

## **The Extreme Measurement Communications Center: Supporting Wireless Communications for Harsh Environments**

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Wireless technology is fueling new paradigms in personal, commercial, and industrial communications systems throughout the marketplace. Many companies supplying sensors and instrumentation are coming to the realization that, without a wireless offering, their product line will be very short-lived with even the company's financial viability eventually being called into question. The wireless industrial automation marketplace is inspiring innovative and imaginative solutions to problems that ultimately reflect on the emissions, energy savings etc. Can these new technologies, innovative in their own right, benefit from the wireless revolution emerging around them? Can the companies developing these new products for sensing, measuring, analyzing, and reporting incorporate new wireless technologies without jeopardizing the security of the overall system? What technologies, just now emerging from the laboratories, are likely to show up in commercial, off-the-shelf components in the near future? Answers to these questions hinge on evaluating an extensive list of candidate technologies and approaches with clear, unbiased, standardized tests that can unequivocally report performance without being accused of coloring the outcomes with predetermined desires and/or financial interests.

The DOE Extreme Measurement Communications Center (EMC<sup>2</sup>) at Oak Ridge National Laboratory is chartered to facilitate the deployment of wireless technology in the harsh environments common to industrial applications. Similar questions to those posed above are being asked by potential wireless users and are being answered through systematic, detailed evaluations with one-of-a-kind equipment and expertise. This facility, jointly funded by DOE's Energy Efficiency/Renewable Energy Program (EERE) and the U. S. Nuclear Regulatory Commission (NRC), is being made openly available to other government agencies and any private-sector companies interested in pursuing wireless technologies for harsh environments like those encountered in industry.

This paper highlights the equipment and expertise available in the EMC<sup>2</sup> and how the Center can be used to facilitate development and deployment of measurement systems for wireless industrial automation. The four key factors in wireless network performance, **(1)** security, **(2)** reliability, **(3)** data throughput, and **(4)** latency, are critical to many applications and are studied extensively through modeling, simulations, and both lab and field measurements. Emerging technologies relevant to the four key performance aspects listed above will also be evaluated for potential applications in industrial automation. Additional capabilities at ORNL available to augment the system measurement facilities of the EMC<sup>2</sup> include the application of state-of-the art modulation techniques, new system architectures, adaptive “intelligent” receiver signal-processing algorithms, advanced data coding, and the detailed analysis of the often harsh RF propagation and coexistence environments in industrial settings. Finally, existing programs at ORNL in software-defined radio (SDR) systems are being applied to develop new paradigms of programmable and reconfigurable wireless systems to address the next-generation performance requirements of industrial users of both in-plant and remote wireless sensing and control devices and networks. In summary, the EMC<sup>2</sup> at ORNL offers a highly capable, independent, and unbiased means of wireless device and system assessment, coupled with the technical resources to resolve performance issues and optimize system designs, for both government agencies and industrial wireless vendors, users, and associations.