almost impossible** to ajust to OEM 'touch and feel' idea of what should be vehicle behavior.

. **Not easy** to test continuity of contol laws in the 2^N junctions between use cases

Deep Learning approach of robot vehicle development

. Needs **billion km database, driven by humans**

. Brings native continuity between use cases

. Also needs a **desired behavior** (learning examples for deep learning) which are human driving

. If desired behavior is unknown, reinforcement learning may help, but a fitness function must be constructed and that covers every use case (**not easy**)

. **Not easy** to validate in a formal way as Neural Networks may always calculate an unpredicable output

Solution: NEXYAD New Paradigm based on PRUDENCE calculation

. **Approach 1**: assess prudence and use **ONE** control law (instead of 100) to keep prudence at a high level
e.g. for the longitudinal part of robotized driving (called predictive ACC):
« *if prudence is too low then slow down else accelerate to speed limit* ».
Reference: STELLANTIS Predictive ACC (city, roads, highways): **simplification by 100** of a Predictive ACC
read scientific paper that pastes speed profiles (fig 33) on STELLANTIS prototype :

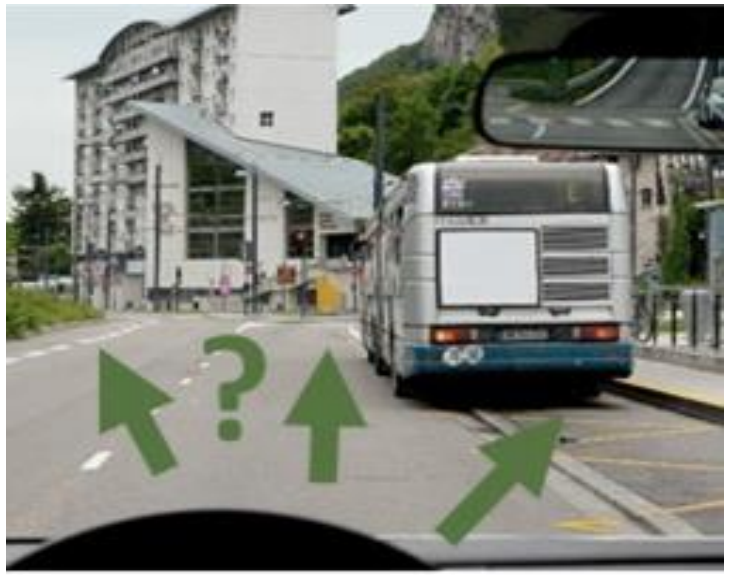
simple

. Approach 2 : **self-learning** Autonomous Vehicle where prudence assessment is the **fitness** function (city, road highway) : **a generalization of Mobileye self-learning** architecture, with prudence assessment still online as an « **in-use monitoring** » module: « in-use monitoring of road safety ». The more the vehicle drives the best it becomes, without formal supervision.

Cornerstone

THE Autonomous Vehicle with a sense of PRUDENCE**, that can anticipate instead of only « reacting »**
THE autonomous Vehicle **that can check/control, record and pastes its own PRUDENCE (for insurance and legal issues)**

Can work for highly variable sensor equipment



. **If you know what is behind the bus** (*), **and if there is nothing**, it is possible not to slow down, go straight ahead, and still stay PRUDENT
(*) e.g. cameras on the infrastructure + V2X, or frontal cam of the bus + V2X

. **If you do not know what is behind the bus** it is necessary to slow down and maybe slightly keep left, in order to stay PRUDENT (because a pedestrian may appear from behind at the last moment)

Vehicle Behavior is no longer a prerequisit desired notion, but **a consequence of PRUDENCE target and equipment set**. You can have **different** PRUDENT Autonomous Vehicles with **different** behaviors that will depend on their equipment set (and start with **cheap** equipment). Also, in real time, behavior of an Autonomous Vehicle will change to stay PRUDENT if some information is temporary missing : a completely new flexible way of thinking.

Flexible Thinking

Prudence can also bring efficient functions to human driven vehicles (ADAS)

recording prudence **profiles can help negociations with insurers and reduce TCO safety Score**

warning driver **when prudence is too low reduces accident rate at least by 25% safety coach**

Pasting what should be vehicle speed **in order to keep prudence at a good level prudent recommended speed** required by EuroNCAP

Pilot a Predictive ACC (reference STELLANTIS) **predictive ACC and level 2 automatization a la TESLA**

ONE AI MODULE SEVERAL FUNCTIONS FOR HUMAN DRIVER

VALUE FOR CUSTOMERS

New vehicles market

Value for OEMs

. Divide by 100 complexity of Autonomous Vehicle (then enable market)
. One AI lots of functions: factorization (more competitive and better margin)
. Bring a metric for impact of ADAS and AD: negociate with insurers and reduce TCO

Value for DRIVER

. Access to many intuitive safety and comfort functions that use the same principles than human brain (easy to understand and accept)

Aftermarket

Value for FLEETS

. Reduce accident rate by 25% = reduce costs for operations + social responsability of companies fullfilled

