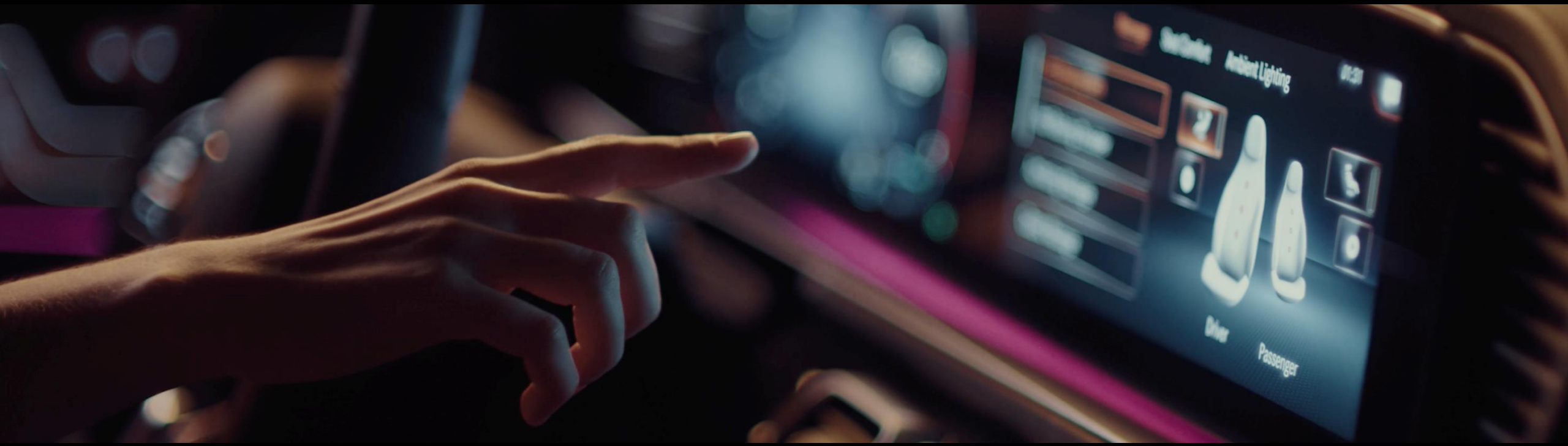


Xilinx Collaboration for

MBUX Interior Assist

Partha Bhattacharya
Mercedes-Benz Research and Development India
Xilinx Adapt, 12.01.2021

Mercedes-Benz
The best or nothing.

RD | U

Vision : Intelligent Interior

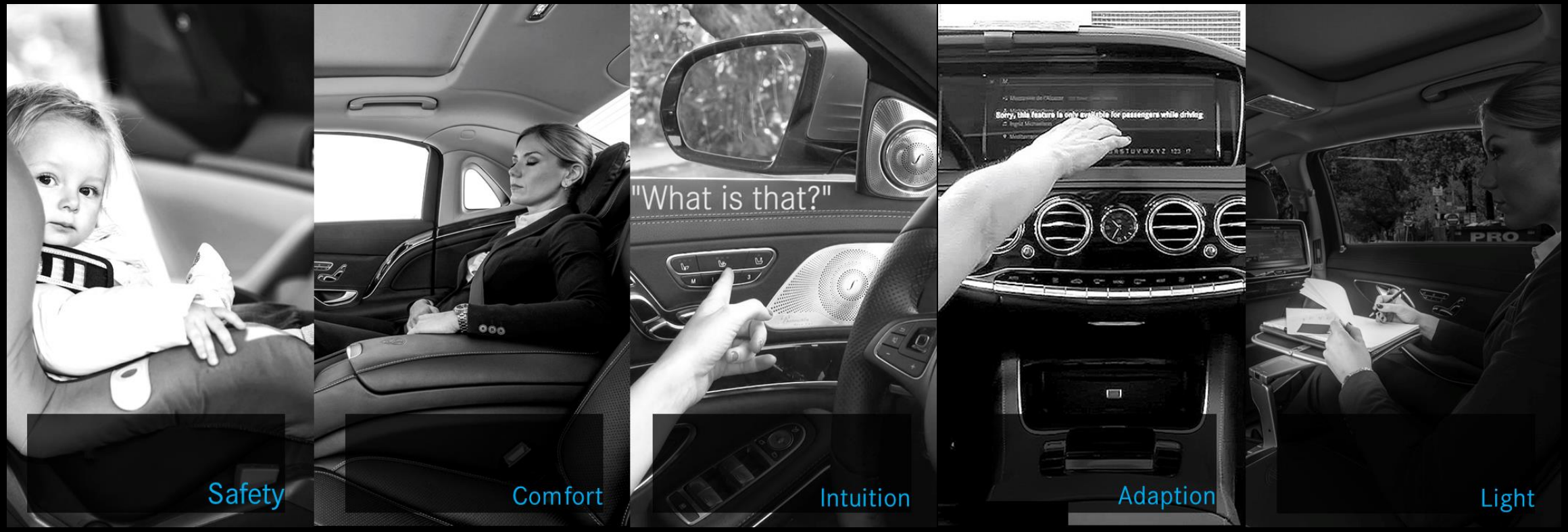
The interior shall become as intelligent as the exterior.
It shall understand and support the actions of the occupants.

