AI/ML at the edge

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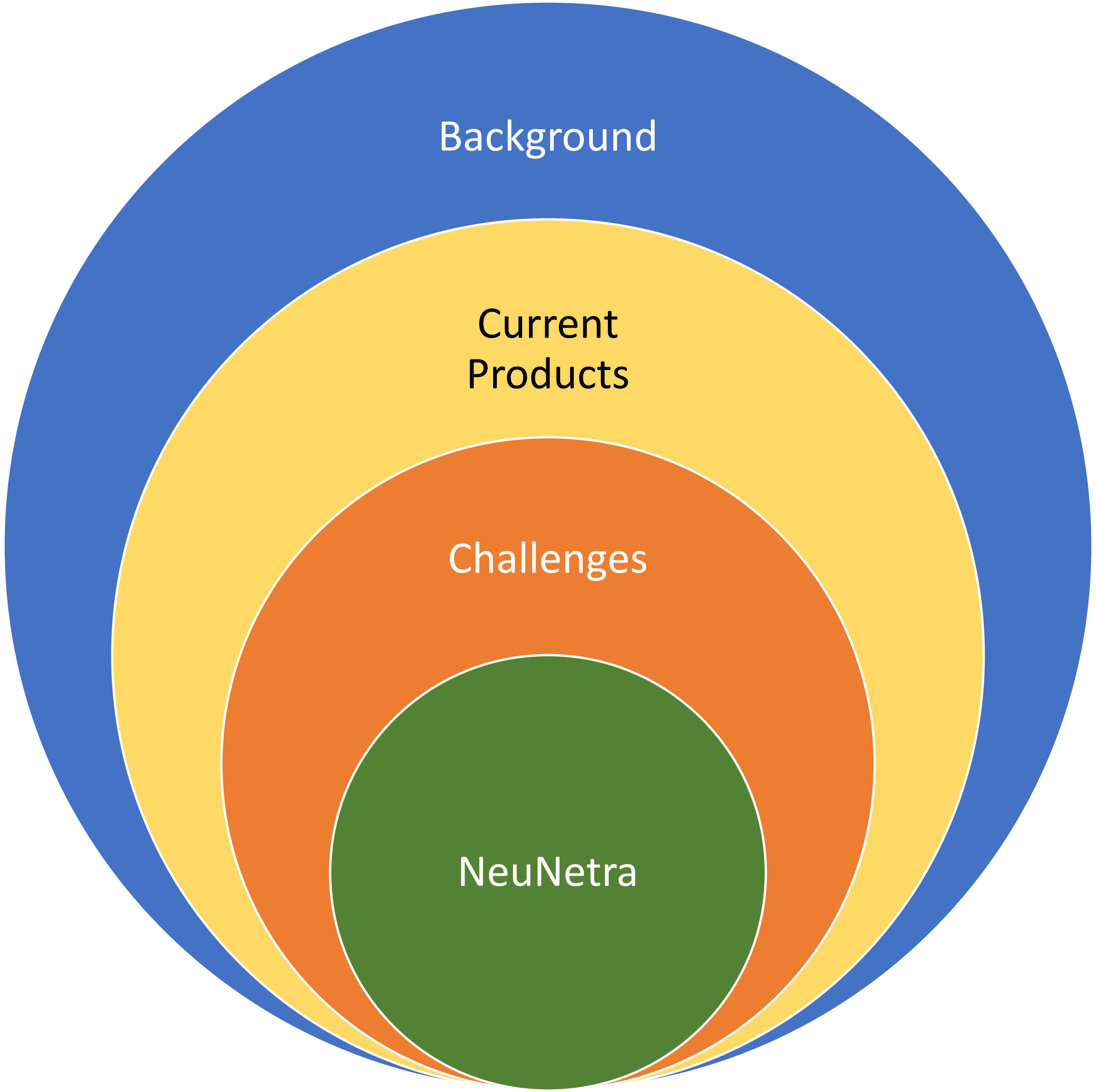
Agenda



