Can I get a WiTNESSS?

Defining a system architecture for wireless data collection in aerospace applications. By **Graham Pitcher**.

The aerospace industry, despite being at the leading edge in some instances, often takes a conservative view of technology. And with good reason; safety is a prime consideration and there is comfort in falling back on what you know.

But there is the need to embrace new technology in planes and systems of the future. One particular area where new technology is being considered is wireless data acquisition, applied not only on aircraft structures, but also in the development process.

Looking to address this area of technology, a consortium has been formed of leading companies in the UK aerospace sector. The 11 companies (see box) are developing wireless sensing, data gathering and transmission technology, backed by a £1.6million investment by the Technology Strategy Board.

Roger Hazelden of TRW Conekt (**www.conekt.net**) is technical lead for the project. He said the idea had developed as part of the National Aerospace Technology Strategy, led by the Aerospace and Defence Knowledge Transfer Network (A&DKTN). "It became clear," he noted, "that a lot of members of the A&DKTN's Health Management and Prognostics National Technical Committee were interested in wireless sensors and data management, so we set up a sub committee to decide what to do."

The project is called WiTNESSS – Wireless Technologies for Novel Enhancement of Systems and Structures Serviceability – and its work will be applicable to testing and health monitoring applications in aero engines, helicopters and fixed wing aircraft.

The project is driven by the fact that current aircraft instrumentation and test systems require complex wiring harnesses. Not only are these heavy and bulky, but they also limit the amount of data that can be collected. Using wireless systems should lead to faster product development and lighter, more efficient aircraft designs.

Hazelden said the project started with a blank sheet of paper. "We knew we needed to do something with wireless sensing, but it needed several meetings to decide what the scope was."

The project has two categories: instrumentation for testing systems and structures during development; and an opportunity to install instrumentation permanently in order to get such information as stress and vibration levels. "With the latter application," Hazelden noted, "maintenance can be scheduled for when it's needed, rather than after a given number of flying hours, reducing the cost of maintenance."

One of the attractions of wireless data gathering is that sensors can be placed where they couldn't previously. "In development, this will cut the time needed to install sensors," Hazelden observed. "Rolls-Royce, one of the partners, uses some 3000 thermocouple and vibration sensors when it tests a new engine. It's a huge job wiring all those up. Using wireless for some of the measurements speeds that process and brings faster time to market."

The project is centred around putting together a common system architecture. "We're looking to create a common way of designing things so that when we move forward to commercialising products, the certification process will be easier because of this common design framework."

Hazelden believes this approach is different

One of the WiTNESSS development platforms will address health moni

Hazelden: "By using functional blocks, which could be hardware or software, we're defining more efficient ways of addressing the problem."

to what has gone before. "There hasn't been a common architecture. While the hardware might not be the same between applications, the way in which the system has been designed will be common."

This process will be centred around modular 'building blocks'. "It means the appropriate blocks can be chosen for a given application," Hazelden continued.

The system architecture will enable work to be done on the development of three demonstration platforms, addressing test and health monitoring in helicopters, engines and composite materials. "A number of technical work packages are also being pursued, addressing, for example, electronic hardware and radio transmission protocols," he added.

monitoring in helicopters, such as this AgustaWestland NH90

The WiTNESSS Project is intended to be modular at all levels, but the partners are only part of the way through the process. However, the top two levels of the architecture have now been defined.

"At the top level, we haven't made any assumptions about whether tasks are handled by hardware or software. By using functional blocks, which could be hardware or software, we're defining more efficient ways of addressing the problem.

"Everything is driven by top level requirements capture and we've spent a lot of time defining at the top level what systems should do, what the design is trying to achieve and what is being done with the data collected."

Because of the different potential applications, different types of sensors and signal conditioning may be needed and data rates could be different. "Some applications may require data to be stored at a sensing module; others may need data to be streamed," Hazelden explained. "So we started by putting together a block diagram as a functional description of the architecture. From that point, we have been decomposing the diagram into a more detailed design."

It's taken longer than anticipated to capture the top level requirements and to get that information into details descriptions. "It was vital to get that right," Hazelden noted, "as, from that, we've produced a top level architecture that covers everything required for each application. You can take the architecture and work out what's needed and what isn't.

"It probably won't be as simple as that in practice," he admitted, "but having a top level architecture will enable us to deal with new applications."

The architecture is modular because different applications will require different blocks. "You might require an analogue sensor with data conversion for one design," Hazelden continued, "or a smart sensor with a digital output in another."

In effect, the modules are 'black boxes'. "Take an a/d converter as an example," he said. "You need to know what the inputs and outputs are, as well as the control signals. Once you have that defined, you can go to the next level and define what goes in the box; choosing a chip with the required performance, for example, and finding out what other components may be needed in the box. Some boxes will be easier to define than others."

WiTNESSS is a three year project and the first demonstration systems are planned to be unveiled

Wireless data capture could speed the development process at consortium partner Rolls-Royce

by the end of 2010. "The engine demonstrator will probably be the first," Hazelden thought, "as the technical requirements are simpler."

The demonstrators won't be the end product. "We're using the demonstrators as platforms to test and derisk the technology. The end point of the project will be derisked technology that can be taken on to exploitation. Our deliverable will be a design methodology; a way of doing things," Hazelden stated. "In the short term, it'll bring time savings in test installation and fewer mistakes

"We have brought together a strong consortium, all of whom want to exploit the rapidly growing field of wireless technology. This project will strengthen the UK's competitive position significantly and will lead to future export opportunities for the partners," he concluded. "WiTNESSS will be a fantastic opportunity to develop specific products and technologies to meet market demand."

Consortium partners

TRW Conekt (lead)
QinetiQ
QM Systems
Rolls-Royce
Airbus UK
BAE Systems
Institute for System Level Integration
GE Aviation
Bombardier Aerospace Belfast
Ultra Electronics BCF
AgustaWestland