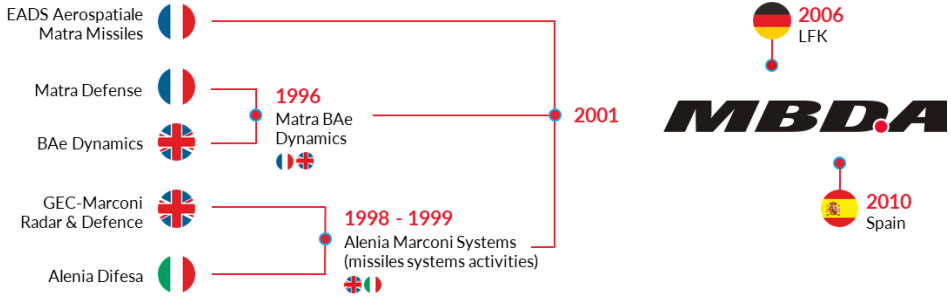
INTEGRATING AI INTO SIMULINK FOR SIMULATION AND DEPLOYMENT

GARY MATSON & NICOLA EASTON

MATLAB EXPO – 5th OCTOBER 2023

Reference: 12210288015

MBDA Heritage



MBDA'S HERITAGE MIRRORS THE HISTORY OF TACTICAL MISSILES IN EUROPE

CREATED IN **2001**

THE OUTCOME OF A SERIES OF **STRATEGIC MERGERS** IN THE TACTICAL MISSILE SECTOR IN EUROPE

THE LARGEST EUROPEAN COMPANY IN THE MISSILE SYSTEMS SECTOR

THE ONLY EUROPEAN COMPANY ABLE TO MEET THE WHOLE RANGE OF COMPLEX WEAPONS NEEDS OF THREE ARMED FORCES

MBDA TODAY

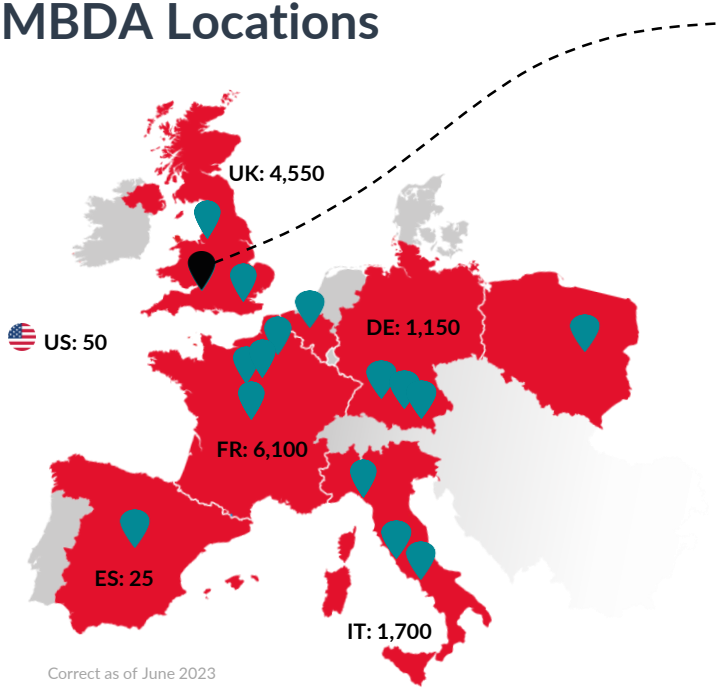
AIRBUS GROUP 37.5% | BAE SYSTEMS 37.5% | LEONARDO 25%

MBDA

Reference: 12210288015

Correct as of June 2023

MBDA Locations



Correct as of June 2023

AROUND **14,000** PEOPLE WORLDWIDE

60% IN TECHNICAL/ENGINEERING FUNCTIONS

UK Image Processing

Responsible for developing computer vision algorithms to provide situational awareness and to navigate and precisely guide weapons to their target across multiple complex environments.

