ADLINK Neuron: An industrial oriented ROS2-based platform

HaoChih, Lin
ROS Technical Consultant
Advanced Robotic Platform Group
2018.03
ADLINK Overview
# ADLINK Overview

Over 20 Years of Embedded Experience

<table>
<thead>
<tr>
<th>Established</th>
<th>CEO</th>
<th>Headquarters in</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 1995</td>
<td>Jim Liu</td>
<td>Taipei, Taiwan</td>
</tr>
<tr>
<td></td>
<td>Angelo Corsaro</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Publicly Traded</th>
<th>Taiwan Stock Exchange Listing</th>
<th>Revenue (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Since 2002</td>
<td>TAIEX: 6116</td>
<td>$301M (Y2016)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$340M (Y2017, F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Employees</th>
<th>USA</th>
<th>France</th>
<th>India</th>
<th>Korea</th>
<th>Israel</th>
<th>Germany (2)</th>
<th>Singapore</th>
<th>China (3)</th>
<th>Japan</th>
<th>UK</th>
<th>Capital (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$67.5M</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Market Cap (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$500M</td>
</tr>
</tbody>
</table>
Vertical Markets & Key Customers

- **Industrial Automation**
- **Test & Measurement**
- **Medical / Healthcare**
- **Transportation**
- **Telecom & Networking**
- **Military & Aerospace**

Customers Across Vertical Markets
A Revolution of Production

Massive Production

Individual Production
Factories of the Future (FoF)

• Predictive maintenance
• Material handling
• Digital solution
• Track & Trace

Source: FFG / ADLINK
Autonomous Mobile Robot in FoF

ROS 2.0

AI & Data Analysis

Predictive Maintenance

ROS packages
- Fleet Management client
- Data Collection
- Pick & Place
- Navigation

Electrical Control System

Smart Devices
- Conveyer
- Lidar
- Barcode scanner

D' ROS packages
- DDS bus (Inter-process)
- EtherCAT-motion Control System
- Sensors (laser scanner, etc.)

AMR

DDS bus (Inter-machines)

- Low latency (<10ms)
- High bandwidth
- Reliability
- Low power consumption
- Scalability

Enterprise Wireless environment (licensed/unlicensed)
ROS 2 with OpenSplice DDS

Application

ROS client library (& drivers)

- 3D data processing
- Localization and mapping
- Computer Vision
- Robot control
- Motion planning

ROS abstract middleware layer (RMW)

DDS

- Vortex OpenSplice Commercial version
- Vortex OpenSplice Community version
- Vortex XRCE

Time Deterministic Network
(Guaranteed Latency)

IEEE 802.1
- Global time
- Schedule

TSN (Ethernet)

5G (Wireless)

Huawei 5G (Wireless)

IEEE 802.1

Global time
Schedule

Building Forward Together
ADLINK ROS-2 Industry-Grade Products

Motion, Vision, Measurement

ROS-based arm and camera for inspection and picking

Integrated
Embedded
Standalone

MEMS sensor
Analog sensor

Machine condition monitoring robots

Embedded ROS-based PC for industrial arms

ADLINK ROS-based PC for AMR

Extracted PLC data/program into GW
Convert register data into state info
Toward Distributed, Autonomous Way!

- **ROS 1** Standalone
- **ROS 2** coordination among machines, adopt **DDS (pub-sub)**

![Diagram](image)

ROS 2 removes the Master Node

- Real-time
- Powerful QoS
- Standard tech.
- Dynamic discovery

ROS 1 (2010) — Server-client (TCP)

ROS 2 (2014) — Distributed (UDP)
ADLINK Neuron
### ADLINK Neuron

An industrial oriented ROS2-based platform

<table>
<thead>
<tr>
<th>Price (US$)</th>
<th>CPU Type</th>
<th>RAM</th>
<th>SSD</th>
<th>PCIe</th>
<th>RS232</th>
<th>RS485</th>
<th>GPIO</th>
<th>USB</th>
<th>GbE</th>
<th>miniPCIe</th>
<th>Input</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>$599</td>
<td>ARM</td>
<td>4-32G DDR4</td>
<td>32G ~ (mSATA)</td>
<td>x16 gen3 * 1</td>
<td>x16 gen2 * 1</td>
<td>3</td>
<td>1</td>
<td>4 (both)</td>
<td>2</td>
<td>2</td>
<td>12 or 5 Volt</td>
<td></td>
</tr>
<tr>
<td>$289</td>
<td>Intel</td>
<td>4-32G DDR4</td>
<td>32G ~ (mSATA)</td>
<td>x16 gen3 * 1</td>
<td>x16 gen2 * 1</td>
<td>3</td>
<td>1</td>
<td>4 (both)</td>
<td>2</td>
<td>2</td>
<td>12 or 5 Volt</td>
<td></td>
</tr>
<tr>
<td>$199</td>
<td></td>
<td>4-32G DDR4</td>
<td>32G ~ (mSATA)</td>
<td>x16 gen3 * 1</td>
<td>x16 gen2 * 1</td>
<td>3</td>
<td>1</td>
<td>4 (both)</td>
<td>2</td>
<td>2</td>
<td>12 or 5 Volt</td>
<td></td>
</tr>
<tr>
<td>$59</td>
<td></td>
<td>4-32G DDR4</td>
<td>32G ~ (mSATA)</td>
<td>x16 gen3 * 1</td>
<td>x16 gen2 * 1</td>
<td>3</td>
<td>1</td>
<td>4 (both)</td>
<td>2</td>
<td>2</td>
<td>12 or 5 Volt</td>
<td></td>
</tr>
<tr>
<td>$35</td>
<td></td>
<td>4-32G DDR4</td>
<td>32G ~ (mSATA)</td>
<td>x16 gen3 * 1</td>
<td>x16 gen2 * 1</td>
<td>3</td>
<td>1</td>
<td>4 (both)</td>
<td>2</td>
<td>2</td>
<td>12 or 5 Volt</td>
<td></td>
</tr>
</tbody>
</table>

