ROBIN FTP
The ROS-CODESYS Bridge

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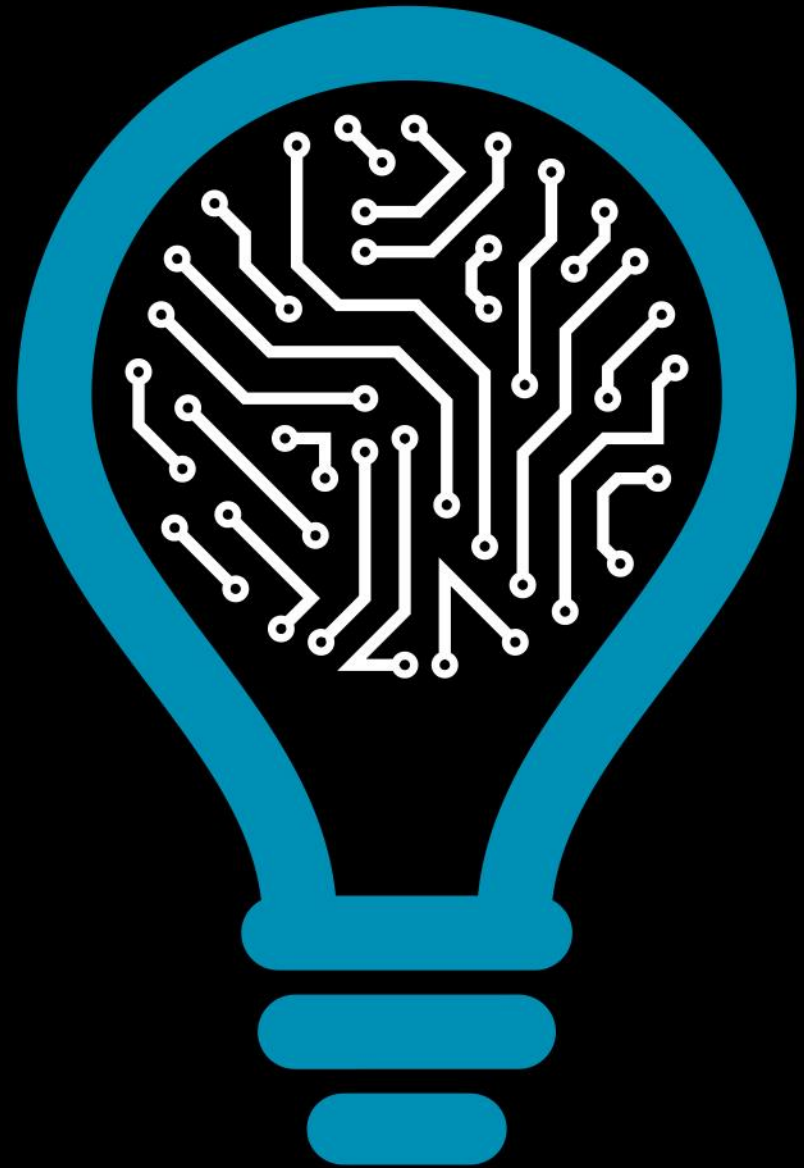rafael.l.arrais@inesctec.pt
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INESCTEC