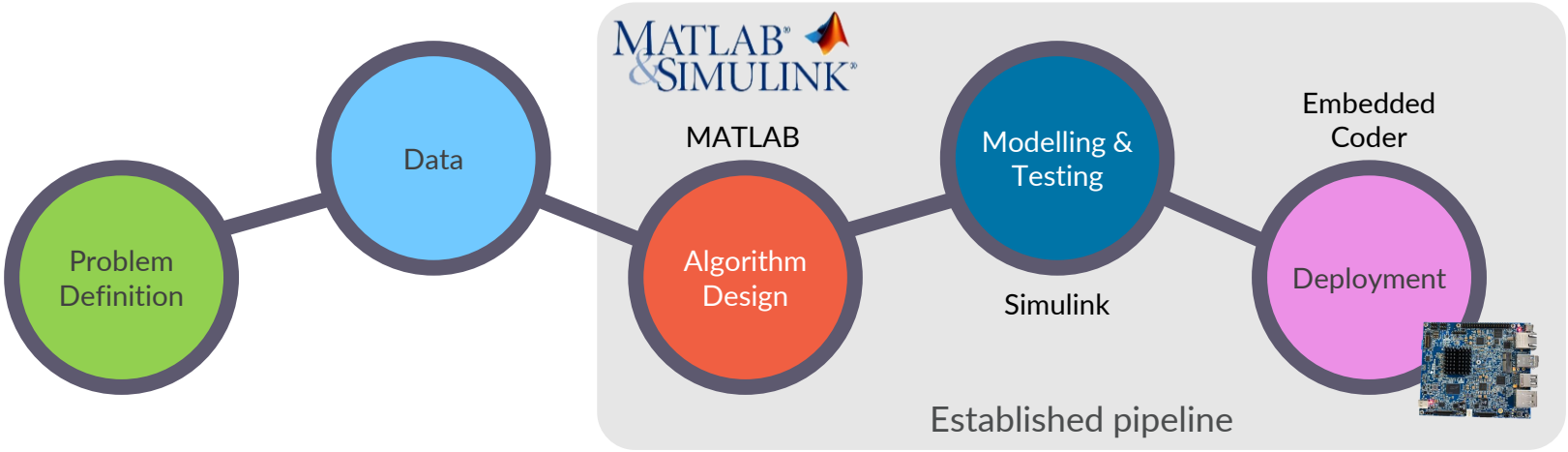
Gary Matson
Technical Expert

Nicola Easton
Senior Engineer

Reference: 12210288015

Algorithm Development Pipeline

- Established use of MATLAB & Simulink for modelling and deployment



- Common model and embedded target processor code
  - Reduces time & cost and increases robustness

- Presented at MATLAB EXPO 2015 - Accelerating FASGW(H) / ANL Image Processing with Model-Based Design

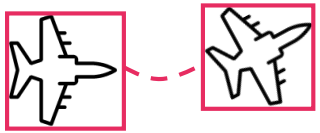
Reference: 12210288015

Exploitation of AI

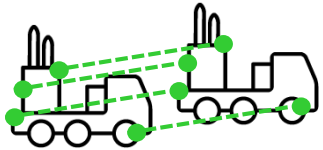
Explosion of AI over the past decade – research demonstrated huge potential in many different applications:

CLASSIFICATION & DETECTION

POSE ESTIMATION



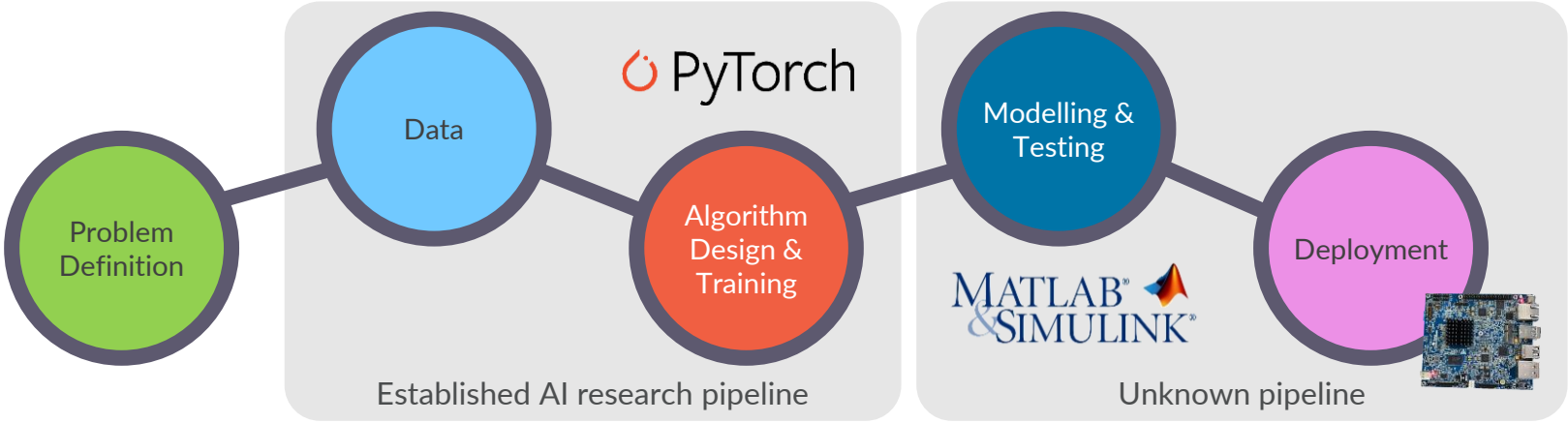
TRACKING



FEATURE EXTRACTION & MATCHING

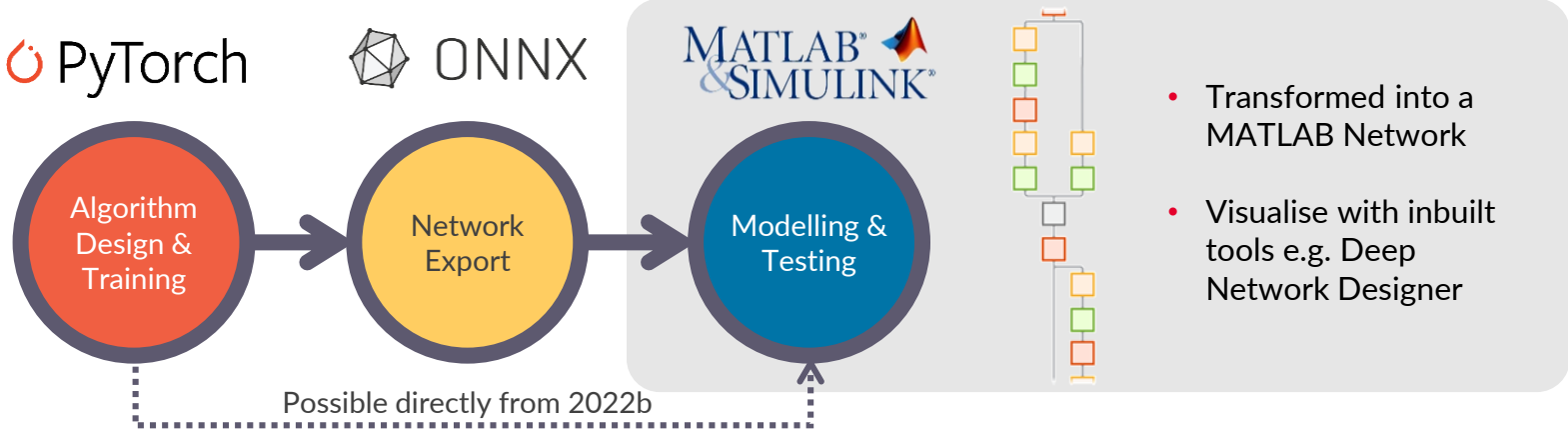
AND MANY MORE ...

