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Enabling Ultra-low Latency Communication and Better Operational Safety with Swarm Awareness

FARobot

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3 Main Challenges When Deploying AMRs

Autonomous mobile robots (AMRs) can carry out their jobs with minimal oversight from human operators. Facilities such as factories and warehouses can use AMRs to improve operational efficiency and quality of production. However, system integrators of mobile robots experience difficulties when deploying AMRs. Here are the 3 main challenges:

1

Traffic Complexity

Robot deadlock and congestion is a common issue, especially in dynamic environments with humans, AGVs, and AMRs moving in the same space. This is a primary source of dissatisfaction for end-users.

2

Single Point of Failure

Traditional system architectures use a server as the central coordinator. This creates risk of software or hardware failure which may disable the entire fleet operations for hours and lead to safety risks or even collisions.

3

Fleet Inefficiency

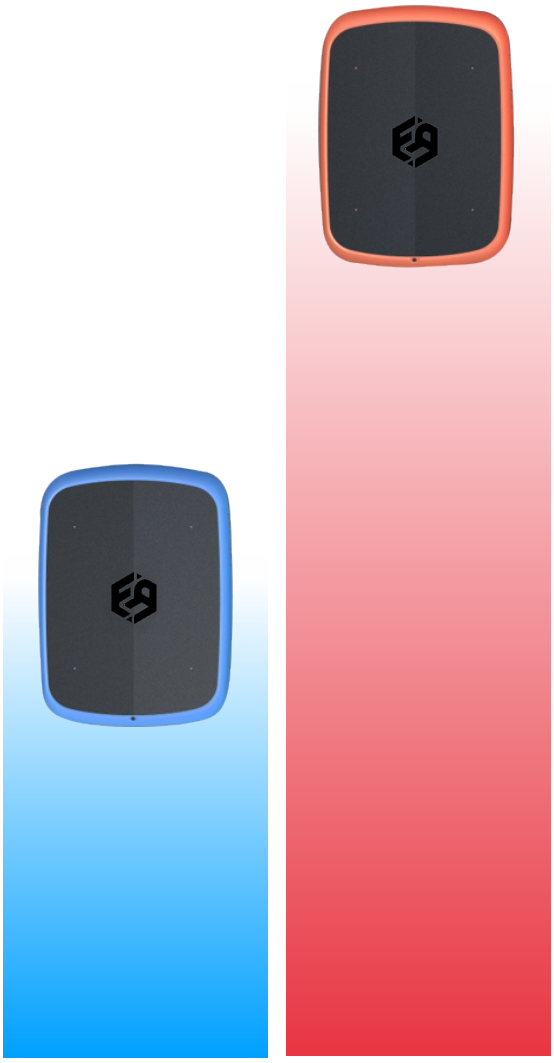
Latency-constrain motion and decision making is another challenge when deploying AMRs. Most robot makers limit the speed of their robots due to the risk of traffic caused by system latency. In addition, because centralized decision making is traditionally slow, the robots may be slowed down even further, decreasing the overall performance of the fleet.

Overcoming the Challenges with Intelligent Traffic Control

When it comes to resolve the problems of traffic complexity, fleet inefficiency and single point of failure, road traffic control and air traffic control (ATC) systems are designed to supervise the movement of people, goods, or vehicles to ensure efficiency and safety. This is also true with **an intelligent traffic control system for AMRs that moves tools, materials, work-in-process, and finish goods around in a factory or warehouse. In these systems, predictability, safety design, and ROI are imperative to overcome the aforementioned challenges. Here is why:**