INSTITUTE FOR SYSTEMS
AND COMPUTER ENGINEERING,
TECHNOLOGY AND SCIENCE

Bringing academia, companies, public administration and society closer together

Mission

Research of excellence
International recognition
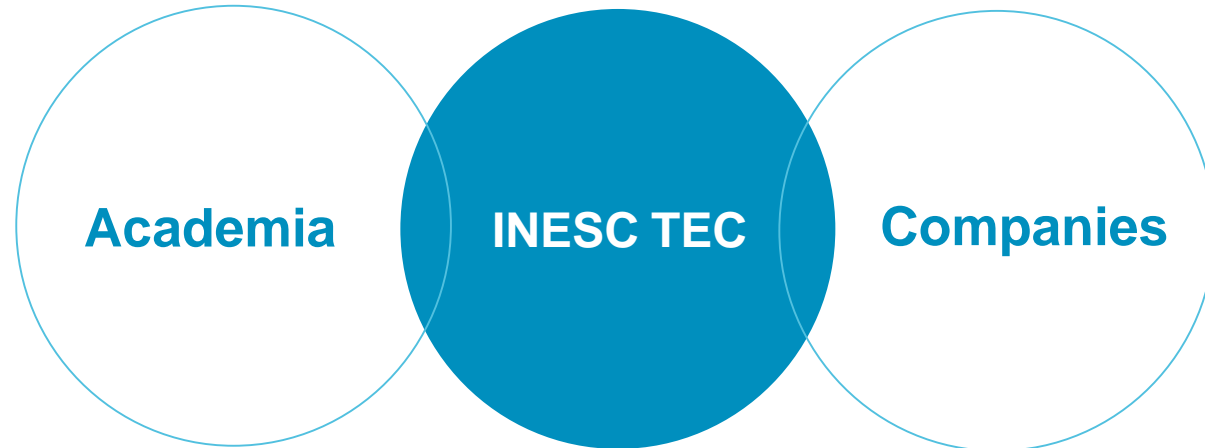Social relevance

Economic and social fabric development
Contribute to the performance,
competitiveness and internationalisation
of Portuguese companies and institutions

Vision

**To be an international player in the
science and technology arena**
To be perceived as an important world
player, in the domains of Computer Science,
Industry and Innovation, Networked
Intelligent Systems, and Power and Energy

Academia   INESC TEC   Companies

728 researchers (345 PhDs) dedicated to R&D and advanced consulting

289	**Senior Researchers**	121	Hired staff (of which 66 have PhDs)
		168	Professors (medium time allocation: 50%)
86	**Support Services**	29	Organisation & Management
		9	Business
		48	Technical-Administrative
350	**Researchers**	40	Postdoctoral researchers
		153	Research assistants
		157	PhD students
73	**Affiliated Researchers**		(medium time allocation: 10%)
369	**Other Collaborators**	199	External researchers
		156	Research trainees
		14	Special projects
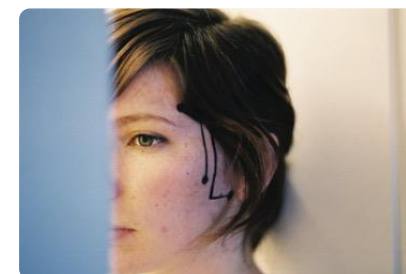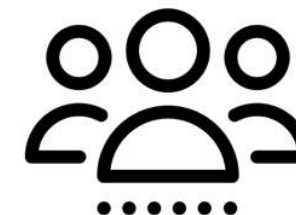
October 2019
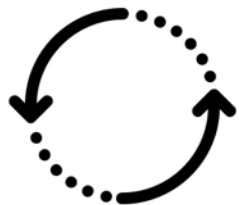
Plataforms for developing global solutions with partners

Strong presence in regional/national Poles and Clusters

Cross-fertilisation

TEC4 **INDUSTRY**

TEC4 **SEA**

TEC4 **ENERGY**

TEC4 **MEDIA**

TEC4 **HEALTH**

TEC4 **AGRO-FOOD**

Supply chain 4.0

Intelligent power networks and mobility

Services/production, diagnosis

Digital Ports, underwater robotics

Contents, creative industries

Precision agriculture, integrated distribution chain

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TEC4INDUSTRY: Some of our Projects