Background

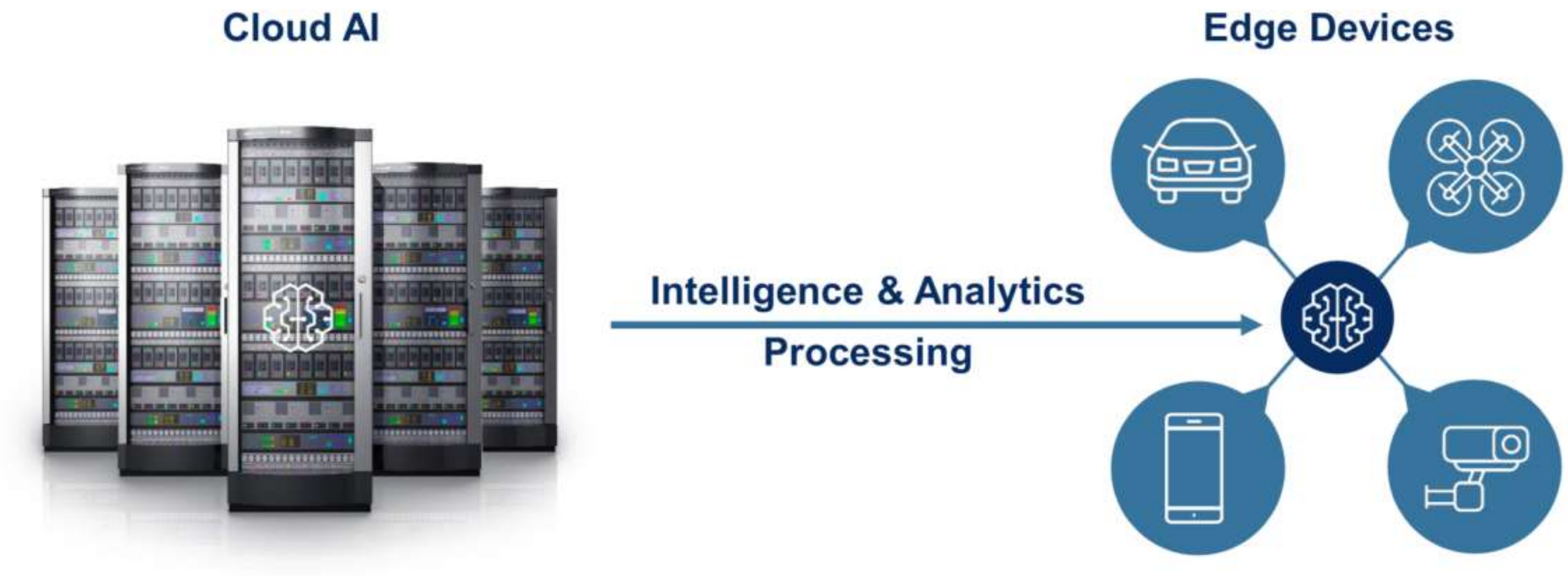
Current Products

Challenges

NeuNetra

Background and Definitions

Intelligence moving to the edge



Cloud AI

Edge Devices

Intelligence & Analytics

Processing

Key benefits of intelligence at the edge:

Low Latency

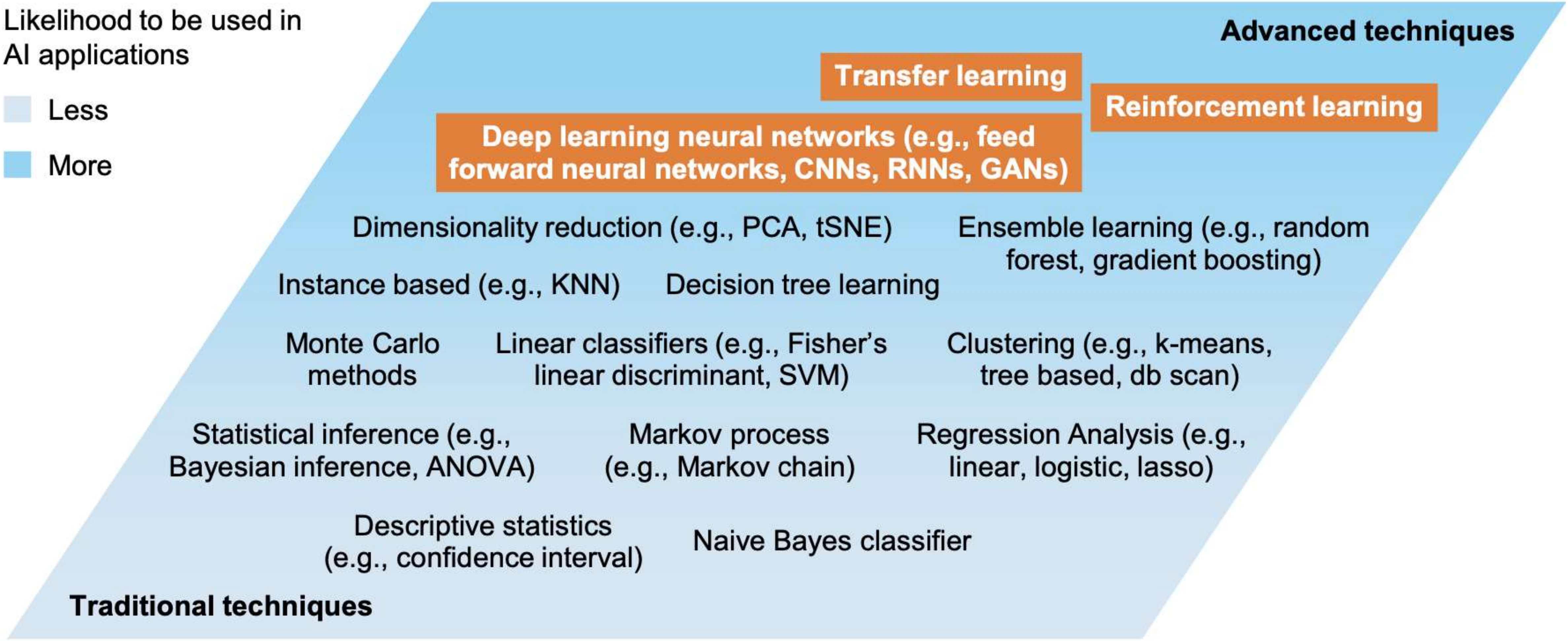
Low Power

Low Cost

High Privacy

High Reliability

AI, ML and other analytics techniques



Likelihood to be used in AI applications

Less

More

Advanced techniques

Transfer learning

Reinforcement learning

Deep learning neural networks (e.g., feed forward neural networks, CNNs, RNNs, GANs)

Dimensionality reduction (e.g., PCA, tSNE)

Ensemble learning (e.g., random forest, gradient boosting)

Instance based (e.g., KNN)

Decision tree learning

Monte Carlo methods

Linear classifiers (e.g., Fisher's linear discriminant, SVM)

Clustering (e.g., k-means, tree based, db scan)

Statistical inference (e.g., Bayesian inference, ANOVA)

Markov process (e.g., Markov chain)

Regression Analysis (e.g., linear, logistic, lasso)

Descriptive statistics (e.g., confidence interval)

Naive Bayes classifier

Traditional techniques

Definitions for this presentation (AI on the edge)

