Qualcomm

# Shifting Incentives in Open Source Participation

**Craig Northway**

Director, Engineering
Qualcomm Technologies, Inc

# From 5G to IoT, innovation starts with Qualcomm

$53+ billion cumulative investment in R&D

# Open Source Incentives

- Key historic incentives for participation:
  - Hardware Vendors
  - Sell Support and Services
  - Provide Platform as a Service
  - Auxiliary process and Infrastructure
  - Talent Acquisition and Retention

- An example of shifting incentives in database technology.

- Future Shifts:
  - Machine Learning
  - Standards
  - Open Hardware

# Hardware Vendors

- Hardware vendors are incentivized to participate in Open Source to support the hardware they sell.
  ◦ Open source software support can be a key enabler to increasing chipset volumes and a differentiator with competitors.

- Examples:
  ◦ Linux Kernel
  ◦ LLVM

# Support and Services

- Many companies have made a business out of supporting Open Source software and providing services.
  - Participation gives them the expertise and reputation needed to perform the support and services.

- Examples:
  - Distribution Support:
    - Red Hat
    - Canonical
  - General Services:
    - Bootlin
    - Rogue Wave
    - Codethink

# Platform as a Service

- PaaS vendors use Open Source to provide services.

- Incentives to participate include:
  - Improving engineering efficiency
  - Using developer familiarity to drive adoption
  - Enable features in the upstream

- Examples:
  - Elastic.co – Elastic Search
  - AWS – Apache Lucene

# Auxiliary Process and Infrastructure

- Companies often participate for parts of their business considered auxiliary.
  - Reduce operating costs by leveraging community and upstream model

- Examples:
  - Google – LLVM
  - Facebook - React

# Talent Acquisition and Retention

- Talent acquisition and retention is (or should be an) incentive for all software related businesses.
  - Developers want to be able to participate in Open Source
  - Having an Open Source presence helps to find relevant developers.

# Shifting Incentives

# Example - Platform as a Service & Database Incentives

- Platform as a Service has made complex infrastructure simple.

- Example of a technology shift that modified incentives to participate in Open Source

- Unless you are an internet scale business or are a PaaS provider:
  - Do you run or control the Operating System anymore?
  - Do you run/control/modify middleware like databases, message buses?

# Databases

## Proprietary to Open Source Shift

- Proprietary Database
  - Selected by the IT department!
  - Pay a vendor for both the software and the service (support)
  - Long turn around time for bug fixes or features specific to your use case