Arrais, R., Ribeiro, P., Domingos, H., and Veiga, G. ROBIN: An Open Source Middleware for Plug'n'Produce of Cyber-Physical Systems. In *International Journal of Advanced Robotic Systems* (in Press)
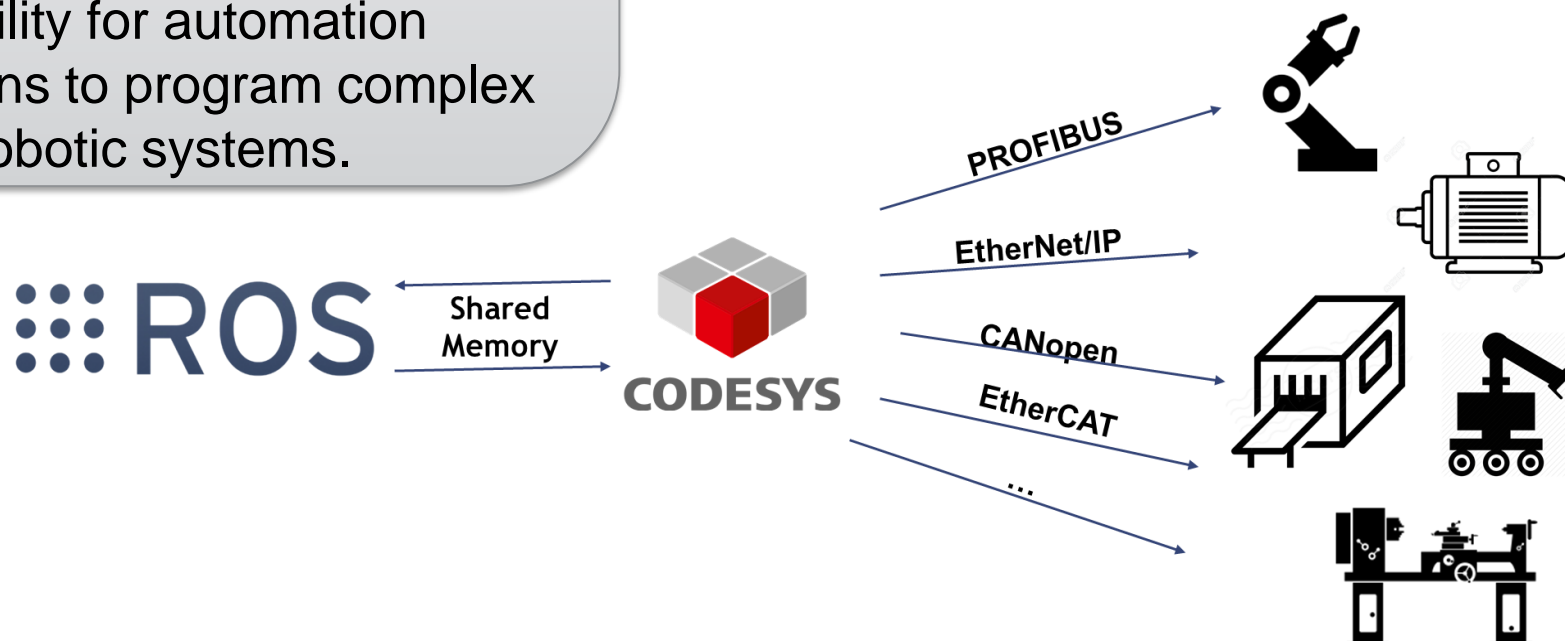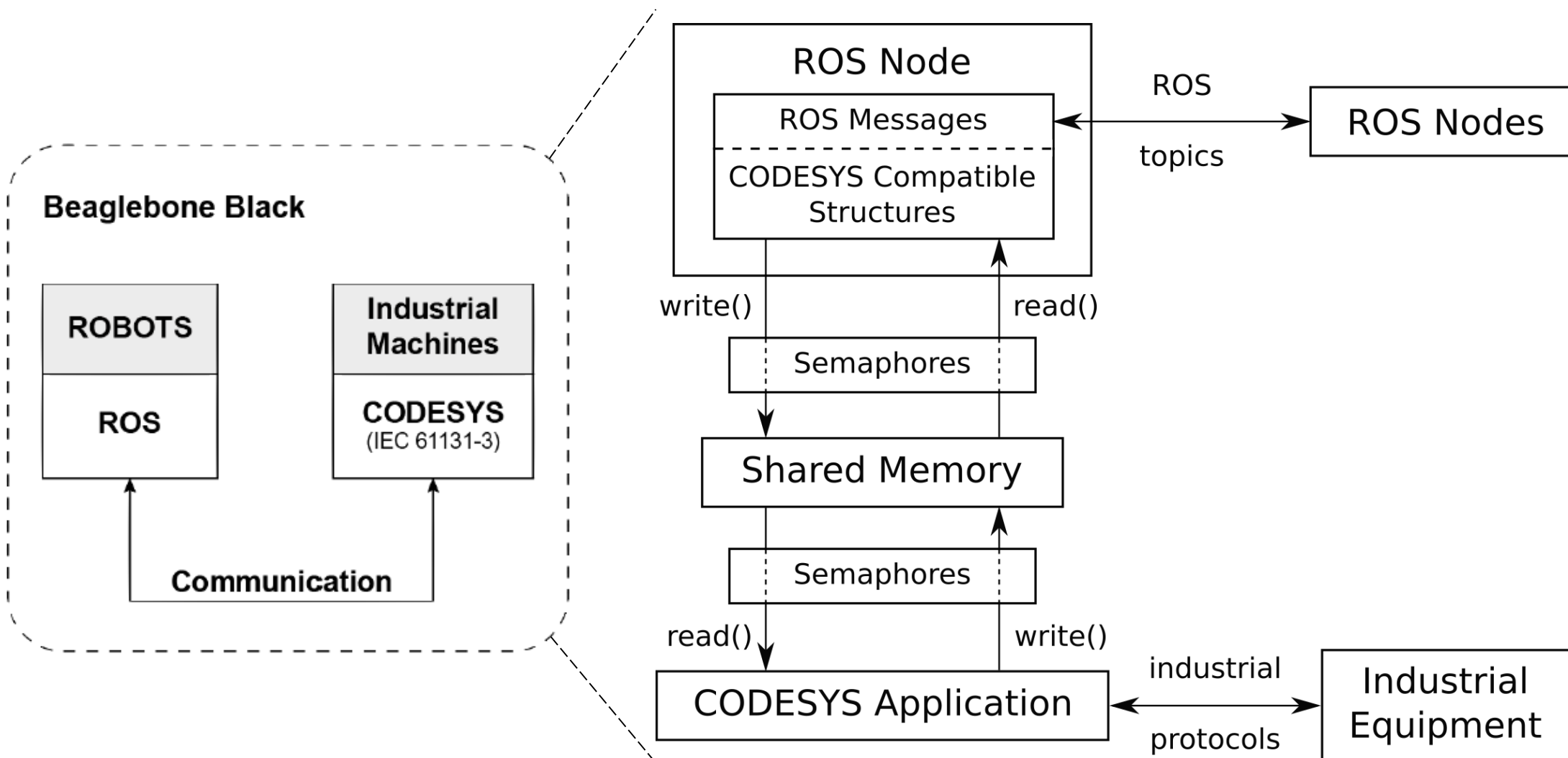
ROBIN FTP: Messages Conversion