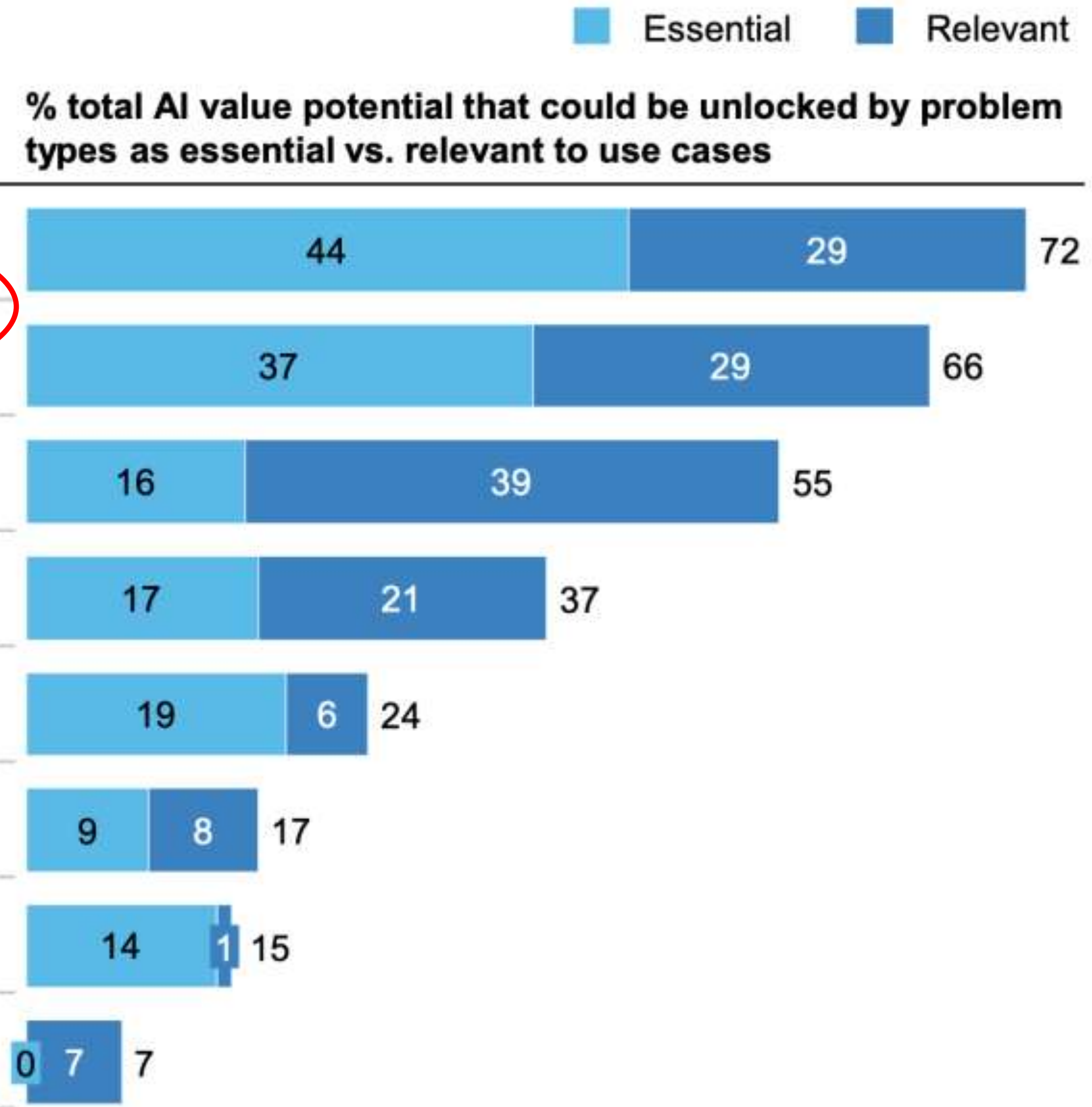
- AI - “deep learning” techniques using artificial neural networks - can be used to solve a variety of problems.

- TECHNIQUES – those that address classification and estimation problems - currently the most widely applicable for the edge

- FOCUS — feed forward neural networks, recurrent neural networks, and convolutional neural networks — Potentially enable the creation of between $3.5 trillion and $5.8 trillion in value annually. (says McKinsey)

Problem types and sample techniques

Problem types	Sample techniques
Classification	CNNs, logistic regression
Continuous estimation	Feed forward neural networks, linear regression
Clustering	K-means, affinity propagation
All other optimization	Genetic algorithms
Anomaly detection	One-class support vector machines, k-nearest neighbors, neural networks
Ranking	Ranking support vector machines, neural networks
Recommender systems	Collaborative filtering
Data generation	Generative adversarial networks (GANs), hidden Markov models



% total AI value potential that could be unlocked by problem types as essential vs. relevant to use cases

Current Products

Smartphones add AI engines

- Apple A11, A12 integrate neural engine
- Samsung galaxy S9 – neural engine from DeePhi
- Huawei Kirin 970, 980 – Neural engines from cambricon
- Qualcomm Snapdragon 845, 855 – Hexagon vector DSP
- Mediatek P90 – Cadence P6 plus custom neural engine
- Trickling down to mid-tier phones

