European scientific project investigates how to transform factories of the future using 6G

PRESS RELEASE

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The PRIME-6G project, coordinated by Universidad Carlos III de Madrid (UC3M), aims to make industrial plants more flexible by enhancing their communication capabilities through 6G technologies, delivering wired-level reliability wirelessly. To achieve this, the consortium will develop an intelligent communications architecture—first validated in laboratories in Leganés (Madrid) and subsequently tested in a real-world industrial setting in Germany—enabling robots and autonomous vehicles to work in coordination and instantly adapt production lines to manufacture customized products.

Currently, most industrial robots rely on heavy cables to receive commands accurately, making factory reconfiguration slow and costly. Existing wireless networks are also unsuitable for these mission-critical tasks, as they cannot guarantee that every message arrives at the exact moment required. To overcome this, the PRIME-6G project will develop a network powered by 6G and artificial intelligence (AI) capable of operating with clockwork precision. The goal is to make "batch-size-one" manufacturing a reality: plants capable of producing fully customized items, one by one, without having to halt or reconfigure all machinery for each new order.

Self-coordinating robots and waves that "see" beyond human sight

The consortium will put this technology to the test in two practical scenarios. In the first, named AURORA and led by Siemens AG, autonomous vehicles and collaborative robots will negotiate tasks among themselves on the fly, without relying on a central computer to direct them. Through direct machine-to-machine communication and control systems hosted within the network itself, two vehicles will be able to self-coordinate to transport a heavy load with a communication latency of under 15 milliseconds.

"Current wireless networks cannot guarantee that a control command will always arrive within the exact timeframe a robot needs to operate safely," explains project coordinator Carlos Bernardos, Professor in the Department of Telematics Engineering at UC3M. "With PRIME-6G, we are creating an intelligent, time-precise network that allows us to take flexible automation out of the laboratory and into real-world factories," he adds.

The second use case, called SENTINEL and led by IMDEA Networks, will turn the communications signal itself into a kind of invisible radar. By analyzing how radio waves bounce off the surrounding environment, the network will detect where people, robots, and obstacles are located—even in blind spots or under dusty, low-light conditions where cameras and lasers lose reliability. This data is combined with input from existing plant sensors, reducing the need for equipment dedicated exclusively to environmental sensing. Together, this information builds a three-dimensional virtual replica of the facility (a digital twin) that pinpoints stationary objects within a margin of about 20 cm and moving ones within about 30 cm, helping to prevent collisions and guide vehicles safely.

"In a factory, there is a great deal of dynamism—many things happening at once—and we have to be able to adapt to the environment. Traditionally, this has been done with cameras,

but we want to enhance that capability with wireless technology so that the communications network itself can sense the environment," explains Carlos Bernardos. Furthermore, by detecting the presence of people in the workspace without needing to identify them or record their image, the system reduces reliance on video surveillance and enables solutions that better protect workforce privacy.

From a laboratory in Leganés to a research factory in Germany

The UC3M team is leading the fine-tuning of this "6G radar" at NEXTONIC, an open research laboratory located in Leganés (Madrid) and jointly managed with IMDEA Networks and Telefónica. University researchers will also provide AI tools enabling the network to self-organize and self-optimize automatically. Once initial trials in Leganés and at Siemens' facilities in Garching (Munich) are completed, all the technology will be transferred to Stuttgart, Germany. There, it will be integrated into a single joint pilot within ARENA2036, a mobility and production research campus that operates as a real, research-scale factory. "This journey from our laboratory in Leganés to a real production environment in Germany proves that we are not talking about a simulation, but about technologies ready to transform European industry," concludes Carlos Bernardos.

To carry PRIME-6G's results beyond the consortium, the project will launch an Innovation Challenge coordinated by ARENA2036. It invites companies, start-ups and research institutions to bring in their own application scenarios, for example in robotics, autonomous mobile robots, drones or intralogistics, and to develop and test them with the technologies and pilot environment of the project. Organizations interested in taking part will be able to register via a short survey and contact form on the project website; details on the format and timeline will follow.

PRIME-6G (Pilot for Resilient Industrial Manufacturing Environments with 6G Technologies) receives funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme (GA 101272485). Spanning two and a half years (from June 2026 to November 2028) with an EU grant of nearly €6 million, the initiative aims to strengthen Europe's technological and industrial autonomy. Spain plays a prominent role in this international scientific project, coordinated by UC3M alongside partners including Telefónica Innovación Digital, the IMDEA Networks Institute, the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), and companies such as Fivecomm, Robotnik Automation, and The Laude Technology Company. The European alliance is completed by Siemens AG and ARENA2036 e.V. (Germany), Nokia Solutions and Networks (Hungary), Australo (Estonia), Incites Consulting (Luxembourg), and the Universiteit van Amsterdam (the Netherlands).

More information: https://prime-6g.eu/



Image caption: The PRIME-6G project will improve the communication capabilities of factories of the future through 6G technologies. Credit: PRIME-6G.