Value for INSURERS

. App in real time for better road safety = image, keep contact everyday with policy holder (instead of once a year), filter young drivers and keep good ones (take market share)

IMPLEMENTATION & REFERENCES

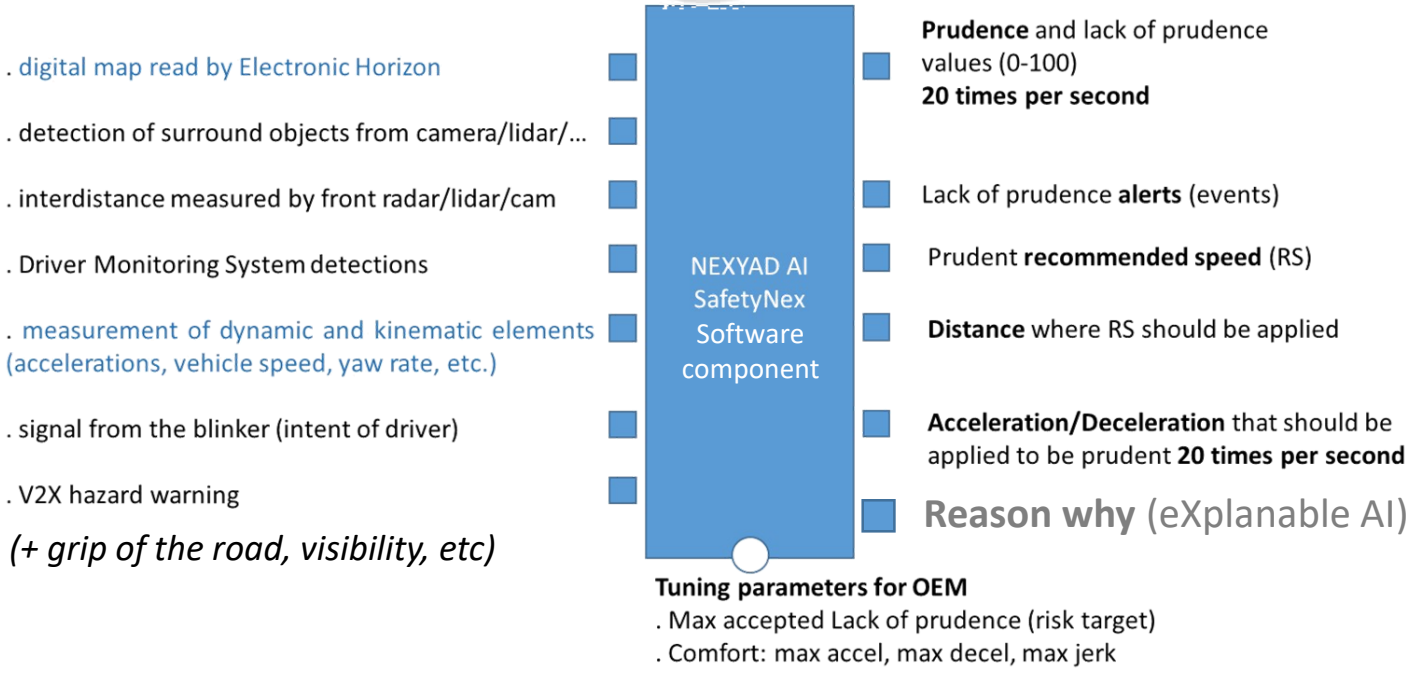
AI SafetyNex **aggregates all data** in the vehicle

Note; functional I/O description, contact us for precise data specification and format

UP TO DATE AI: XAI, PHYSICS-INFORMED, HYBRID

Hybrid physics-informed AI:
fuzzy sets, possibility theory deep learning, reinforcement learning, neural gas, physics, applied maths

DATA AGGREGATION IN REAL TIME IN A CENTRALIZED AI



ANTICIPATION ALERTS

EURONCAP

PILOT PREDICTIVE ACC or longitudinal part of Autonomous Vehicle

In blue mandatory inputs for Minimum Viable Product
Available for **Aftermarket** into **SMARTPHONES**

(*) Lack of prudence is called ‘risk’

References &Testimonials

. **Scientific reference**: including STELLANTIS LabCar results for Predictive ACC

Paper: Gérard Yahiaoui & Pierre Da Silva Dias, *Hybrid Physics-Informed Artificial Intelligence for Driving Assistance. Application to preventive Automated Cruise Control*,, SIA congrès IA pour les nouvelles mobilités France Sept 2022.