CHALLENGE: How can these be exploited?



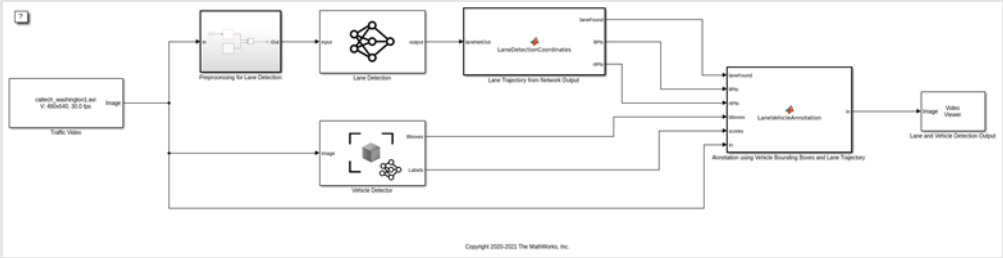
Reference: 12210288015

Inclusion of AI in System Level Simulation



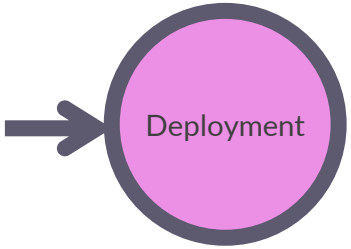
- Transformed into a MATLAB Network
- Visualise with inbuilt tools e.g. Deep Network Designer

- Integration into wider model possible with Predict block
- Enables whole system testing
- Traditional algorithms work in tandem with AI



Reference: 12210288015

AI Hardware Challenges



Why is AI hard to deploy?

- Huge number of matrix operations
- Unsuitable for regular CPUs

Network	Type	Parameters
Resnet-18	CNN	~ 11M
AlexNet	CNN	~ 62M
VGG-16	CNN	~ 135M
ViT-L	Transformer	~ 860M
GPT-3	Transformer	~ 175B

Examples of commercial embedded AI platforms:

NVIDIA® Jetson™ Products

Texas Instruments Jacinto™ 7

AND MANY MORE:

Xilinx Versal®

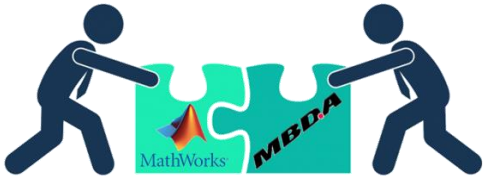
NXP i.MX 8M Plus®

⋮

Reference: 12210288015

Deployment of AI to Demonstration Hardware

- Initial work commenced in 2020
  - Beta tested Simulink support for GPU Coder
  - NVIDIA® hardware selected for demonstration



Initial benchtop demonstrator

Air carry trial

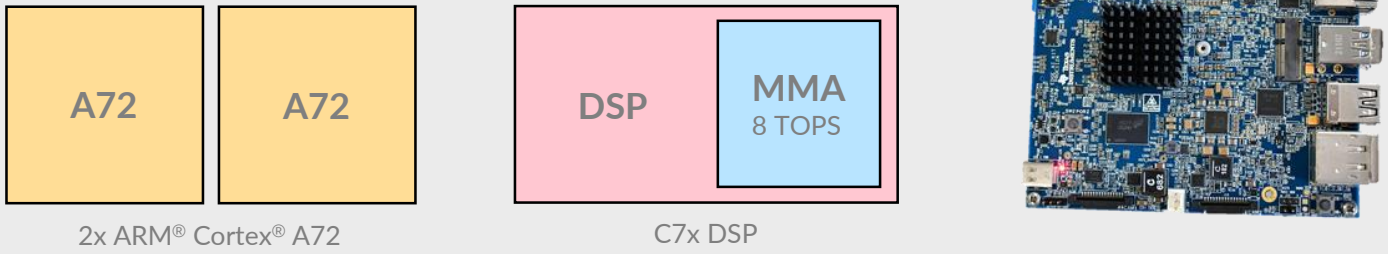
Reference: 12210288015

Deployment of AI to Embedded Hardware

- TI Jacinto™ initially selected as the embedded hardware platform for future systems