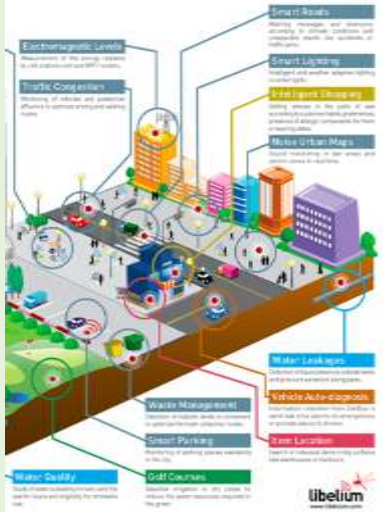
➢ These engines enable “new applications” such as 3D face recognition

➢ More efficient than CPU or GPU

AI in IoT

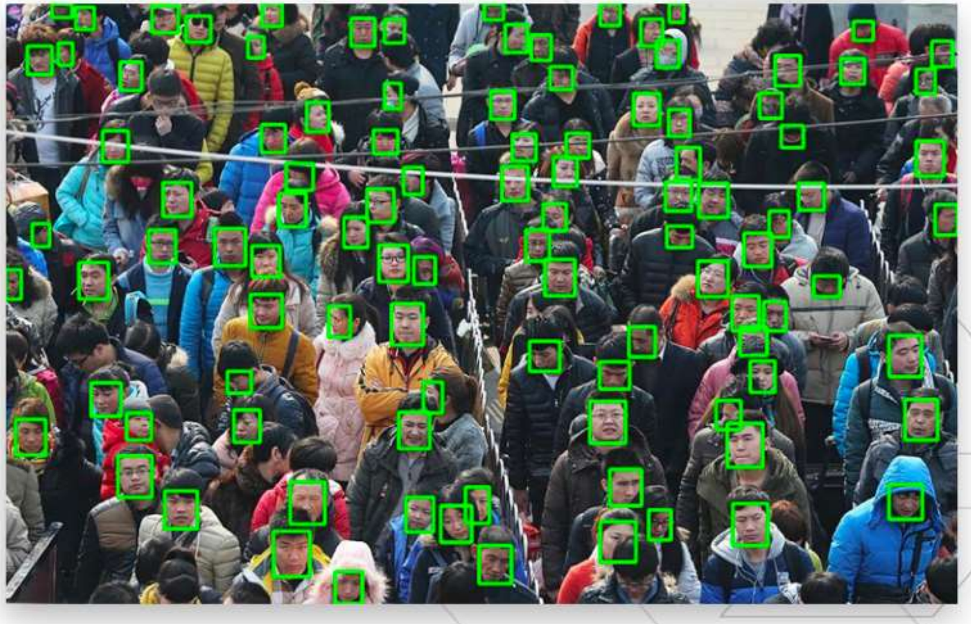
- Voice assistants
- Security cameras
- Drones

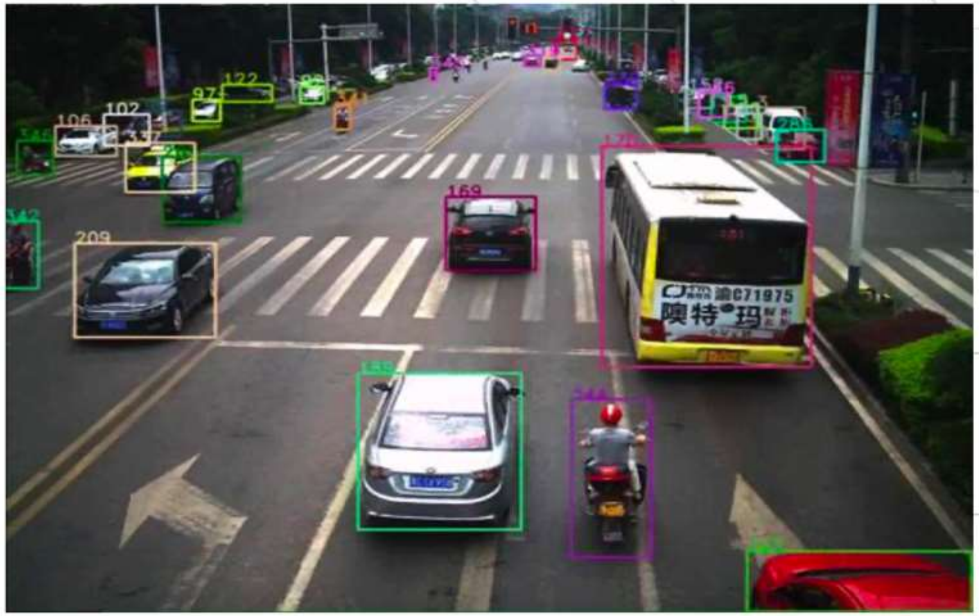
- Industrial IoT is booming
  - Smart buildings, hospitals,
  - factories, farms, infrastructure
- Consumer IoT is starting to take off
  - Wearables, Smart homes, video doorbells