Link to paper: HERE

. **Testimonials**

« NEXYAD SafetyNex cognitive AI brings a new paradigm for road safety in ADAS and Autonomous Driving »

Vincent ABADIE, VP of ADAS and Autonomous Driving at **STELLANTIS Group**

« Impressive. The recommendation for acceleration and braking are very natural. A further step towards autonomous driving »

Dr. Jochen Langheim, VP at **STMicroelectronics**

« We have integrated NEXYAD technology into our smartphone App Brightmile for insurers and fleets, abd our App reduces accident rate by 25-35% through its worldwide deployment in more than 50 coutries»

Dominic Saunders, CEO of **BRIGHTMILE**

PRODUCTS

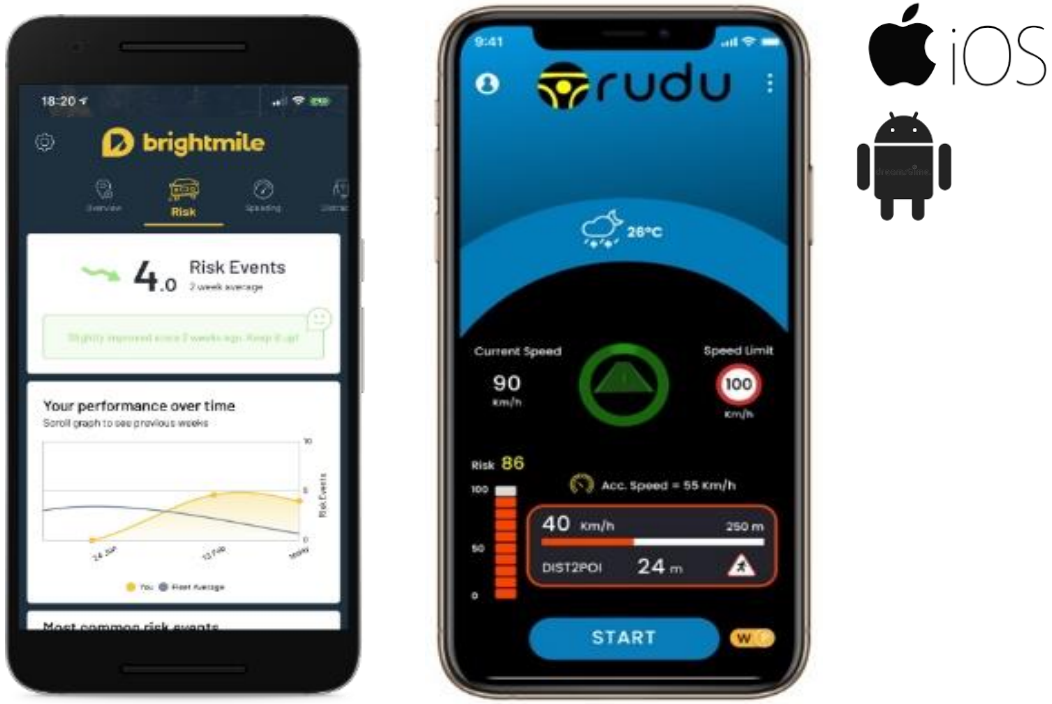
PRODUCT 1
AI brick for aftermarket solutions development (markets of FLEETS and INSURERS)

AI brick for smartphone Apps/Telematics developers

1. **SafetyNex SDK/API** for Smartphones can run a Minimum Viable Product that can help driver in tricky road infrastructure situations. Today's customers develop smartphone Apps for insurers and fleets, that help driver to avoid emergency situation and then **reduce accident rate by at least 25%:**
   a. Better **social responsability of companies**
   b. Reduction of **costs for operations** of professional fleets

2. **SafetyNex White label smartphone App** : some teams at insurers and fleets management companies do not have resources for software development. NEXYAD can then propose a **white label smartphone App**, ready to deploy (finite state graph non modifiable)

3. **Customers References** : **PIONEER Corporation** (Japan), **MONTBLEU Technologies** (India), **Brightmile** (UK), **SYNOX** (France)



Functions:

. **Safety Coach**, in real time while driving to reduce accident rate by 25%
  . Alerts in case of unsafe driving (beep)
  . Advices to slow down at the right moment
  . Prudent Recommended Speeds

. **Safety score**
  . Profiles of risk and prudence
  . Explainations of how to improve safety

NEXYAD tools and services to help App dev

SDK

Secured
Cloud

```
import java.util.Scanner;

class Main {
  public static void main(String[] args) {
    Scanner in = new Scanner(System.in);

    System.out.print("How old are you?: ");
    int age = in.nextInt();

    if (age < 16) {
      System.out.println("Sorry, you are not
      quite old enough to drive!");
    }
    else {
      System.out.println("Yeah! Happy driving!");
    }
  }
}
```