- Open Source Database
  - Selected by developers
  - May pay a vendor for service (support)
  - Need to fix a bug? Add a feature? Self-service!
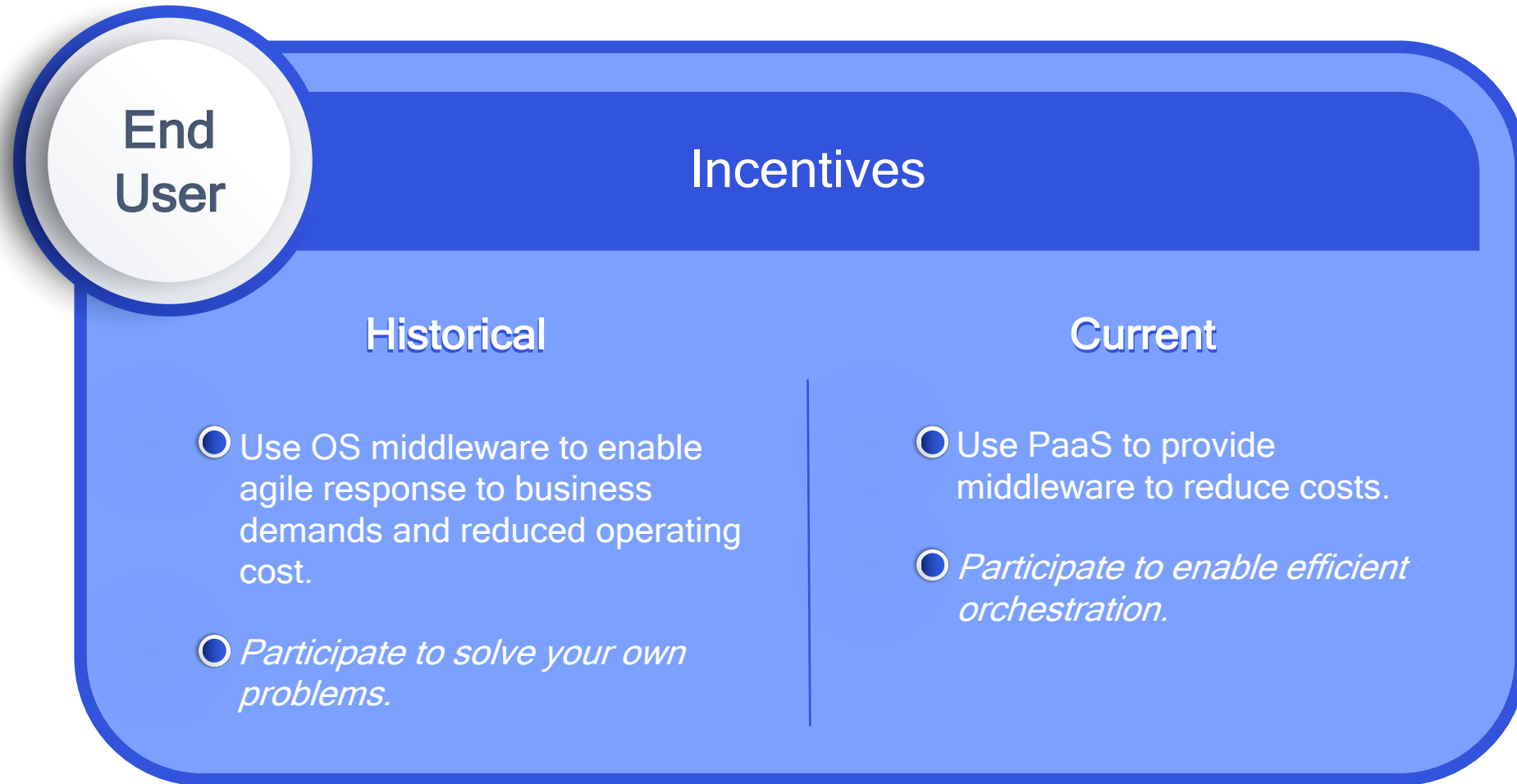
# Databases

## Cloud (PaaS) Shift

- End user abstracted from Database and Operating System implementation

- More economical to buy service than run yourself

- Pay a vendor for the service

- Need to fix a bug? Add a feature?
  - Vendor request
  - Upstream?

# Example - Platform as a Service & Databases

## Shifting Incentives

- Reduced incentive for **end user** to contribute to middleware like database

- **End user** incentive moved to cloud orchestration, cloud native deployment

- Platform as a Service value chain participates in Open Source database technologies

# Shifting Incentives: Database/Middleware

## End User

## Incentives

### Historical

- Use OS middleware to enable agile response to business demands and reduced operating cost.

- *Participate to solve your own problems.*

### Current

- Use PaaS to provide middleware to reduce costs.

- *Participate to enable efficient orchestration.*

# Future Shifts in Incentives

- Machine Learning
  - How do we shift incentives to broaden participation further?

- Standards
  - How to we enable participation for varied incentives?

- Open Hardware
  - How do we ensure the right incentives exist?

# Machine Learning

- Boom of Open Source Machine Learning software being given away by those using it for their business.

- How do the related businesses make money? How do they differentiate if the software is available to all?

# Machine Learning Incentives

- Companies using machine learning to monetize data.
  - Incentives – increase efficiency, attract talent, leverage community support and expertise.