Target – Smart cameras

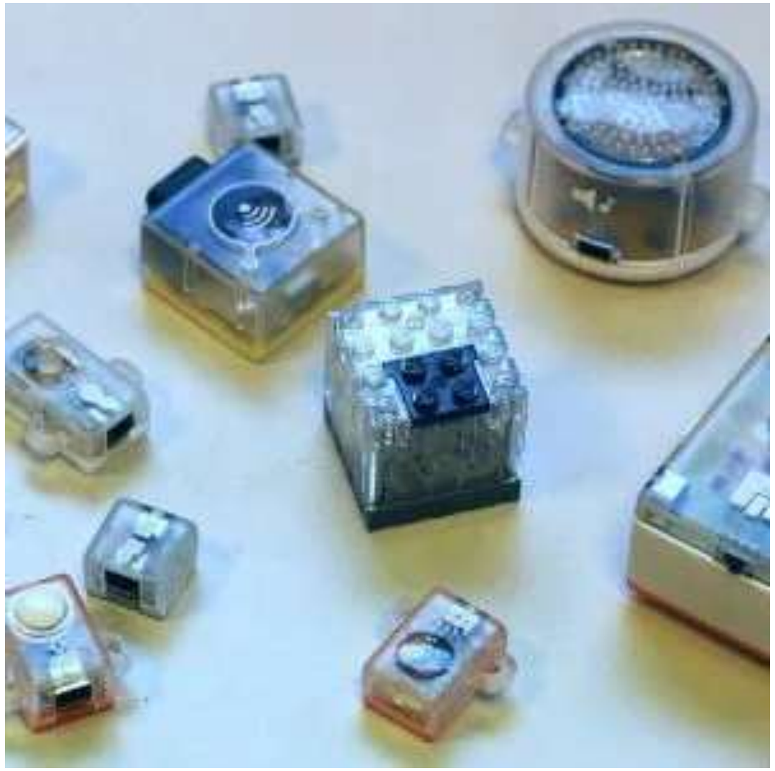
- Custom HW enables more complex DNNs than a CPU can handle
- Surveillance market is booming
  - Especially in China
- Intel Myriad X, Bitmain BM1880 offer 1TOPS at 2.5W
- Other Chinese chip makers:
  - Canaan/Kendryte, Cambricon, HiSilicon, Horizon robotics