Source code
samples of
API integration in
every environment

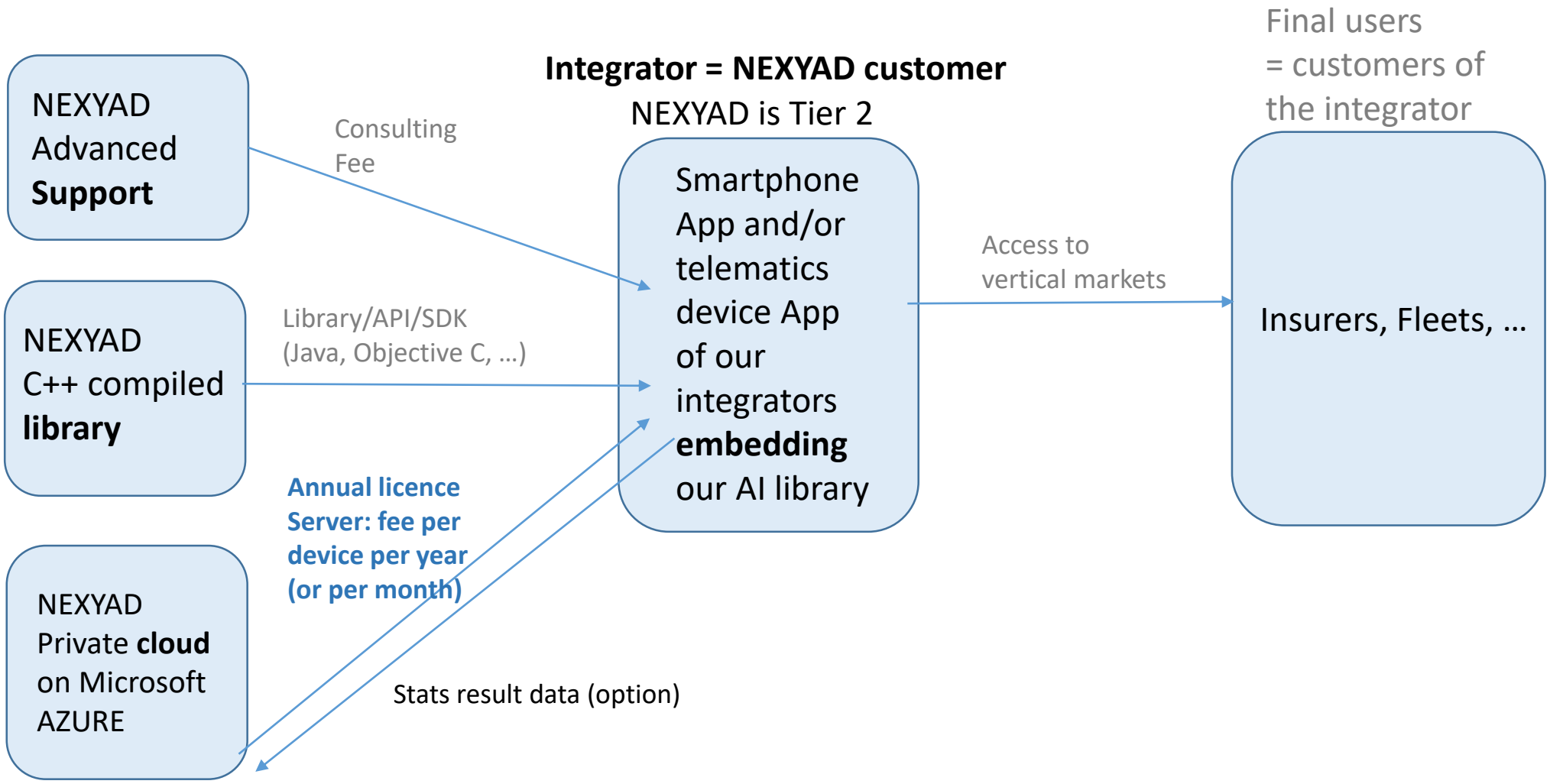
Environments: Java, Objective C, C++

NEXYAD platform for replay, debugging,
non regression tests and validation

Integration
into an App

e.g. Smartphone App rudu
by MONTBLEU Technologies, **India**

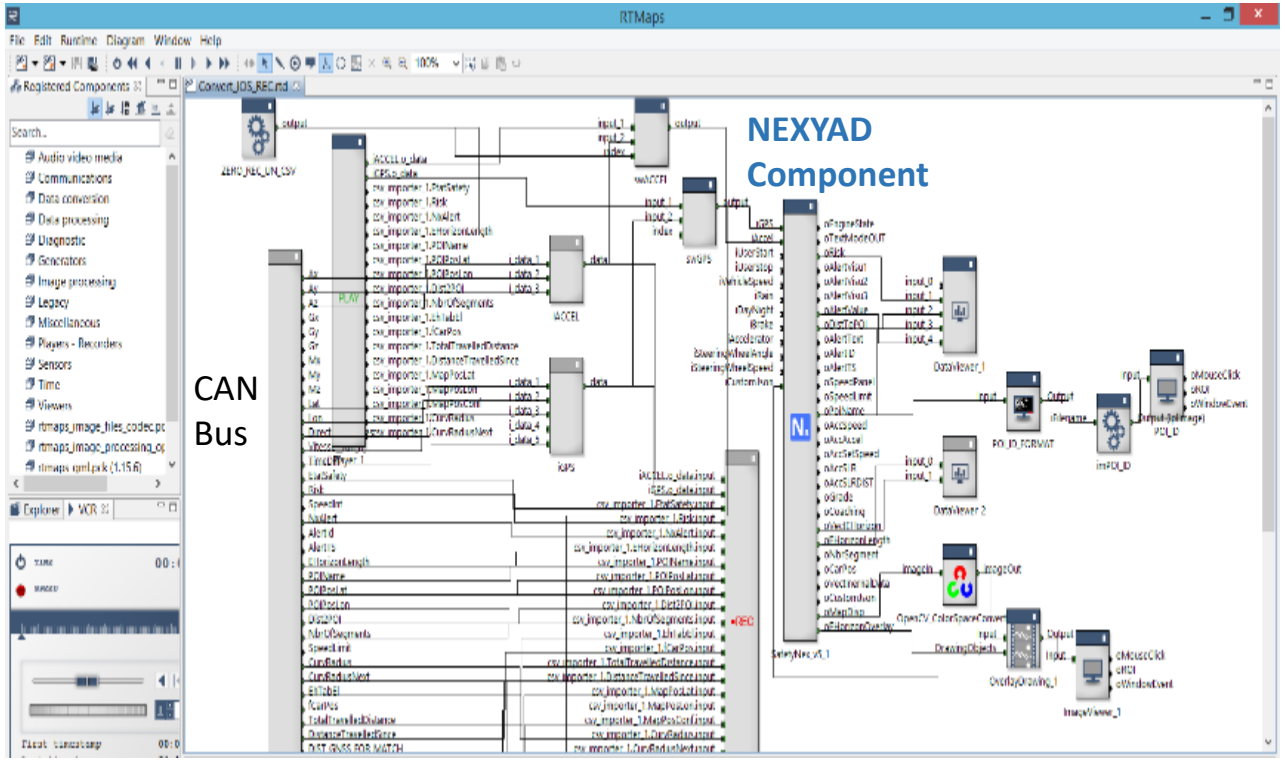
Business model



PRODUCT 2 :
Tool for Automotive Engineers that develop ADAS functions and Autonomous Vehicles (prototypes)

SafetyNex Studio for Automotive Engineers

SafetyNex Studio user licence on laptop : SafetyNex AI is a component in RTMaps asynchronous framework (RTMaps licence not included into NEXYAD offer). Note a version is also available for ROS framework