Design

“The best, most natural designs are those that seamlessly adapt to what humans already do.”

Natural Seamless Intuitive Predictive

Our Use Cases



IN-HOUSE E2E DEVELOPMENT

TIMES TECHIES

India engineers bring gestures to Mercedes

SujitJohn@timesgroup.com

CUTTING EDGE MADE IN INDIA

The 2019 versions of at least two Mercedes-Benz cars – the GLE, the company's bestselling SUV, and the CLA Coupe – will come with gesture controls. If you extend your hand towards the touchscreen on the dashboard or centre console, the media display changes and individual elements are highlighted so that you can choose the one you want. In the dark, if the driver reaches over towards the unoccupied front passenger seat to search for something, the area will be illuminated automatically to make it easier

the massage function needs to be activated for.

This entire work was done by Mercedes-Benz Research & Development India (MBRDI) in its Bengaluru facility – right from conceptualising to productionising it. "Mercedes-Benz is known for its intelligent exterior, the cameras and radars we have for safety, for cruise control. We are now trying to make the interior as intelligent, because with autonomous driving, it's becoming the third living space, after your home and workplace," says Partha

SEAT DESIGN

- The rear seats designed by MBRDI engineers in Pune are a part of the recently launched Mercedes-Benz A-Class, B-Class and GLE models
- Rear seat safety mandate for all Mercedes car lines is in India
- The Pune centre has major R&D responsibilities for fuel and hydraulic lines in Mercedes-Benz cars

searchers in deep learning/AI with excellent computer vision skills to create the necessary algorithms and train them. It needed lots of people to annotate vast numbers of images appropriately for use in training the algorithms to recognise hand and body movements and positions (such as the V-pose and pointed finger), and the car interiors. And it needed engineers who could port the algorithm to the small hardware device in the car.

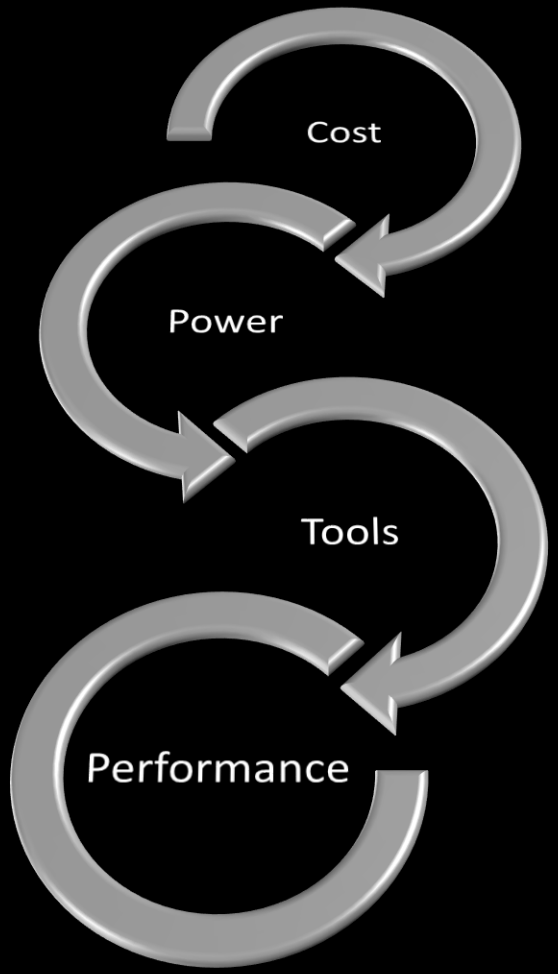
Bhattacharya says the biggest challenge was to fit the whole system in the tiny hardware device. Doing deep learning takes a lot of mem-

Deep Learning @MBRDI

- *algorithm* — algorithm for identification of human pose/gesture and objects
  In house AI/ML research and development
- *software for image annotation* — tools for recording and annotating data
  tool for dense video annotation
- *image annotation* — Large team of in house annotators and customized annotation process
  huge data set with millions of images
- *on premise data infrastructure* — Data engineering and analytics teams with
  lots GPUs for compute and TBs of storage
- *embedded implementation* — Implementation on FPGA platform
  Xilinx Collaboration

Neural Networks on the Edge

Why Xilinx is the best fit?