Safety

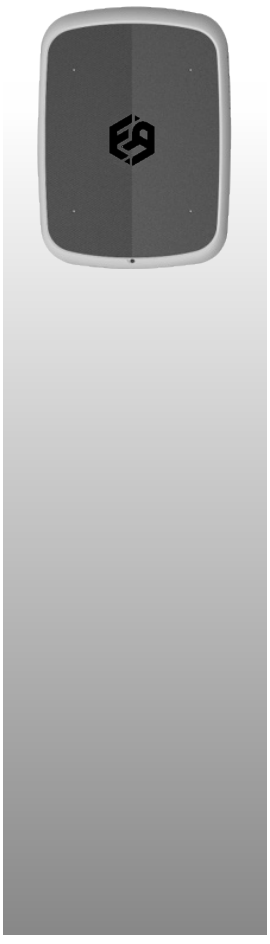
is also key when it comes to better traffic control. In many factory settings, humans coexist with robots. Any accidents that occur can lead to a halt in operations or worse.



Predictability

Factories using humans or moving robots for WIP (work-in-progress) or the transportation of finished goods will have one thing in common. Each of them will have a well-defined process with clear travel time expectations.
This requirement for operational predictability cannot be met without strict and predictable traffic control. Low latency communication then becomes strategic. For example, re-routing may sometimes create time loss, especially in the case of low latency systems. This includes low latency at the robot action level, for example, robotic arms.

> In a very latency-prone network environment, the actual re-routing may take longer than waiting for the obstacle to move



Integrity

Cargo integrity also benefits from better traffic control. Pallets or fragile components may not support shaking from sudden movements such as harsh braking. The role of the traffic control will be to guarantee the room for smooth local navigation.

ROI

Every end-user wishes to increase their robot’ s longevity and reduce maintenance costs. This can be achieved using better traffic control by reducing over-speeding, harsh braking, idle time, and more.

Choosing a Future-proof Traffic Control

As a system integrator or end-user, how can you recognize good traffic control?
Technology evolves fast but the industry is still filled with legacy technologies. There are three main visible components to identify a future-proof, flexible, and state-of-the-art traffic control for your AMH systems:

1

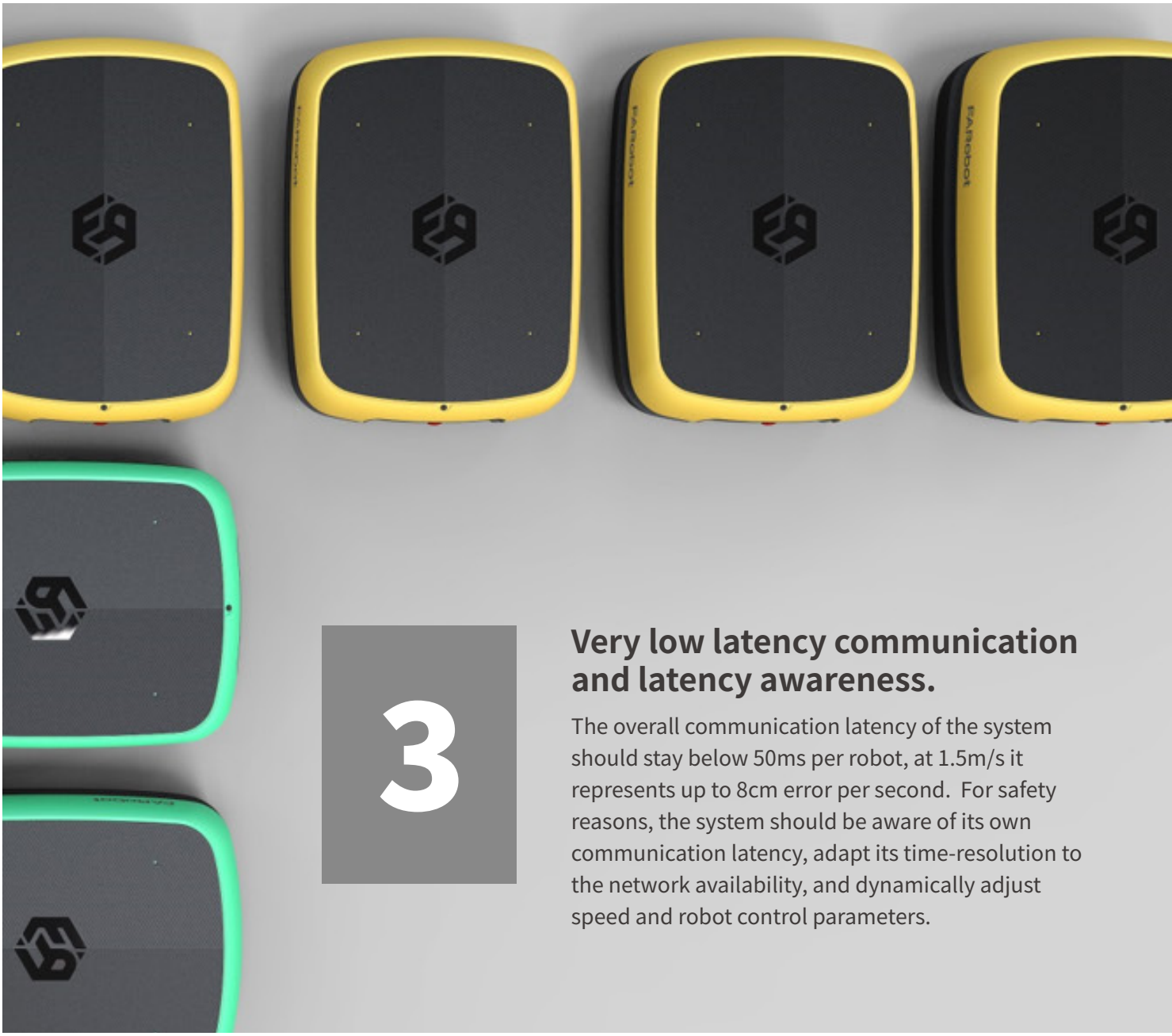
No hard coded traffic rules

Although more system configurations may look attractive on paper, it can create unnecessary complexity and risk for operations. An automated traffic control with minimal manual set-up will be much easier to learn and deploy.

2

Infrastructure-independent

No infrastructure should be needed to add precision and safety to the traffic control. In the event that an infrastructure is required, the startup and maintenance costs may not deliver their expected value.