Note: Think of 2 user licences:

. ONE licence for engineer 's PC

→ . ONE licence for laptop into the vehicle

Automotive engineer can manipulate the SafetyNex powerful AI with potentially all the possible inputs (including insterdistance, closeness speed, location and nature of other objects, grip of the road, …), add OEM or Tier1, 2, … components, work on vizualisation.

. Runs in the demo vehicle like on the desktop

. Possibility to replay with exact same time stamps

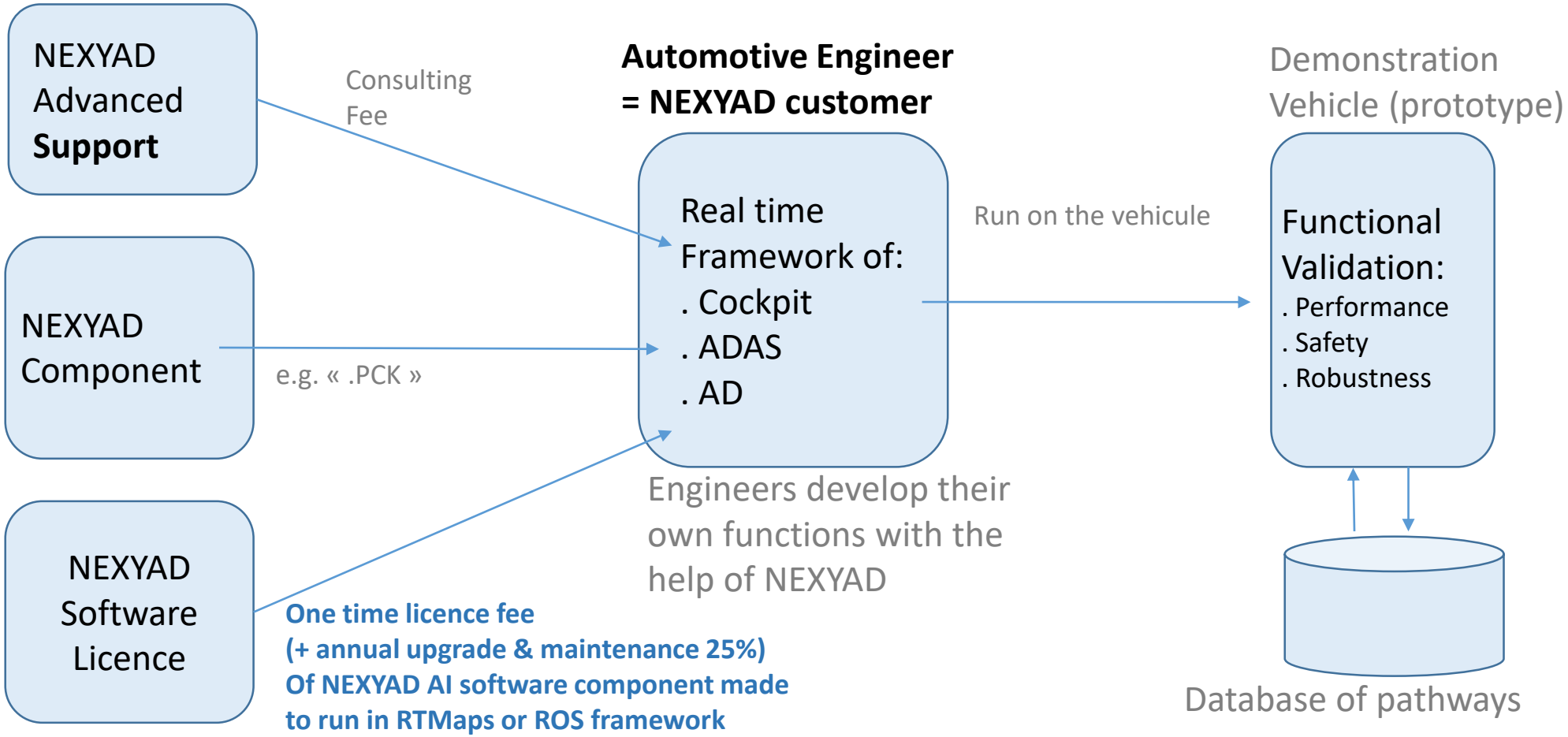
. Reduction of development times and functional validation times