**CPU:** i7/5/3, Celeron
**RAM:** 4-32G (DDR4)
**SSD:** 32G ~ (mSATA)
**PCle x16 gen3:** 1
**PCle x1 gen2:** 1

- **RS232:** 3, RS485 1
- **GPIO:** 10
- **USB 3/2:** 4 (both)
- **GbE port:** 2
- **miniPCIe:** 2
- **Input:** 12 or 5 Volt

- **OpenSplice DDS fine tuning** (*shared memory*)
- **Real-time kernel** (Xenomai)
- **ROS supported sensors integration/testing**
- **ROS 1(Kinetic) & ROS 2** (GPIO control node)
ADLINK Neuron

An industrial oriented ROS2-based platform

Hardware
- Replaceable CPU & Extensible RAM
- RS-232 x4 & RS-485 x2
- PCIe x16 Gen3.0 (Nvidia GPU)
- Two standalone USB 3.0 ports
- GPIO 10 pins & I2C, SPI

Kernel & Middleware
- Realtime OS (Xenomai)
- Linux drivers maintenance (Nvidia GPU)
- GPIO integration/testing (API for users)
- PrismTech DDS fine tuning (shared memory)
- ROS supported sensors integration/testing

Software
- Pre-configured OS image (Ubuntu)
- ROS 1(Kinetic) & ROS 2 (released)
- ROS 2 nodes for I/O control
- ROS demo scripts (VSLAM, Navigation...)

ROS 2
- ROS 2 Environment (Nodes, packages)
- ROS 2 GPIO Node
- ROS 1 & 2 Bridge

ROS 1 (Kinetic)
- ROS 1 Environment (Nodes, packages)

API
- (C/C++/python)
- Linux O.S. (Ubuntu)

Linux driver
- Realtime kernel Patch (Xenomai)

Hardware
- GPIO, RS-232/RS-485
- NVidia GPU (PCIe)

Nvidia

Intel

Movidius
ADLINK Neuron
An industrial oriented ROS2-based platform

**Applications**
- AI, Vision (Object Classification)
- Autonomous Navigation
- Distributed Swarm

**ROS 2.0 (Ardent)**
- OpenSplice DDS (shared memory)

**OS (RTOS)**
- Hardware
  - GPU
  - x86 CPU
  - Nvidia
  - Movidius

- Sensors
  - Lidars/RGBD
  - RS-232/485

**ADLINK Neuron**
Cases & Demo: DDSBot
ADLINK Neuron Use Cases

Real Implementation/Cases

- **Fog/Edge Computing Test-bed**
  (ROS2/DDS for cooperative SLAM)

- **AMR/AGV onboard computer**
  (ROS2/DDS for multi robots collaboration)
  (Realtime implementation & robotic arm manipulator)

- **Smart Grid**
  (DDS node for each Electric Tower)

- **Agriculture Factory**
  (ROS2/DDS node for each industrial machine)
ADLINK NeuronBot

ROS 1.0/2.0 based swarm robots architecture

- **Architecture Overview**

  - Intel Object Analytics
  - OpenCV
  - RealSense Technology
  - ADLINK NeuronBot
  - Lenovo Yoga Book
  - Lenovo Yoga Book
  - NVIDIA GPU
  - INTEL Movidius
  - Neuron Board
  - Movidius
  - SPENCER Framework
  - Lidar sensor
  - RGB-D Camera (Depth Sensor)
  - VORTEX 2 DDS
  - People Tracking Mobile Robot
  - Swarm poses sharing through ROS2/DDS
  - DDS Global Data Space
ADLINK NeuronBot

ROS 1.0/2.0 based swarm robots architecture

- Software Architecture (Swarm)
ADLINK NeuronBot

Demo Video in Embedded World Conference 2018
Summary

• The source codes of Vortex OpenSplice will be fully opened by March!
• Vortex OpenSplice has been successfully tested with ROS2 (shared mem)
• ADLINK Neuron will be officially released by Q2 2018
  • Offer reliable/robust ADLINK ROS2/DDS Industrial Developer Kit
  • Easy, abstract, reliable, real-time ROS platform (DDS-based)
  • Speed up developing cycle
  • Enable ROS2 ecosystem in Asia
  • Increase ROS2 adoption for AMR/Arm/Smart factory