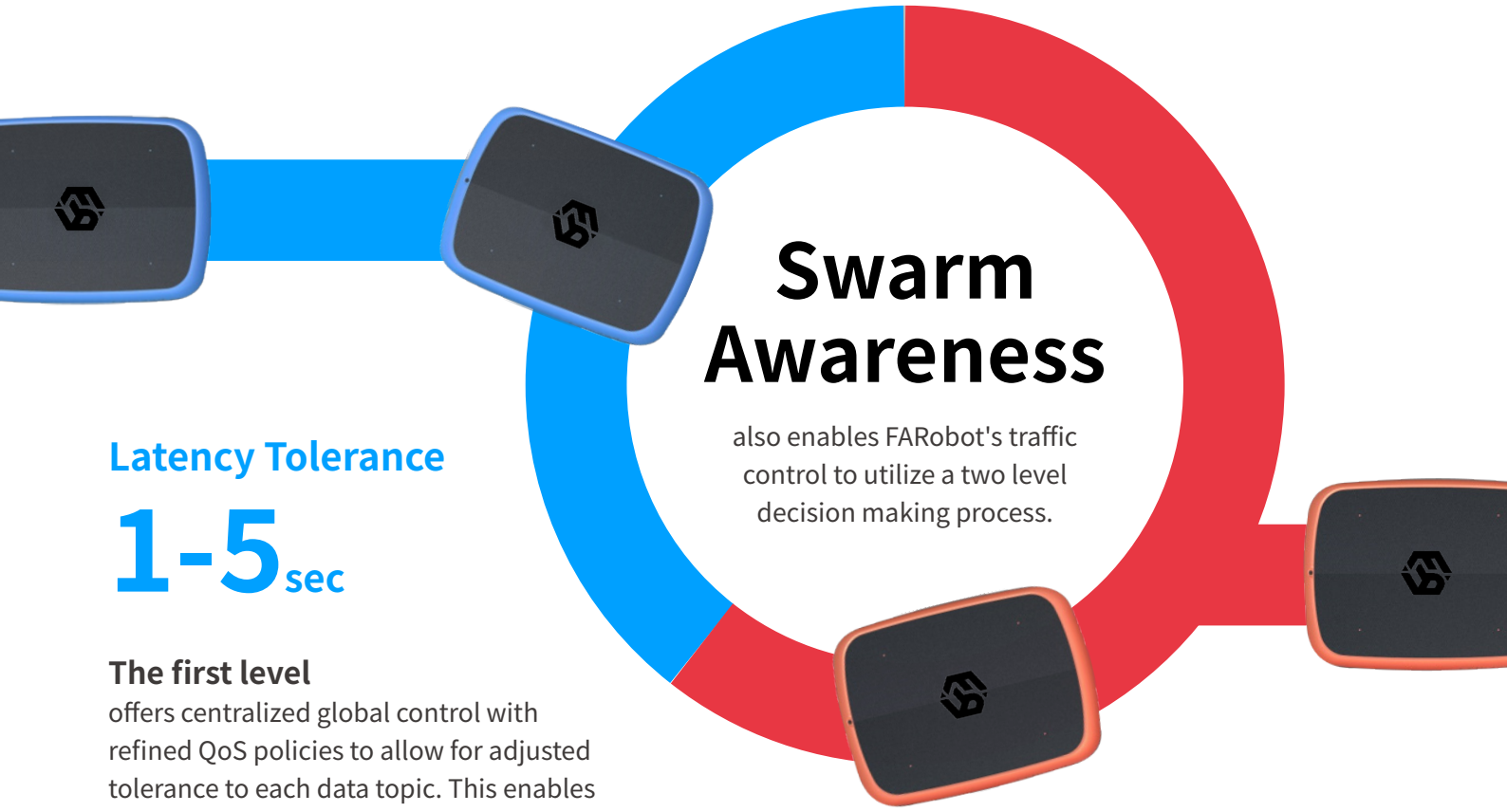
3

Very low latency communication and latency awareness.

The overall communication latency of the system should stay below 50ms per robot, at 1.5m/s it represents up to 8cm error per second. For safety reasons, the system should be aware of its own communication latency, adapt its time-resolution to the network availability, and dynamically adjust speed and robot control parameters.

An Intelligent Traffic Control System with Dual Level Decision Making

FARobot's Swarm Awareness is designed to improve traffic control.. Adopting Cyclone DDS, a decentralized communication key technology distributed by ADLink, Swarm Awareness introduces the world' s first DDS-based peer-to-peer route negotiation feature for robot fleets with the right mix for simplicity, low latency communication, and low failure-risk.



Latency Tolerance

1-5 sec

The first level

offers centralized global control with refined QoS policies to allow for adjusted tolerance to each data topic. This enables much better operation and navigation prediction features and enables dynamic rescheduling of up to 500 robots.

> If the obstacle is an actual robot, the DDS-based approach can save between 2 and 10 secs and sometimes avoid both robots to get locked for hours.

The second level
resides at the edge within the robots. It happens directly using Robot-to-robot and Robot-to-infrastructure communication. The traffic control consists of local negotiation with communication within 50 ms.
The speed at which the robots communicate allow them to keep a constant pace while avoiding collision.

Latency Tolerance

50ms

With this dual-level traffic control, FARobot Swarm Awareness delivers clear benefits for our customers.

- Simplicity: Customers will not have to manually program their traffic rules down to the minute details
- Performance: Allocates appropriate latency to each function depending on the level of priority.
- Reliability: A stable system that is shielded from server crashes with defined hand-off strategies and local traffic control that isn't dependent on servers.

FARobot Swarm Awareness will enhance traffic control capability of robot control systems tending toward Ultra Low Latency Communication (ULL) and better QoS assurance over complex projects.