. Recording of a validation database of pathways

Customers References

MILLA, MtC, RENAULT Group, STELLANTIS Group, VALEO

Business model

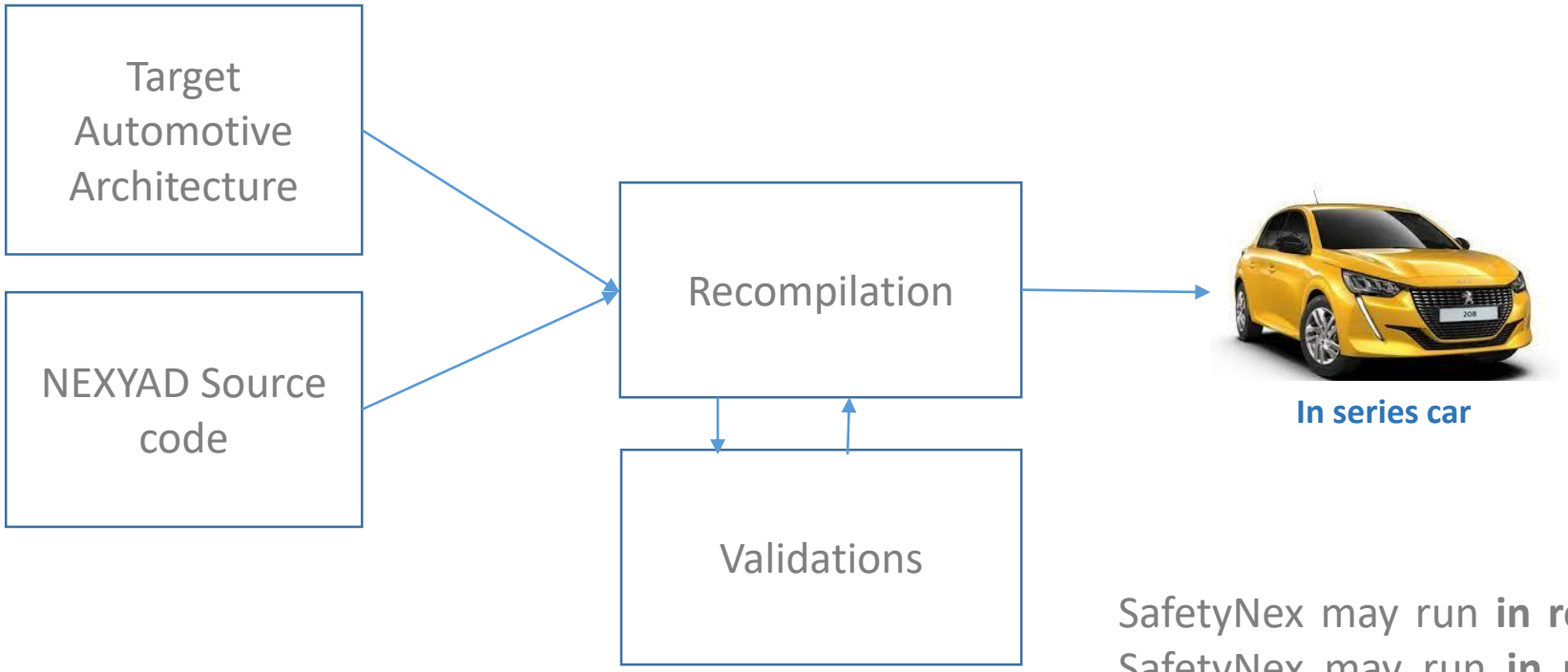


Note 1: rerequisit is that customer is equiped with RTMaps or ROS, independently from NEXYAD

Note 2: necessity to buy a licence of map data to a NEXYAD partner – e.g. HERE Technologies through Benomad