Description	ROS Messages Primitive Type	C++	IEC 61131-3
Unsigned 8-bit Integer	bool	uint8_t	USINT
Signed 8-bit Integer	int8	int8_t	SINT
Unsigned 8-bit Integer	uint8	uint8_t	USINT
Signed 16-bit Integer	int16	int16_t	INT
Unsigned 16-bit Integer	uint16	uint16_t	UDINT
Signed 32-bit Integer	int32	int32_t	DINT
Unsigned 32-bit Integer	uint32	uint32_t	UDINT
Signed 64-bit Integer	int64	int64_t	LINT
Unsigned 64-bit Integer	uint64	uint64_t	ULINT
32-bit IEEE Float	float32	float	REAL
64-bit IEEE Float	float64	double	LREAL
ASCII String	string	std::string	STRING
Time (secs/nsecs)	time	ros::Time	TIME
Time (secs/nsecs)	duration	ros::Duration	TIME

Converted to Bool on CODESYS

Fully Supported by Current Implementation

WIP Partial Support by Current Implementation

Converted to a fixed length array of char on ROS implementation

Pinto T, Arrais R and Veiga G. Bridging Automation and Robotics: an Interprocess Communication between IEC 61131– 3 and ROS. In *2018 IEEE 16th International Conference on Industrial Informatics (INDIN)*. IEEE, pp. 1085–1091.