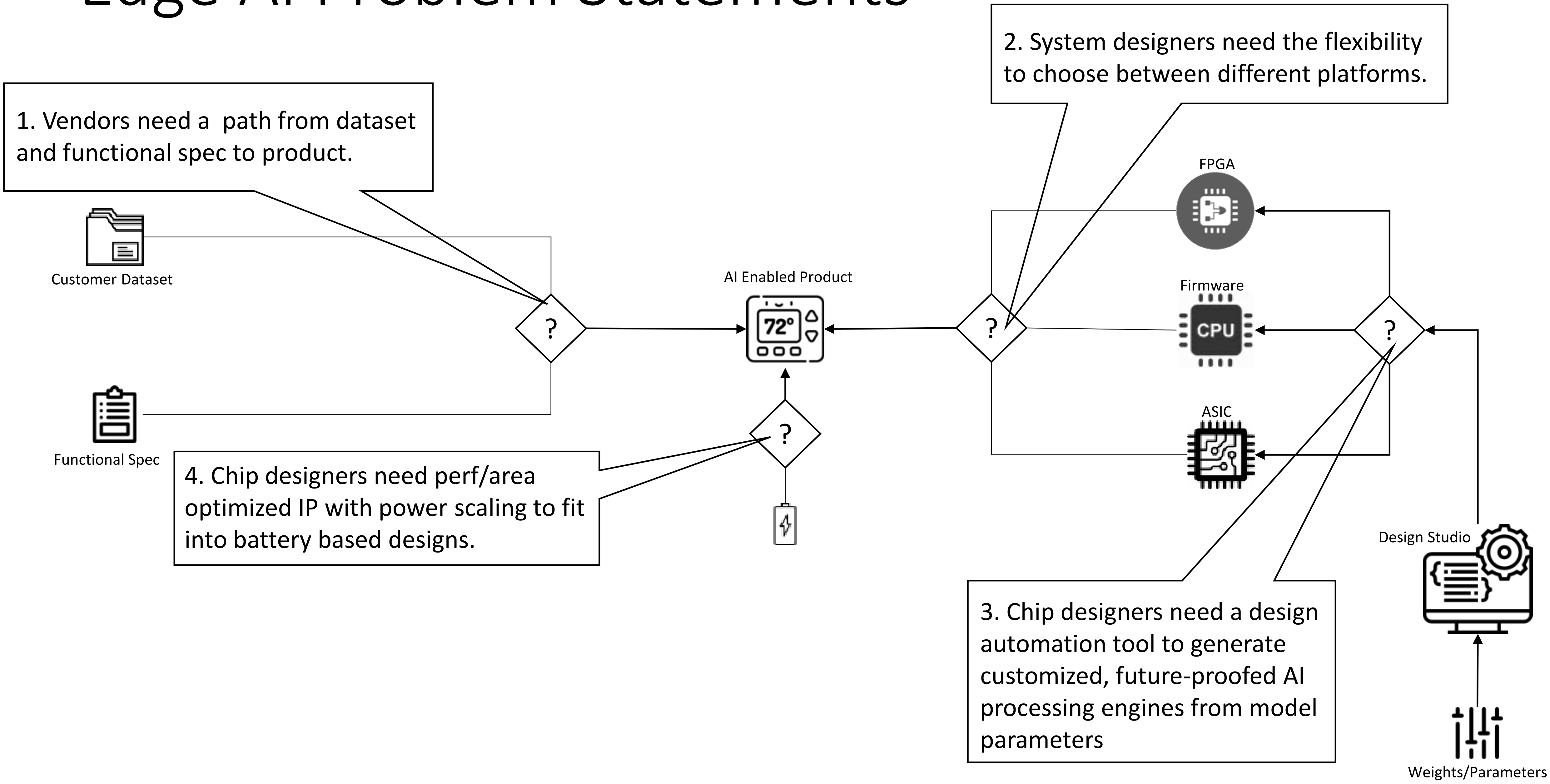
Tiny AI engines for IoT sensors

- Many IoT devices today use cloud processing
- Microcontroller CPUs can handle simple neural networks
  - Cortex M4 has DSP extensions to improve DNN perf
  - ARM CMSIS-NN includes tools for porting DNNs to its CPUs
- Small IoT devices benefit from AI accelerators
  - Extends battery life
- Eta compute offers Tensai MCU with coolflux DSP accelerator
  - Handles basic voice recognition at 2mW (15x less energy than standard CPU)
- Greenwaves GAP8 MCU implements 8 core accelerator using RISC-V
  - Scales from 4mW to 70mW, can handle voice/image recognition
- Syntiant
  - Analog NDP