PRODUCT 3 :
Embedded software and/or
Cloud service for series vehicles

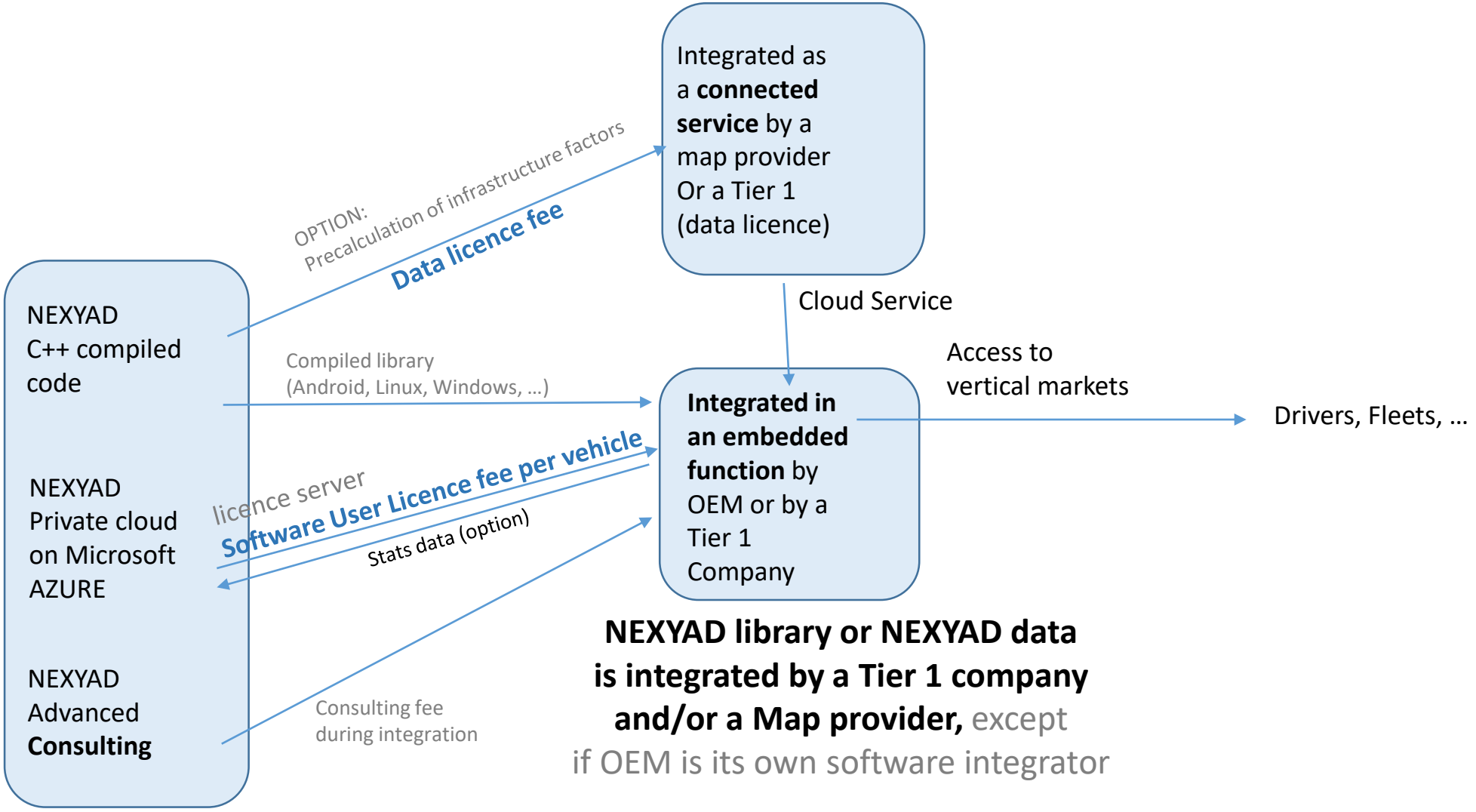
SafetyNex into series vehicles



SafetyNex may run **in real time in the vehicle**
SafetyNex may run **in real time in the cloud**
SafetyNex may run **offline in the cloud to precalculate data for cloud service**
Main automotive functions: Safety Score, Safety/Driving Coach, Prudent Recommended Speed (EUroNCAP), Predictive ACC, Prudence-based autopilot, in-use monitoring of prudence

Customers References:
Currently answering our 1st **OEMs RFQs** embedded in solutions of Tier1 companies and Map providers

