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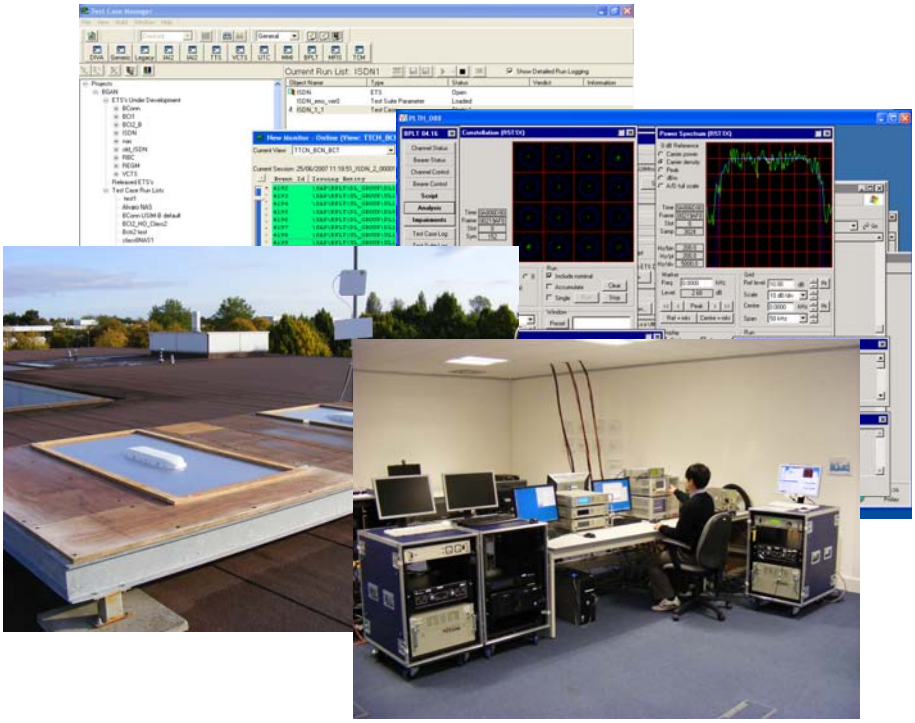
Smart solutions for satellite communications

Software Defined Radio
From Requirements to Interoperability



Requirements Definition

System Engineering

Architectural Design

Programme Management

Type Approval Testing

Interworking

Field Trials

The wireless communications industry has been migrating to Software Defined Radio (SDR) since the late 1980s. Implementation of functionality in the digital domain has numerous, well-documented advantages, including flexibility in design and repeatability in operation, and performing signal processing in software was a natural first step to take. As the speed of digital hardware has increased, the digitization of the signal has moved closer and closer to the antenna, to the point where dedicated, high bandwidth SDR platforms today digitise at a high intermediate frequency in the RF chain, and process the high rate samples in FPGAs and/or DSPs. Sophisticated, multi-layer protocol stacks have also evolved, taking full advantage of the high speed general-purpose processors now widely available.

e2E Satcom has accumulated significant experience of this technology transition through its staff and work for major User Terminal (UT) wireless and test equipment vendors in both the commercial and defence domains. This has given us a wide-ranging view of the different architectural and implementation approaches being employed, and a valuable understanding of common and unique issues arising across the different approaches. Our impartial position allows us to advise clients on the range of development solutions available, and deliver an unbiased and pragmatic assessment of the advantages and disadvantages of each. Our fully-equipped test laboratory also allows us to undertake UT integration as well as functional and performance testing, delivering a true end-to-end service.

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Software Defined Radio Challenges and the Way Ahead

A topical example where we are able to supply an impartial view concerns the advantages and disadvantages of the Software Communications Architecture (SCA). The US defence radio industry has taken the digitization process a step further with the definition of a complete internal architecture for how SDR platforms should be designed in their military radios. The goals of SCA are stated as facilitating interoperability, opening up competition and reducing life-cycle costs. The European defence procurement agencies are also now evaluating whether to follow this path or not for their own military radios.

A number of implementation hurdles have arisen with SCA over the years, and there has been no uptake in the commercial world. The terms SDR and SCA have also become inextricably linked in the defence community, with many decision-makers viewing the two as synonymous. Confusion has been exacerbated by the multitude of objectives brought to the table by each participant, and SCA has come to mean "all things to all people" in many debates. The level of confusion has resulted thus far in a relatively superficial analysis of the objective merits and best use of this particular architecture and approach to building radios.

Looking forward, we recognise a number of key issues to be resolved in SDR development. Every year many wireless product developments are started, and every one faces the same set of challenges, revolving around efficiently fitting one or more SDR interfaces onto typically bespoke hardware meeting specific combinations of size, weight, power, performance and cost. This is particularly true for mobile UTs, where the need for specific tailoring and optimisation are at their greatest. Once one generation of products is delivered, the cycle begins again as the hardware capabilities extend and the air interfaces evolve to exploit them.

Unfortunately, a significant percentage of effort in each project is solving the same set of real-time embedded development and test problems as peers and forerunners, leading to duplication between projects within each manufacturer, and across the industry as a whole. Tight bundling between the application software development environment and the target hardware further limits the potential for portability and reuse between contemporary products and subsequent generations. Combined with the low productivity associated with debugging the application software on target hardware, the overall effect is a significant reduction in development efficiency across the industry. In addition, unanticipated effort and surprises arising during integration and test late in the project are major causes of project schedule and cost over-runs.

e2E Satcom, with backing from the European Space Agency, UK Technology Strategy Board and key strategic partners, has therefore embarked on the creation of a fundamental and wide-ranging development environment and methodology to address these issues. By improving portability, reuse and development productivity, the ultimate benefits of the work will be to facilitate more rapid and cost-effective development of new wireless UTs in the future, and secure improved efficiency levels for the industry as a whole.

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