ROBIN FTP: ROS Implementation

- Topic-based implementation;

- Shared memory written automatically on subscriber callback;

- Shared memory read periodically and published to topic.

Executed internally ➡

Executed externally ➡

```cpp
1  class Robin
2  {
3    std::string name_;
4    Semaphore semaphore_;
5    SharedMemory shared_memory_;
6    ros::NodeHandle nh_;
7    ros::Publisher pub_;
8    ros::Subscriber sub_;
9    std_msgs::Bool msg_;
10   const uint32_t queue_size_ = 100;
11   const bool latch_ = true;
12   void write(const std_msgs::Bool::ConstPtr& msg);
13 public:
14   Robin(std::string name, bool mode=READ, bool open=true);
15   bool isOpen();
16   bool isClosed();
17   void read();
18   void open(bool mode=READ);
19   void close();
20   ~Robin();
21 };
```

Public interface

# ROBIN FTP: ROS Implementation

```cpp
1  #include "robin/robin.h"
2  #include <ros/ros.h>
3  int main(int argc, char **argv)
4  {
5    ros::init(argc, argv, "robin");
6    Robin move_conveyor("move_conveyor", WRITE);
7    Robin wait_conveyor("conveyor_finished", READ);
8    ros::Rate read_rate(10);
9    while (ros::ok())
10   {
11     wait_conveyor.read();
12     ros::spinOnce();
13     read_rate.sleep();
14   }
15   return 0;
16 }
```