TI Jacinto™ 7 SK-TDA4VM

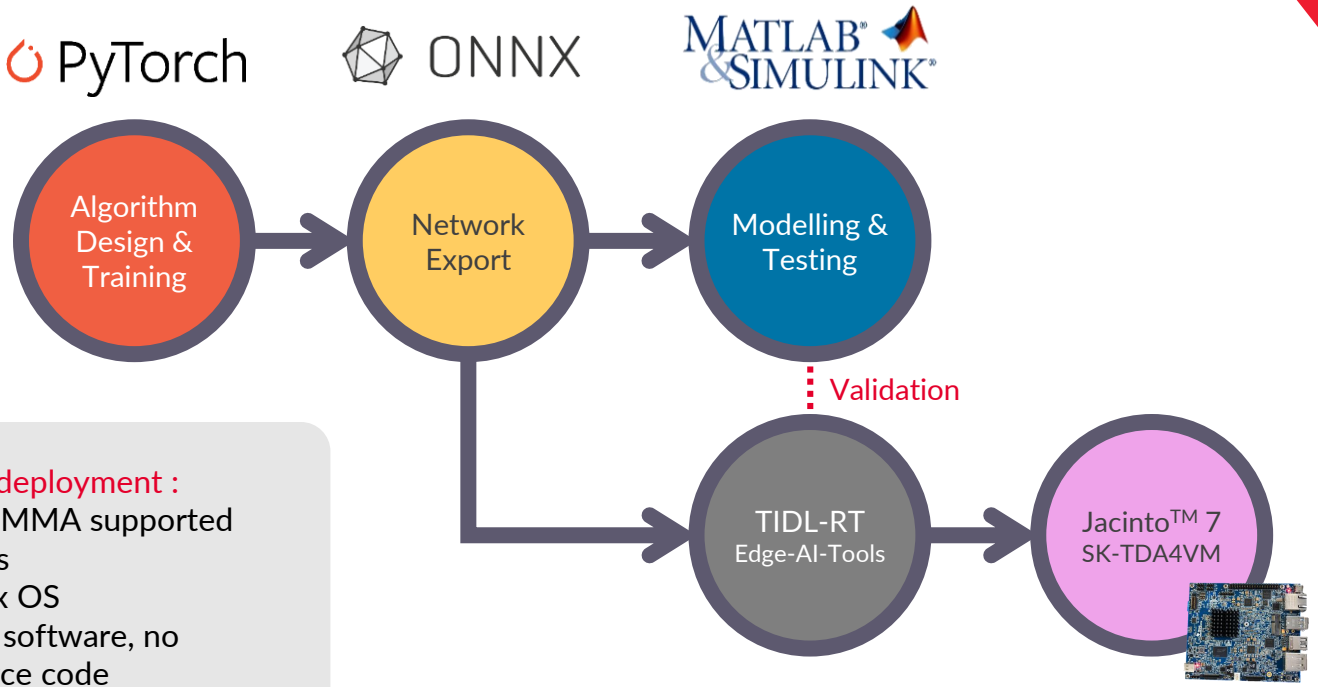
TDA4VM processor starter kit for Edge AI vision systems



- TI provide TIDL-RT libraries for quick implementations onto the MMA
  - Standard network architectures can be deployed efficiently
  - Supported networks run in real-time