- Extremely competitive on pricing that suits low cost automotive ECUs

- Low thermal footprint.
- Xilinx had the lowest power consumption (and heat dissipation)

- Tools were integrated into their Vivado suite and this helped a development team with C / C++ expertise to not use RTL

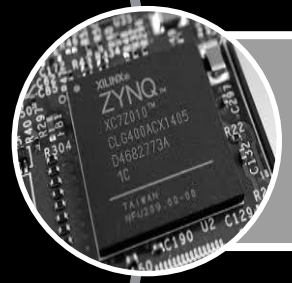
- Supported all commonly used CNN operators already in 2016
- Real-time inference of CNN models
- Availability of a product portfolio with increasing compute on the same die size and pin configurations

TensorBlaze for Intelligent Interior

What were some key milestones in this journey?

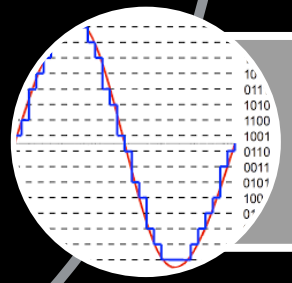
Design Fitment & Timing Closure

- Best support from the Xilinx team and experts from San Jose, Colorado, Dublin & India



16-bit & 8-bit

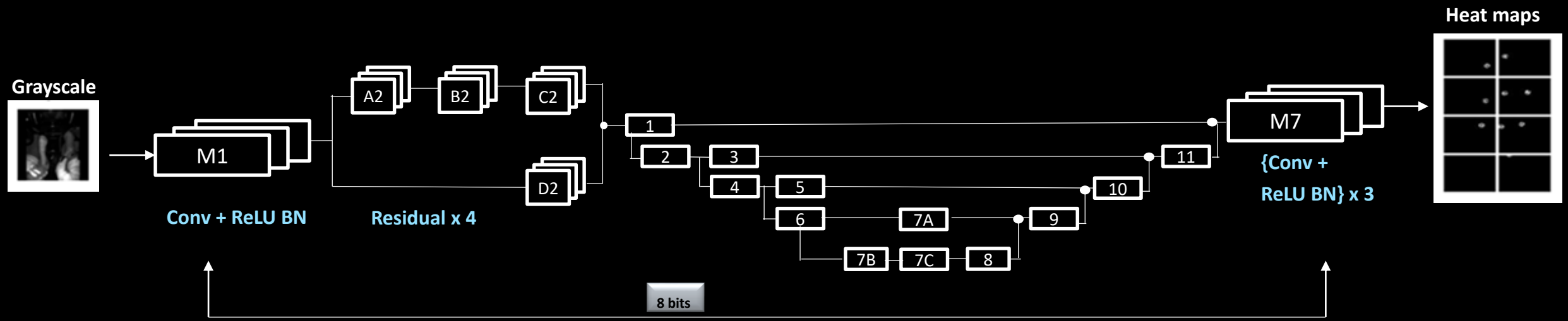
- Integer arithmetic to compute CNN operators with marginal loss in inference accuracy
- Reducing to 8 bit arithmetic retaining the same accuracy