Object creation

Periodic shared memory reading

Must be executed manually when reading

ROBIN FTP: CODESYS Implementation

Project structure

Mapping task
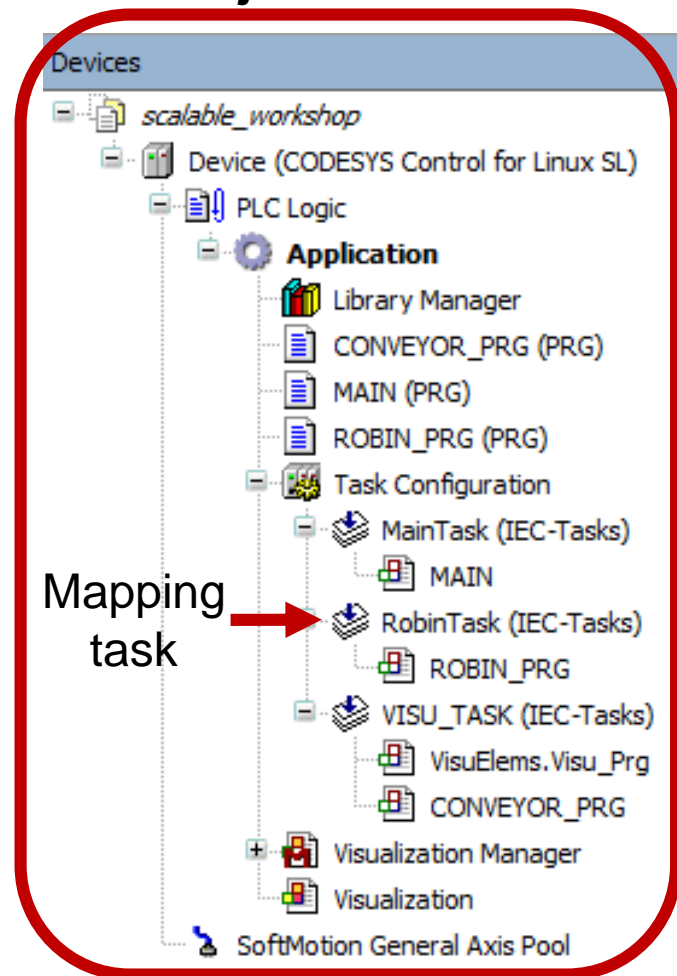
Main program

```
MAIN ×
1    PROGRAM MAIN
2    VAR_INPUT
3        msgFromRos  : BOOL;
4    END_VAR
5    VAR_OUTPUT
6        msgToRos    : BOOL;
7    END_VAR

1    CONVEYOR_PRG.on := msgFromRos;
2    msgToRos := CONVEYOR_PRG.finished;
3
```
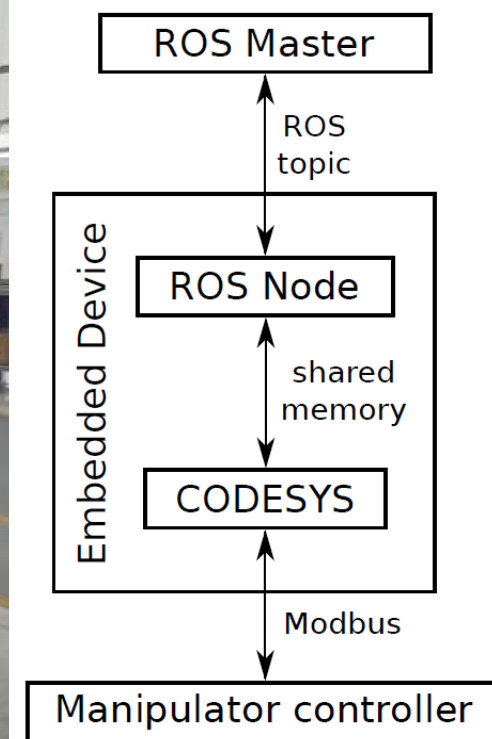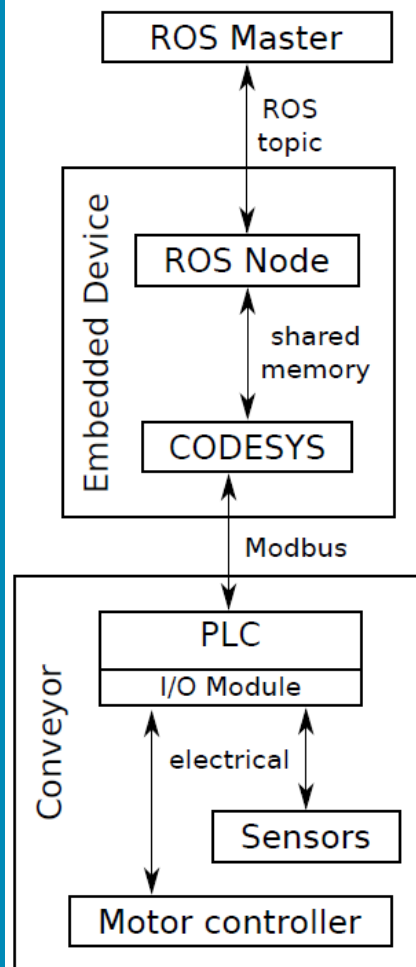
Variable mapping program

```
ROBIN_PRG ×
1    PROGRAM ROBIN_PRG
2    VAR
3        msgFromRos  : Robin('move_conveyor', RobinConstants.READ);
4        msgToRos    : Robin('conveyor_finished', RobinConstants.WRITE);
5    END_VAR

1    // read
2    MAIN.msgFromRos := msgFromRos.read();
3    // write
4    msgToRos.write(MAIN.msgToRos);
5
```

- **Ongoing:**

  - Support for more data types and custom data structures;

  - Development of Automation Methodologies to Expedite Integration;

  - **Milestone 1:** Public Release in the scope of the ROSIN Project.

    Github.com/ScalABLE4.0/ROBIN

- **Future:**

  - Standard interfaces for commonly used components;

  - Easier reconfiguration of mapped variables;

  - Support for ROS services and actions.

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