Reference: 12210288015

Deployment of AI to Embedded Hardware: 2022

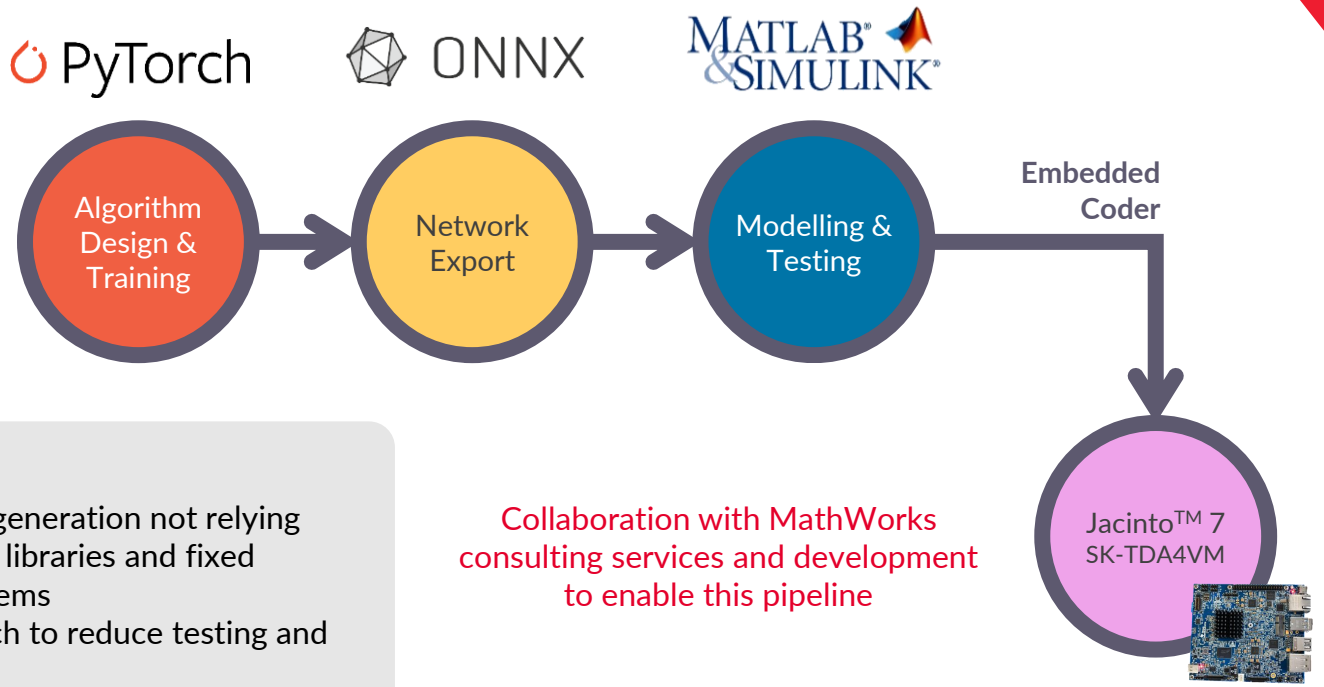


Challenges with deployment :

- Limited list of MMA supported network layers
- Requires Linux OS
- TI proprietary software, no access to source code
- Separate validation required

Reference: 12210288015

Deployment of AI to Embedded Hardware: 2023+



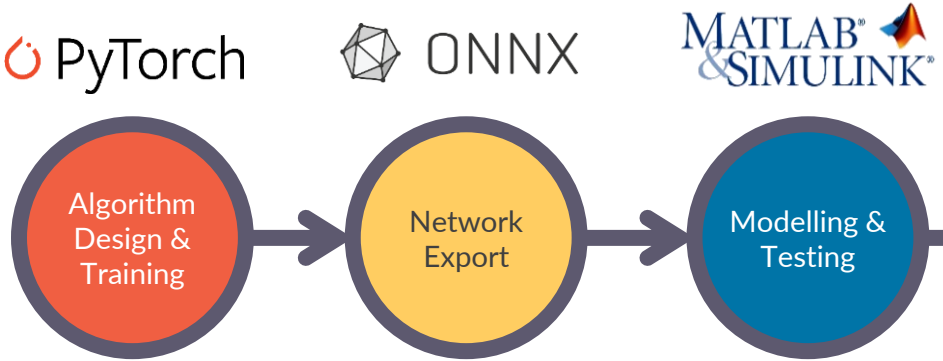
Needs:

- Generic code generation not relying on proprietary libraries and fixed operating systems
- MBSE approach to reduce testing and validation

Collaboration with MathWorks consulting services and development to enable this pipeline

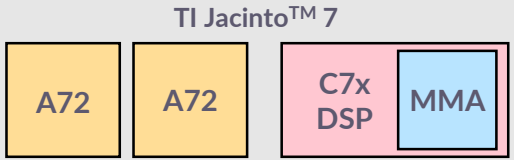
Reference: 12210288015

Deployment of AI to Embedded Hardware: 2023+



Current status:

- Successfully targeted the C7x DSP
  - ~5x speed up when using SIMD

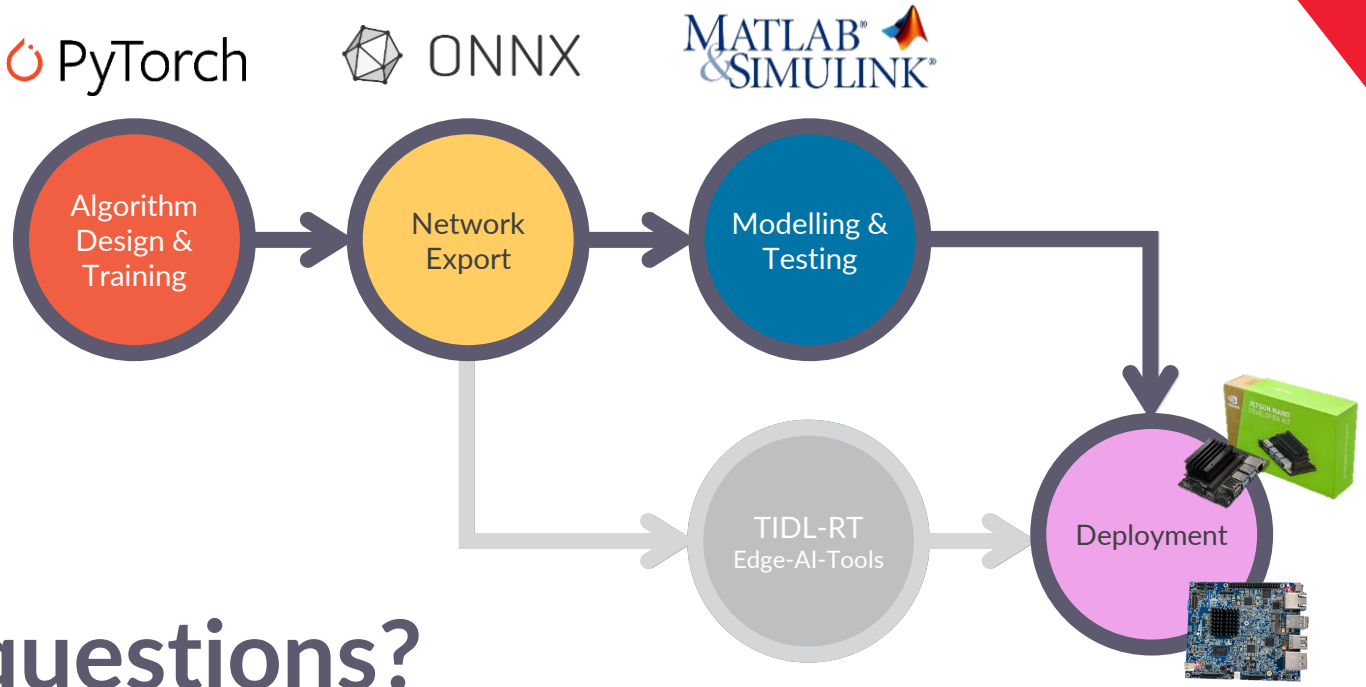


Future capability:

- Target the MMA to further reduce run-time
- Compare run-time with that achievable from TIDL-RT
- Consider other embedded hardware platforms

Reference: 12210288015

Thank you for listening



Any questions?

Reference: 12210288015