- PaaS companies also have an incentive to participate in machine learning Open Source as can run machine learning as a service
  - Incentives – increase efficiency, attract talent and use developer familiarity to drive adoption.

- Hardware vendors have incentive to participate in ensuring the software runs effectively on their hardware
  - Incentives – sell more hardware.

- How do we continue the innovation in Open Source machine learning?
  - Broaden the incentives to include companies where data is tangential to their business.

# Open Data

- Enabling Open Data will continue the innovation boom in machine learning software.
  - Extend the incentive to other businesses.

- How do we open up data for sharing the same way we share software?

- Licenses for data.
  - https://cdla.io
  - https://creativecommons.org
  - https://opendatacommons.org
  - http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/
  - https://project-open-data.cio.gov/open-licenses/

- How much is this used in practice?

# Example - Incentives when data is tangential to business



5G

# Example - Incentives when data is tangential to business



**+**



Menu

**+**   ML

# Shifting Incentives: Machine Learning

**ML Software User**

## Incentives

### Current

- Machine Learning software is an enabler. Value is typically in the data.

- *Participate to share development cost, attract developer talent.*

### Future

- Open data plus machine learning can enable innovative new businesses and increase participation further.
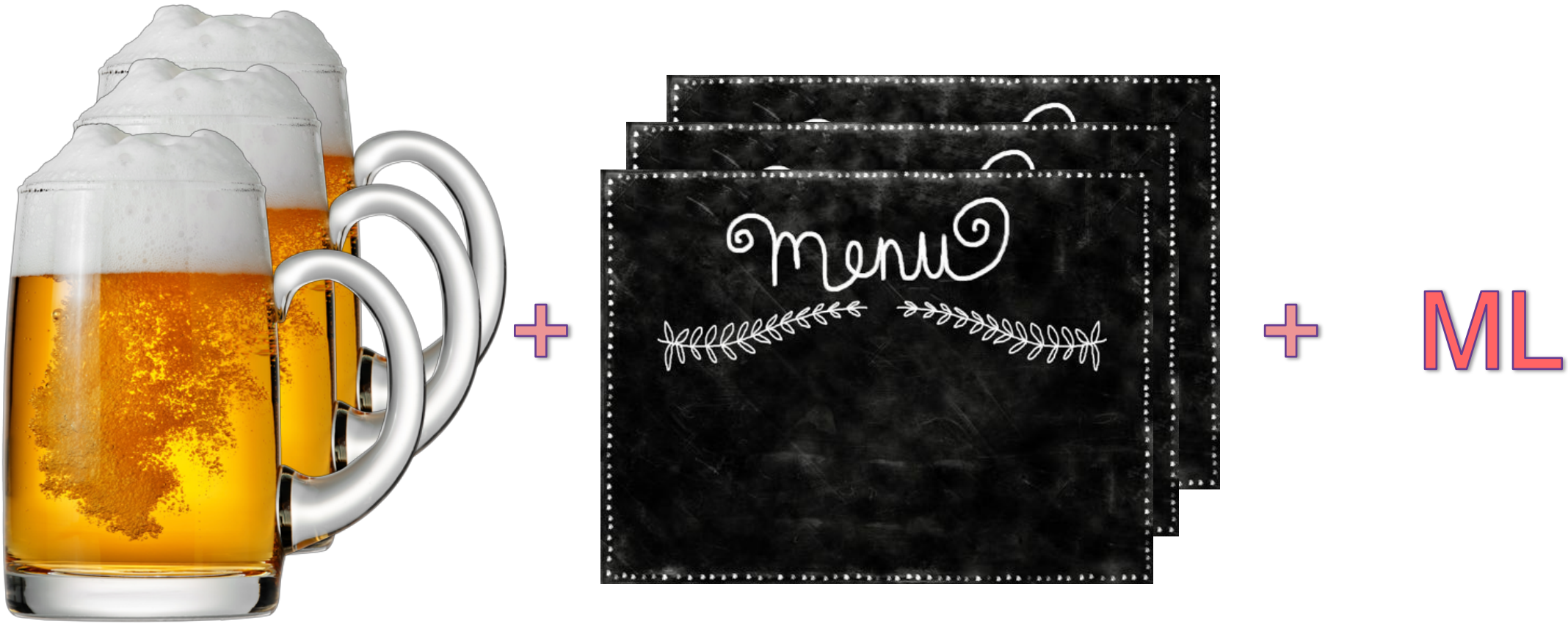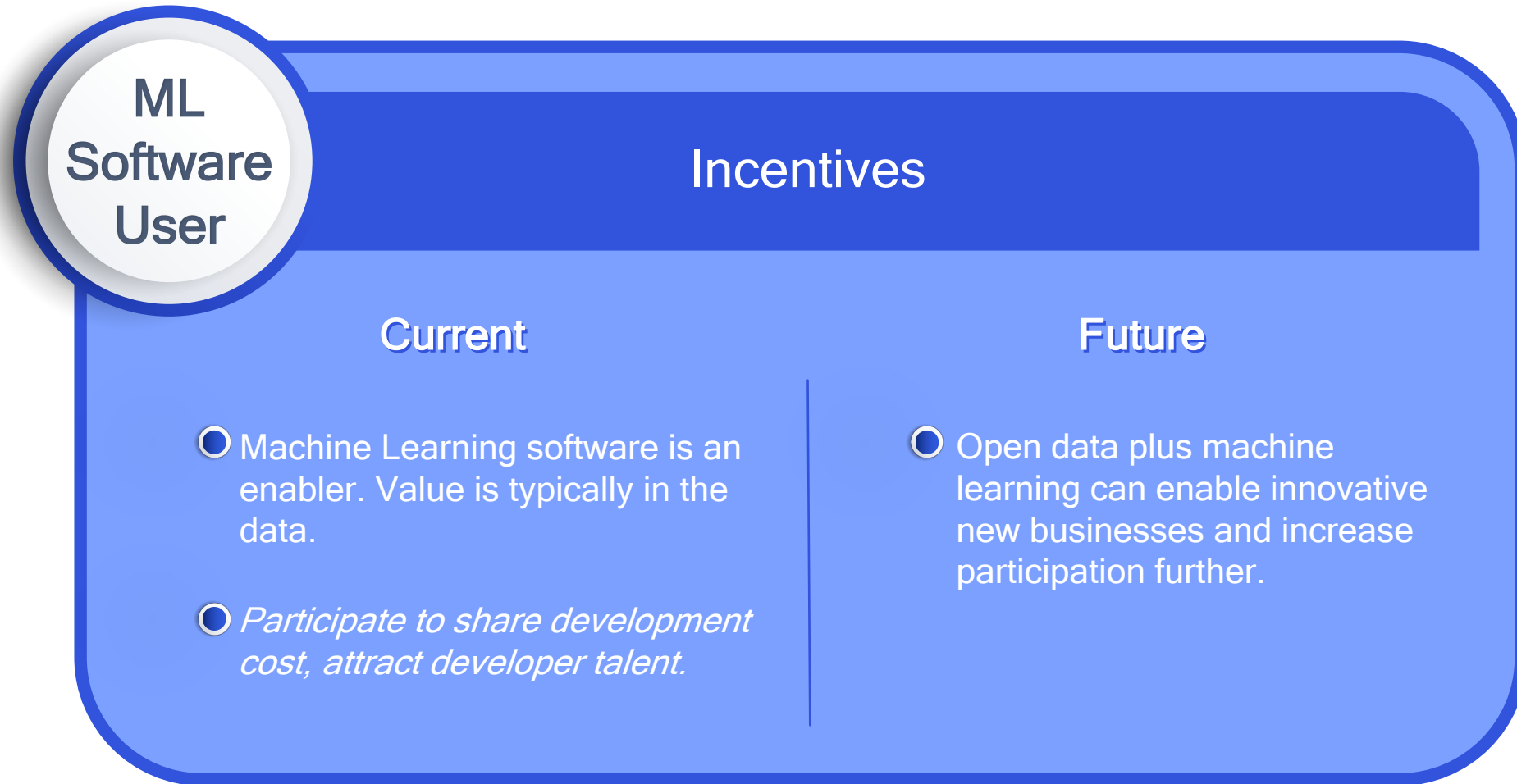
# Standards

- Historically limited incentives to directly participate in Open Source.