Challenge

Edge AI Problem Statements



1. Vendors need a path from dataset and functional spec to product.

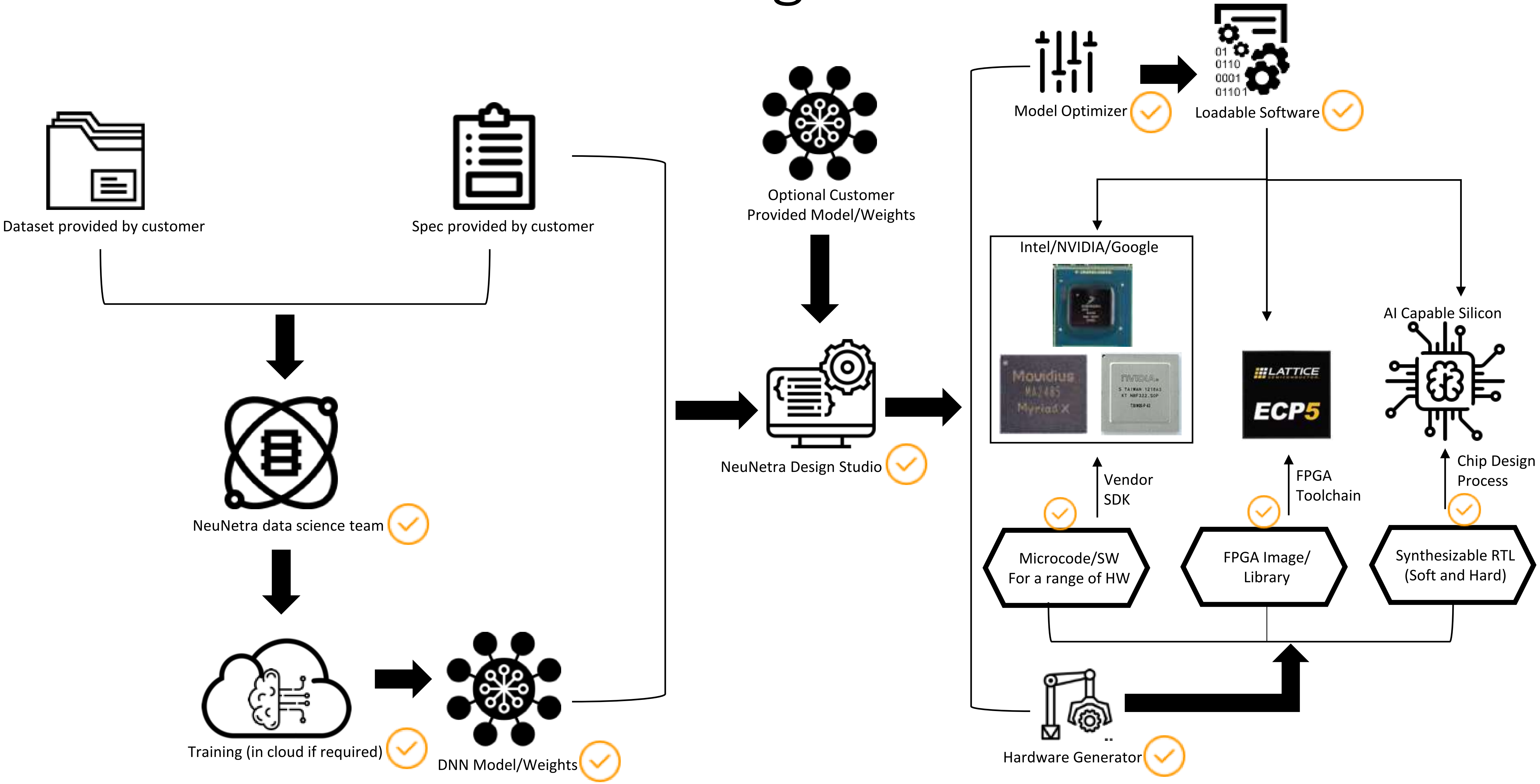
2. System designers need the flexibility to choose between different platforms.

3. Chip designers need a design automation tool to generate customized, future-proofed AI processing engines from model parameters

4. Chip designers need perf/area optimized IP with power scaling to fit into battery based designs.

NeuNetra

The NeuNetra advantage



NeuNetra Unique Value/Positioning

- ✓ End-to-End (data to product) capability
- ✓ Fully functional, Stand-alone, Customizable and Extensible AI processing engines
- ✓ Platform independent. Can generate for ASIC, FPGA, Intel, Google, NVIDIA, Flexlogix
- ✓ AI Engines come with critical optimizations and power scaling capabilities to support sensor level applications
- ✓ Design Studio based solution

Thank You!

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