

## Collaborative Research Programme Project Definition (1 of 2)



<b>Project Number:</b>	004
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<b>Project Title:</b>	Modulation scheme development
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<b>Relation to WRC Research Areas:</b>
Applying Advanced Wireless

<b>Background of Project Provider:</b>
Tait Electronics are seen as the main beneficiary of this project, due to them proposing the project and providing the funding to support the project.

<b>Statement of Need:</b>
<p>Private Mobile Radio (PMR) systems are out of necessity restricted in the amount of spectrum that is allowed for usage in a communication channel. Because of these restrictions various modulation schemes have been developed in an attempt to make the optimum use of the available bandwidth, phrased differently, optimize the reliable data throughput of the channel. PMR channels are typically characterized by 12.5kHz channel spacing and are commonly limited to standard modulations and protocol structures. Further, these systems are deployed across rural, urban and city centre locations each creating different channel distortion characteristics. All of the current efficient modulation schemes use a simultaneous combination of phase and amplitude modulation techniques in their attempt to get optimum usage of the available spectrum. The consequence of this is that one needs a “linear” amplifier in the transmit path to enable the device to use these modulation schemes.</p> <p>Since these devices often have to be powered by a battery, their efficiency is a further constraint that must also be optimized. Since the amplifier in the transmit path has a large power drain, the optimization of the efficiency of this amplifier would be a big benefit. Very efficient amplifiers operate effectively as switches. This is a highly non-linear process and destroys any amplitude information that might have been present. Single amplifiers can only be “linearised” at the loss of efficiency.</p> <p>A technique that is used in various forms of implementation is to use two amplifiers in parallel, one very efficient one handling most of the phase information and a secondary one “adding” the rest. The secondary amplifier has to be linear, since it has to carry the amplitude information of the modulated signal as well as the information as to at what level it was stripped of the composite signal to enable one to “add” it back at the right level.</p> <p>The problem therefore is to try to find a way to split the modulated signal into two separate signals, one carrying pure phase information and one carrying pure amplitude information. One can then potentially use techniques to optimize the efficiency of the amplitude-modulated amplifier. (Single sideband techniques could potentially be a starting point.)</p> <p>It is anticipated that three key areas require investigation to solve the above problem.</p> <ul style="list-style-type: none"><li>• Investigate which of the existing modulation techniques can be broken up into two signals, one carrying pure phase information and one carrying pure amplitude information. Alternatively, to what extent can the existing modulation techniques be broken up?</li><li>• Find a way to maintain phase synchronization.</li><li>• Determine the criteria needed for a complex modulation signal to be separable into purely phase and amplitude information.</li></ul>

## Collaborative Research Programme Project Definition (2 of 2)



- Investigate the feasibility of the design on new efficient separable modulation schemes.

The output of the activity will be a description of

- The algorithms needed to separate a modulated signal or to design a new modulation scheme.
- The design of such a system.
- The physical and practical constraints.

### Potential for Follow On Work:

Dependant on the outcomes of the research, there is the potential of follow on work to build on the findings the research undertaken in this project or to investigate related other related areas.

### Anticipated Duration:

The anticipated period for undertaking this project is 12 months, although the industry partner expects continuous engagement with the researchers, in order to make use of findings as early as possible and to transfer knowledge in the subject area to their staff and the WRC.

### Project Budget:

\$75,000

(This is a nominal figure, the actually funding provided will be finalised once the project has been fully scoped.)

### For further information Contact:

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### Appendices

Schedule A – Non-Disclosure Agreement

Schedule B – Intellectual Property Agreement