- Started participating to improve the speed of iteration and quality of standards.

- Standards are wide and varied in their complexity, so incentives may differ.

# Standards – Collaboration Models

Commodity Technology ←——————————————→ Research Intensive

# Standards – Collaboration Models



- Lower energy, higher accuracy
- Lower risk
- Invest in product development
- Roadmap (clarity)

- Higher energy, lower accuracy
- Higher risk
- Invest in R&D
- Science (might fail)

# Standards – Collaboration Models
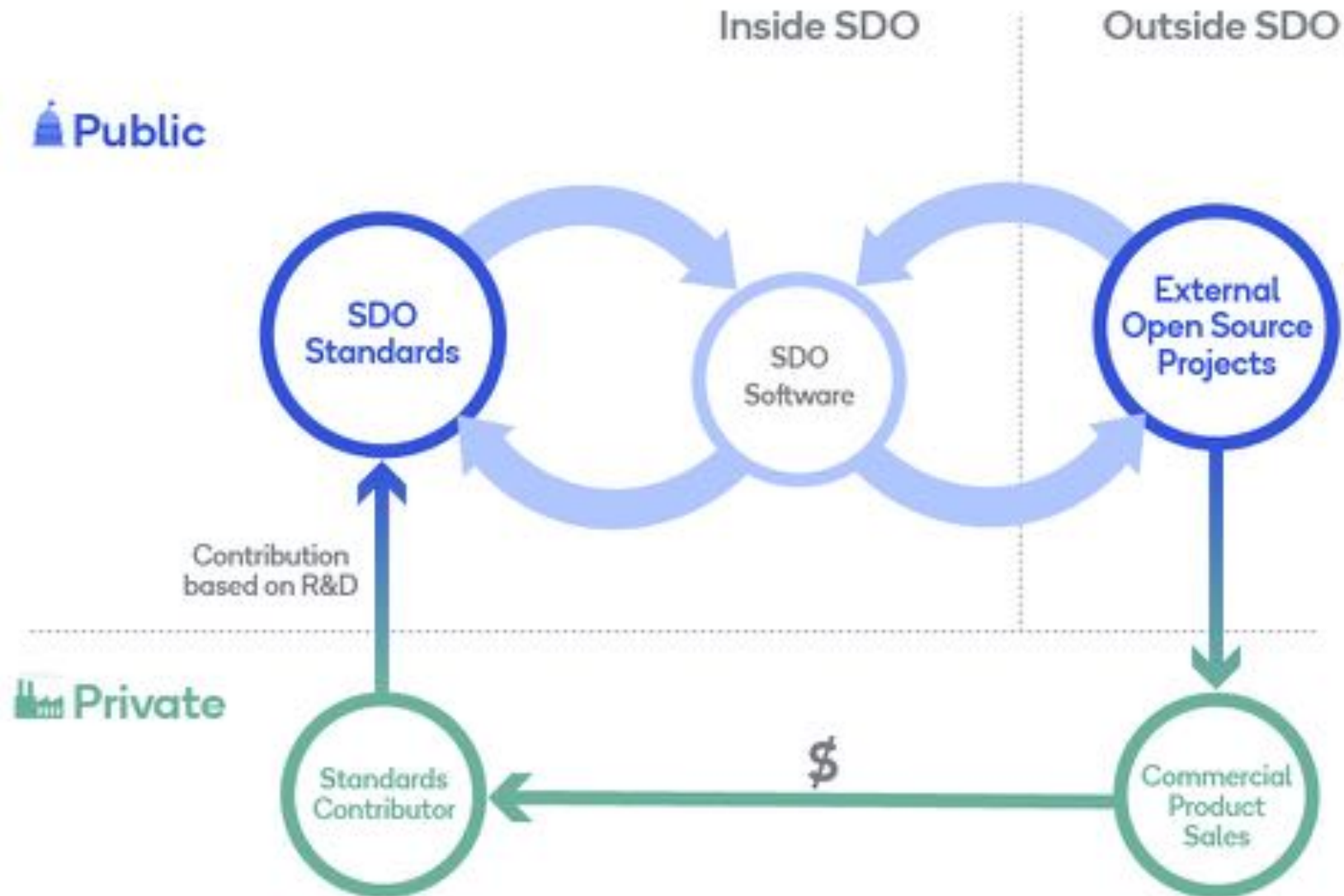
# Shifting Incentives - Standards

• Open Source and Standards collaboration is not a one size fits all solution.
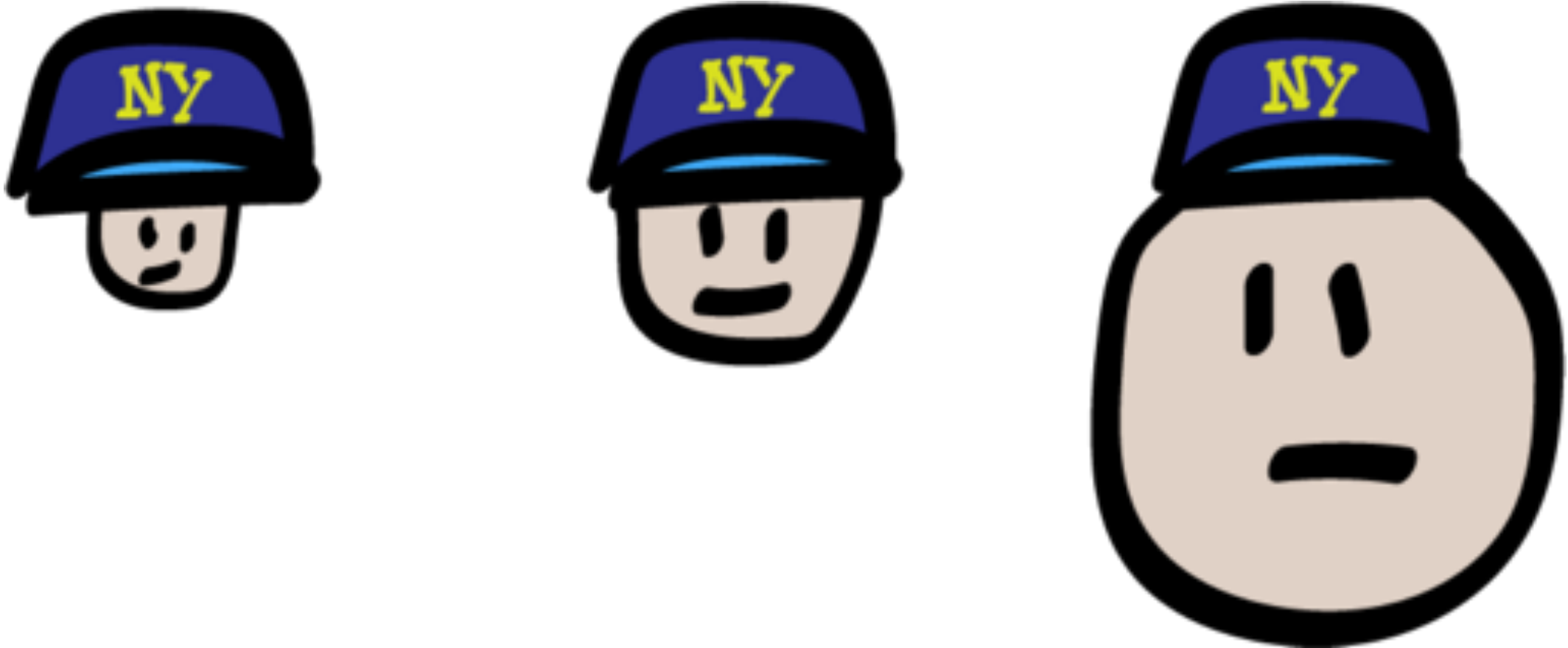
# Shifting Incentives: Standards

