iMinds

AN iMINDS ICON RESEARCH PROJECT | PROJECT RESULTS

MANUFACTURING

FORWARD

Creating robust and reliable wireless networks for harsh industrial environments

The roll-out of robust and reliable wireless networks in harsh industrial environments (such as factories and large warehouses) is utterly complex: machines constantly interfere with the network, and its signals may get blocked by moving piles of stock and materials – resulting in loss of connectivity. This often negatively impacts productivity and business operations.

The FORWARD project investigated how white spots (i.e. areas that lack wireless coverage) and sources of network interference in industrial settings can be predicted more quickly – using that knowledge to automatically initiate on-the-fly network (re)configurations. Objective: to provide optimal network coverage and support a quick hand-over of traffic between (Wi-Fi) access points at all times – in any warehouse or production facility.

FORWARD resulted from a very concrete and pressing need, down at the production floors and warehouses of industrial partners ArcelorMittal, Volvo and Egemin. While their range of activities is very different – going from steel and car/truck manufacturing up to the delivery of automated material handling solutions for warehouses and production/distribution centers, each of them was suffering from unstable indoor wireless coverage, massive interference and hand-over issues between the Wi-Fi access points at their industrial facilities.

The Volvo plant in Ghent, for instance, has to rebuild its assembly lines to support the production of new truck models. However, the Wi-Fi network (which is used for material scanning) cannot rapidly adapt to those infrastructural changes – leading to coverage and interference issues.

Moreover, the presence of loads of Bluetooth devices negatively affects Wi-Fi network performance.

At ArcelorMittal, steel coils prove to be a major source of wireless network interference. This interference leads to disruptions in the hand-over of the wireless signals that are used to communicate with ArcelorMittal's moving cranes, and result in those cranes performing emergency stops.

Last but not least, Egemin wanted to investigate how a Wi-Fi network that is used to communicate with its automated guided vehicles (AGV's) can automatically reconfigure itself based on the sudden appearance of big obstacles – so that optimal network coverage (and smooth communication with the AGV's) can be provided at all times.

THE OUTCOMES

1. A software tool that accurately predicts Wi-Fi coverage, and sources of interference, in industrial settings 10x faster than current approaches

Sudden infrastructural changes in industrial plants and warehouses can lead to the creation of white spots (i.e. areas that lack wireless coverage). Today, white spots are calculated through individual access point measurements – a process that takes a lot of time and does not allow for quick network reconfigurations.

In the framework of FORWARD, researchers from iMinds - Ghent University developed and finetuned WHIPP, a user-friendly software tool that accurately predicts wireless

coverage in homes or industrial settings for a given set of access points – based on a simple floor map. Together with Excentis, radio channel models and a channel emulator that form the basis of the WHIPP engine were developed.

During FORWARD, the WHIPP tool has proven to reduce the time that is needed to generate an accurate wireless coverage map by a factor of 10; an exercise that used to take three weeks with a site survey (15 working days) can now be conducted in just one day and a half.

2. Tools that lay the foundation for the intelligent reconfiguration of Wi-Fi networks

In order to continuously assess network performance from the viewpoint of the connected devices on the factory floor, an advanced monitoring system has been designed that makes use of mobile robots. Monitoring data is collected and processed centrally in order to create various heat maps that reflect the quality of the network.

Secondly, researchers from iMinds - Ghent University developed a new Bluetooth emulator that realistically mimics interference. This way, the potential impact of using Bluetooth technology in a certain environment can be assessed quickly and cost-efficiently prior to deployment.

Both tools have been used to identify the root cause of hand-over performance problems, and to evaluate state-of-the-art industrial Wi-Fi hardware from Siemens that allows for intelligent network (re)configurations.

3. Algorithms that automatically (re)configure Wi-Fi networks on-the-fly, switching access points on/off (and adapting their energy levels) as is needed

A unique software platform was built to intelligently and automatically (re)configure Wi-Fi networks on-the-fly, to provide optimal network coverage at all times. Depending on the network conditions, and sources of interference, access points are switched on/off to compensate for sudden lay-out changes in factories and warehouses. Moreover, the algorithms are capable of automatically steering Wi-Fi nodes' signal strength, to achieve the optimal balance between coverage, interference and energy consumption.

NEXT STEPS

Looking into the potential of their WHIPP tool, researchers from iMinds - WiCa - Ghent University are currently investigating whether this technology – which is ten times faster than current commercial solutions – can be subject to any spin-off or commercialization activities.

From a research perspective, follow-up projects (on wireless localization, for instance, or building devices into AGV's for data capturing) are being studied.

FACTS

NAME	**FORWARD**
OBJECTIVE	Creating robust and reliable wireless networks for harsh industrial environments
TECHNOLOGIES USED	WiFi 802.11n, Bluetooth
TYPE	ICON project
DURATION	01/01/2014 – 31/12/2015
PROJECT LEAD	Wim Van Betsbrugge, Egemin
RESEARCH LEAD	Wout Joseph, iMinds - WiCa - UGent
BUDGET	1,409,300 euro
PROJECT PARTNERS	ArcelorMittal Ghent, Egemin, Excentis, Siemens, Volvo Group Belgium
IMINDS RESEARCH GROUPS	Technical Testing Lab (iLab.t) IBCN - UGent WiCa - UGent

WHAT IS AN
ICON PROJECT?

iMinds is the digital research center and business incubator for Flanders, Belgium. Its ICON research projects are agile and demand-driven, combining academia and industry partners. ICON projects typically have a duration of two years, yet quickly adapt to the rapidly-evolving digital landscape. ICON partners intend to use the project results in their products or services.

FORWARD project partners:

The FORWARD project was co-funded by iMinds, with project support from IWT.