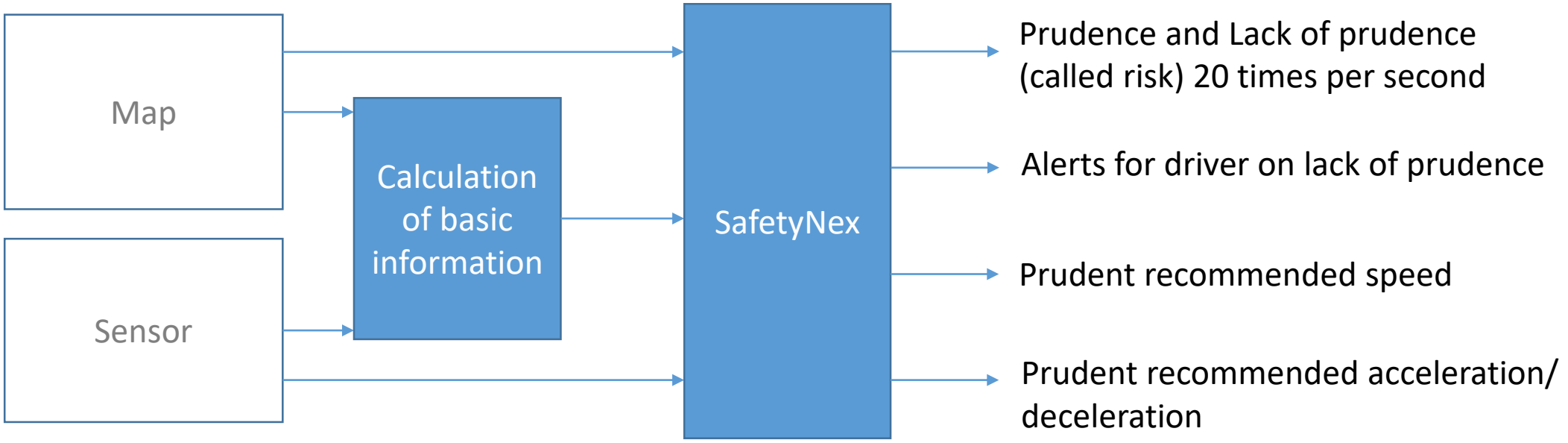
Business model



NEXYAD library or NEXYAD data is integrated by a Tier 1 company and/or a Map provider, except if OEM is its own software integrator

PRODUCT 4 :
Basic geolocated data calculated to feed our AI

Series vehicles generating data



Basic informations are for instance:

. Curve radius

. Speed bumps

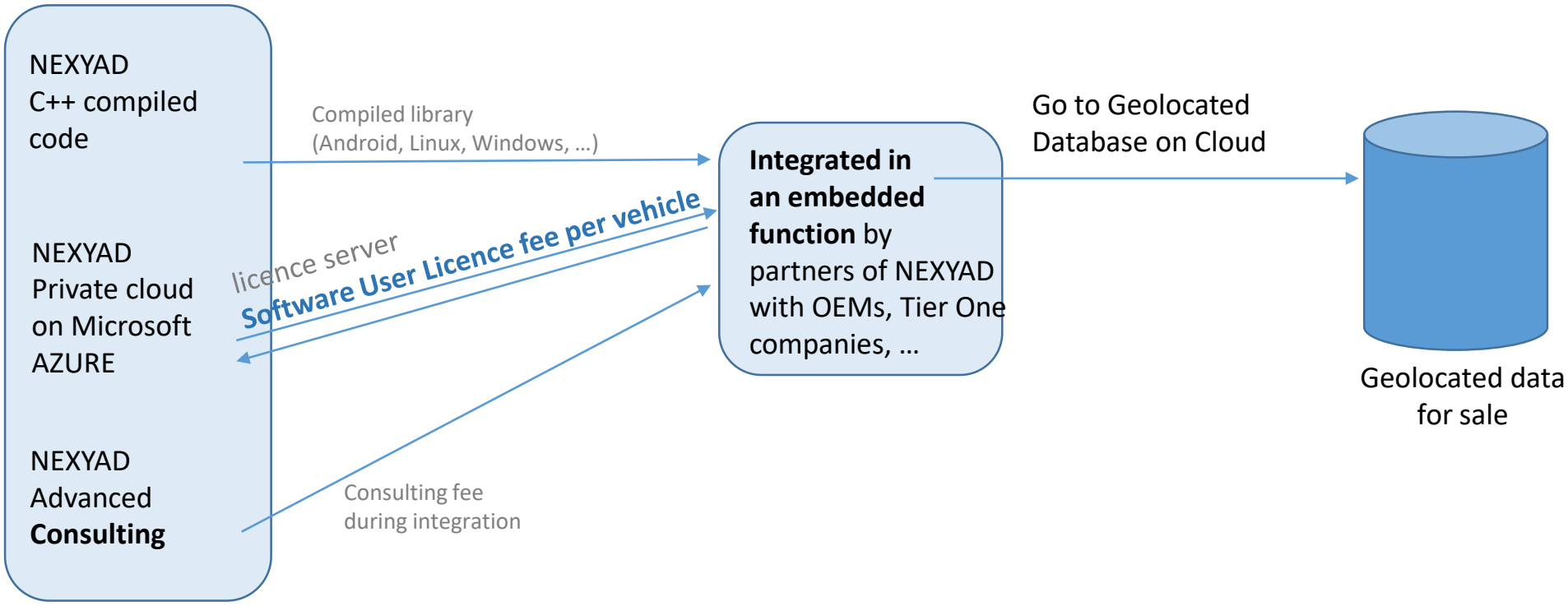
. Quality of road surface (in a vibration POV)

Some OEMs consider that their vehicles are « sensors » that may generate basic data that have a commercial value.

Customers References:

Currently discussing with **OEMs** that may equip their vehicles with our calculation of basic information module and sell geolocated data to generate extra revenues.

Business model



REAL WORLD DEMOS
Real vehicle, Real situations,
Real infrastructure (city, road, higway)

NEXYAD demo vehicle: **DREAMOTOR1**

Thanks for your attention

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NEXYAD AI description