**Standards Contributor**

## Incentives

### Future

- **Shared implementation** – Aligns with typical Open Source incentives and participation models.

- **Validate and improve standard** – Use Open Source and Open Source collaboration methods to drive the pace of standardization.

# Open Hardware

- Existing commercial architectures:
  - x86
  - PowerPC
  - SPARC

- Driven by vendor or a small set of vendors

- ARM architecture:
  - Many SoC (System on Chip) vendors with different requirements

# ARM and Linux Kernel circa 2010/2011

- Fragmentation between ARM SoC vendors and lack of upstream

- ARM Tree size

- ARM Tree changes between releases

- Linus

- Linux Foundation, Linaro and Vendor response.

# Open Hardware

- What about an architecture without a main commercial backer?

- RISC-V – Open ISA (Instruction Set Architecture)

- Enables Open Source or Commercial Implementations

https://pixabay.com/photos/refugees-economic-migrants-1015294/

# Shifting Incentives: Open Hardware

**Hardware Vendor**

## Incentives

### Current

- Vendor incentive to ensure support. Software support need to sell hardware/architecture.

### Future

- Democratized, so less differentiation? Open and collaborative?

- Or "leave it to the others"? Tragedy of the commons.
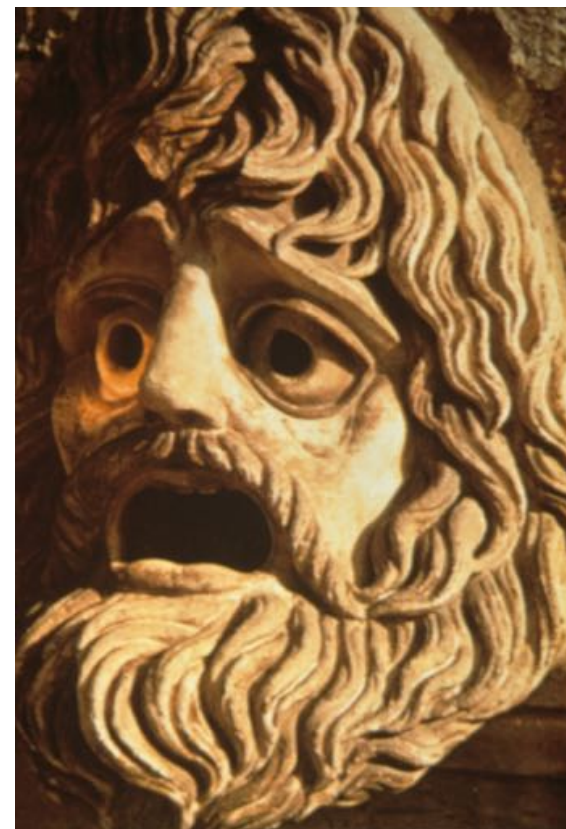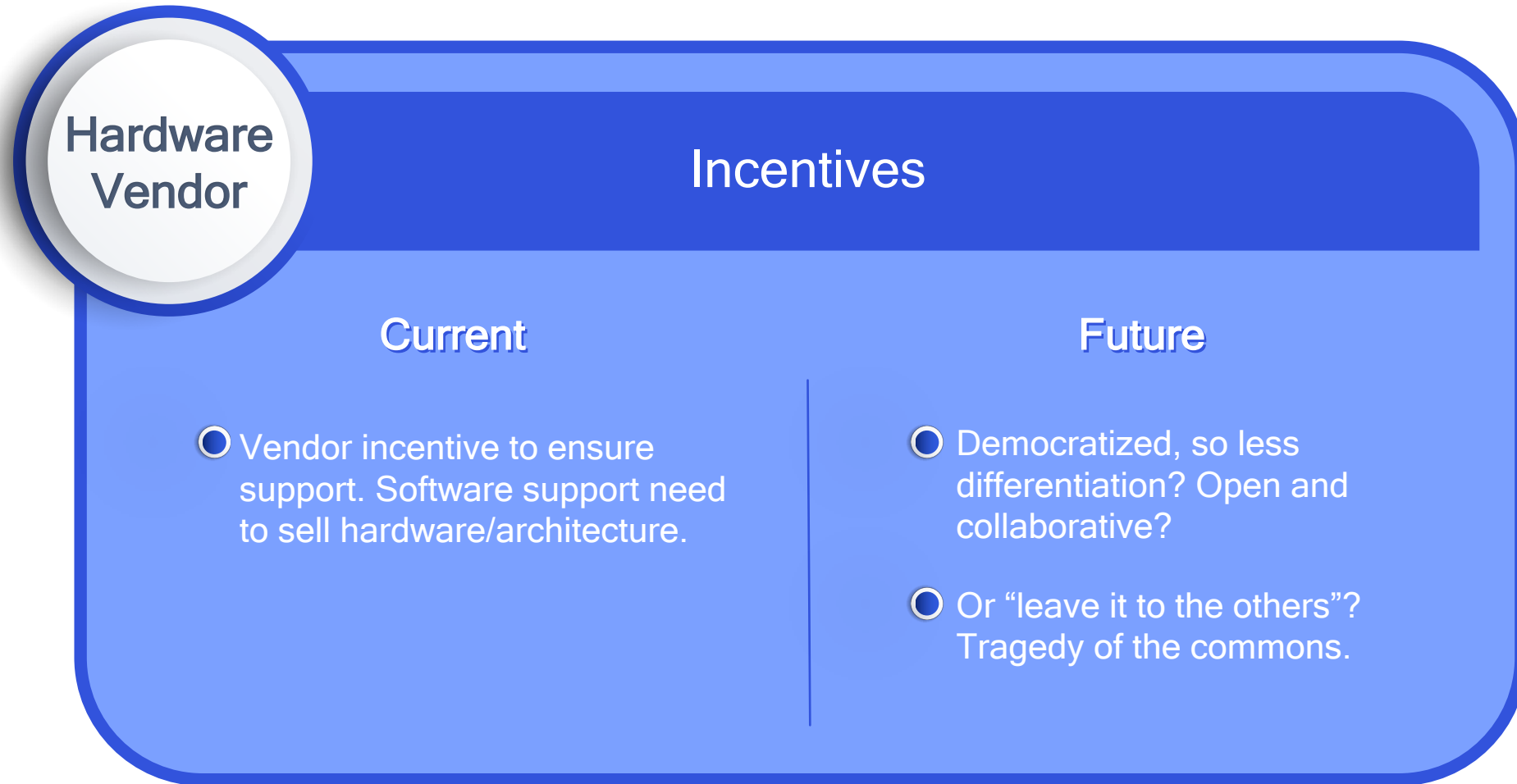
# Historical Incentives

- Hardware Vendors

- Sell Support and Services

- Provide Platform as a Service

- Auxiliary process and Infrastructure

- Talent Acquisition and Retention

# Shifting Incentives - Future Examples

- Machine Learning:
  - Will we successfully enable open data?
  - Open data may be key to continuing innovation and broadening participation.

- Standards:
  - Standard and Open Source collaboration may not be one-size fits all.
  - We need a variety of models for standards to participate in open source

- Open Hardware:
  - To avoid tragedy of the commons and unnecessary fragmentation we may need to align around open implementations.

# Qualcomm

# Thank you

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