Network Quantization

- Developing a generic quantization stack for reduced bit-width computation

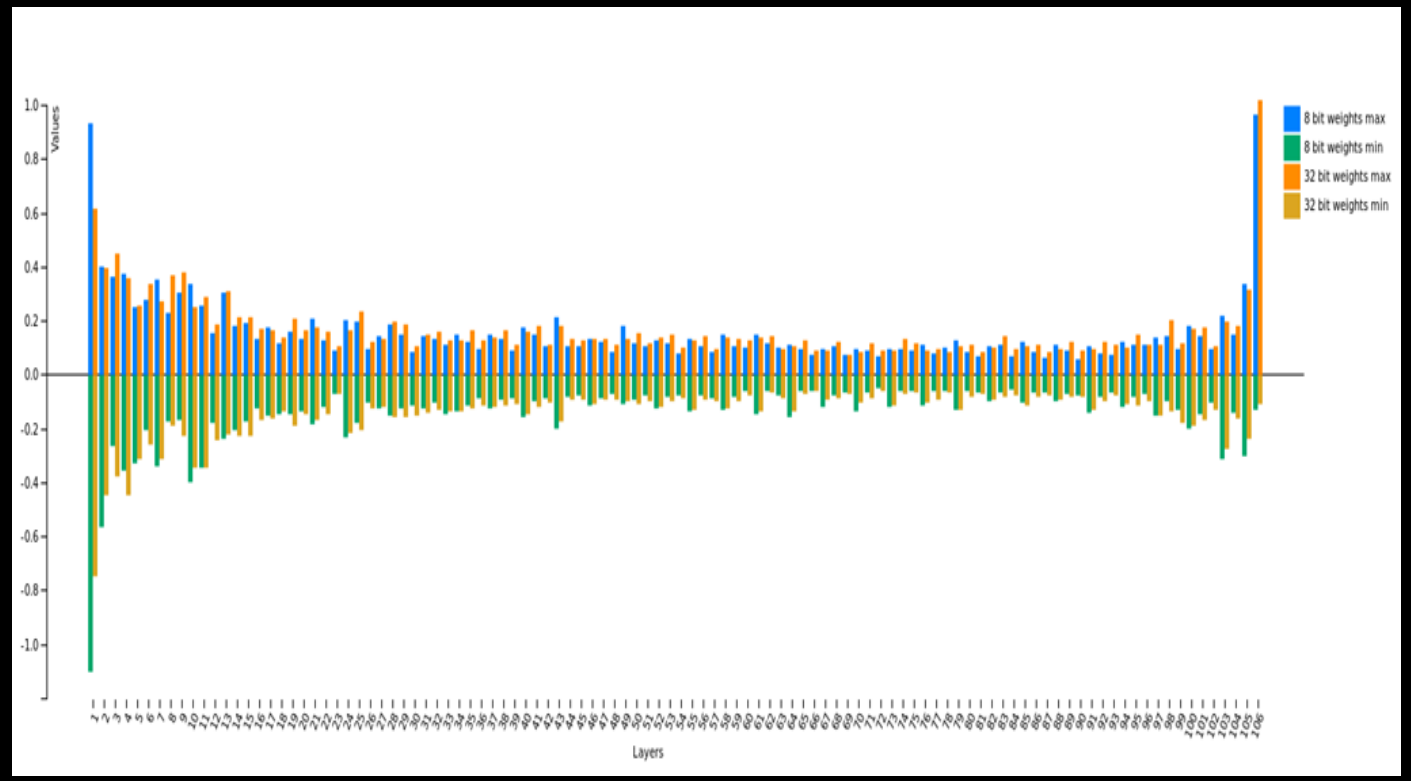
QUANTIZATION : CHALLENGES FACED



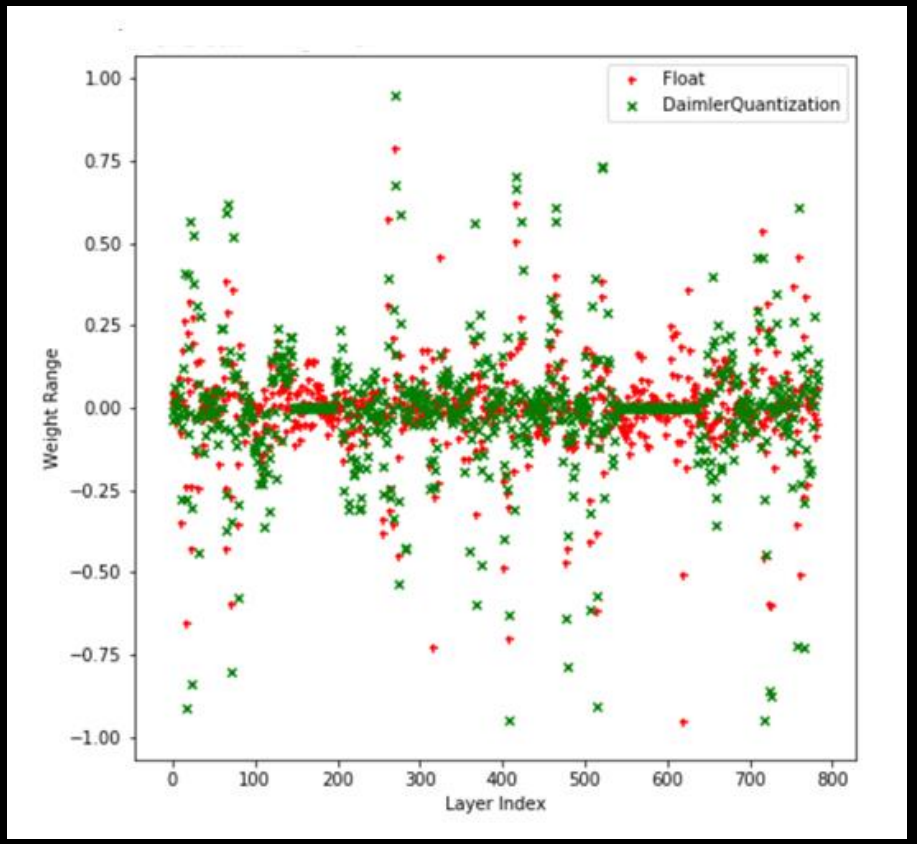
Hour Glass Network

- Residual Block Handling
- Best fit scaling Factor
- Quantizing Batch Normalization
- Bias Correction

DATA DISTRIBUTION OF HOUR GLASS NETWORK



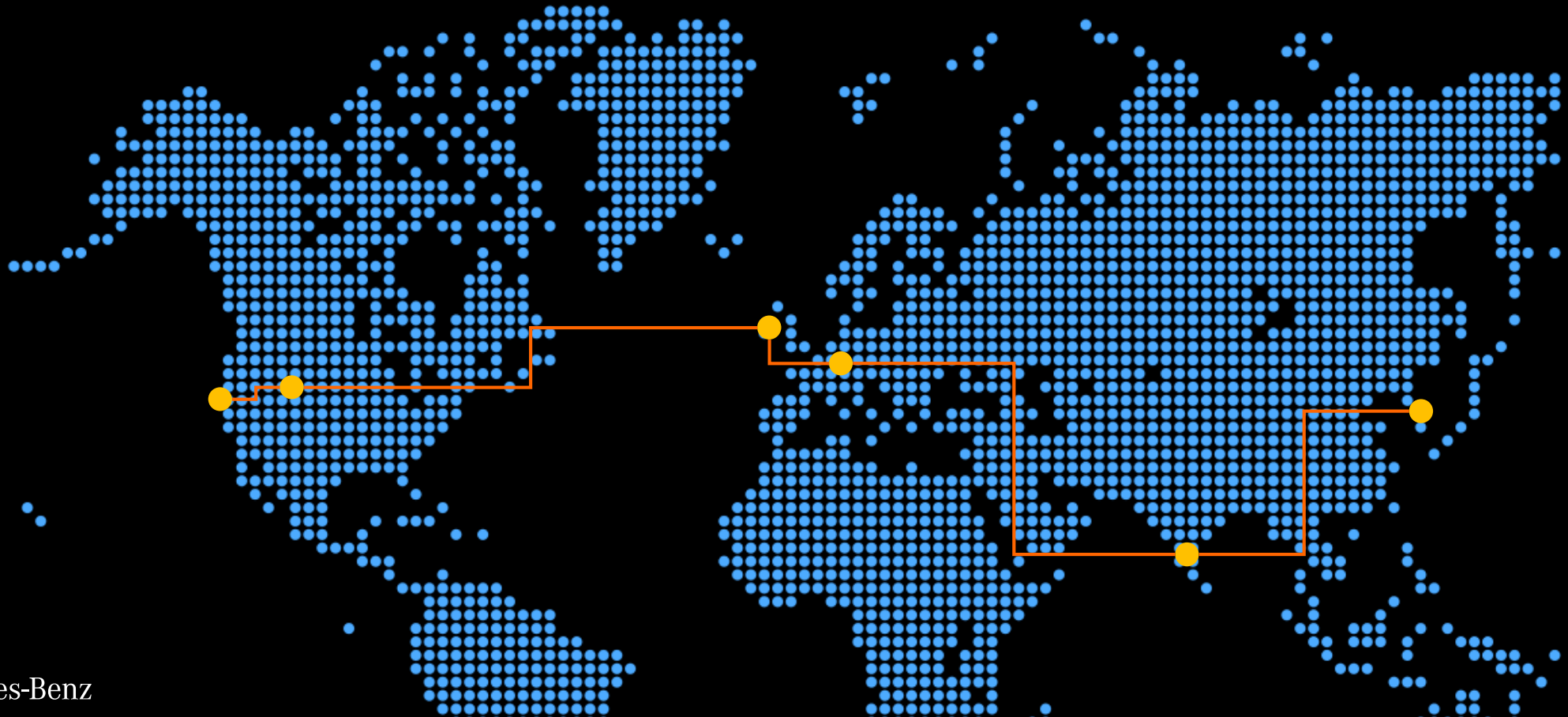
Weight distribution of Hour Glass model



Single Convolution layer weight distribution

MBUX Interior Assist

The Xilinx collaboration is a world wide co-creation process where experts from Automotive and Semiconductor industries came together to create a Deep Learning solution for an automotive grade edge device for a production car



Mercedes-Benz