



RadioComms Connect 2011

Vicom Australia Pty Ltd
Roger Kane – Managing Director

Testing in the Digital Age

- Evolution of Land Mobile Radio
- Testing Digital Systems
- Testing in the Field
- Remote monitoring and analysis

Australia

Melbourne

Ph 61 3 9563 7844 Fax 61 3 9579 7255

Sydney

Ph 61 2 9648 4757 Fax 61 2 9648 4959

New Zealand

Auckland

Ph 64 9 379 4596 Fax 64 9 379 4597

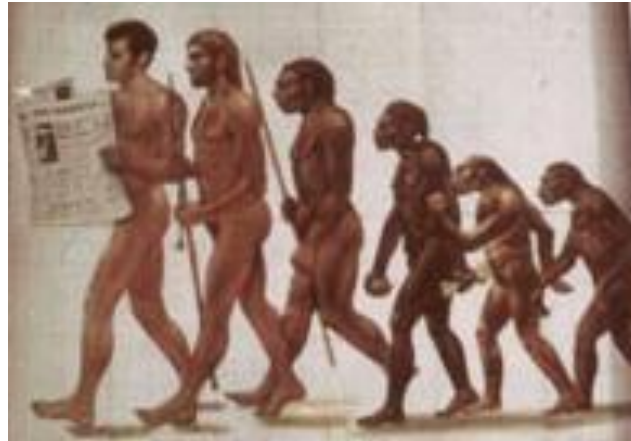
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Evolution of Land Mobile Radio

The Land Mobile Radio industry has seen significant changes over the last 30 years



Demand for:

- More information and services
- Greater Spectrum Efficiency
- Interoperability
- Reliability
- Cost effectiveness

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Evolution of Land Mobile Radio

Driven by these pressures the industry is transitioning to digital formats.

Early 2000s TETRA and P25 Phase 1
(Initially in Public Safety Applications TETRA EU, P25 US)

2005 DMR

2006 NXDN (primarily US)

2007 dPMR (primarily EU)

dPMR and NXDN FDMA 4FSK Others TDMA

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Evolution of Land Mobile Radio

Besides Voice Call

- Database look up
- AVL
- Email
- File transfer
- Limited slow scan video
- Text Messaging
- GPS Tracking

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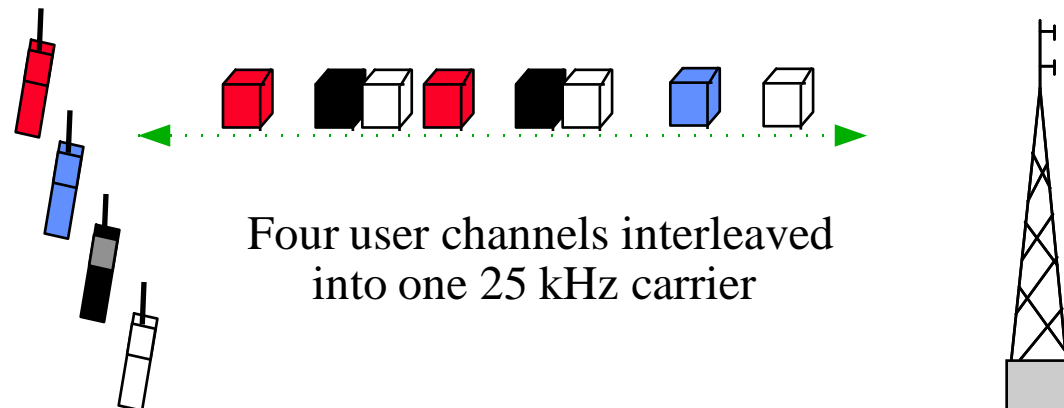
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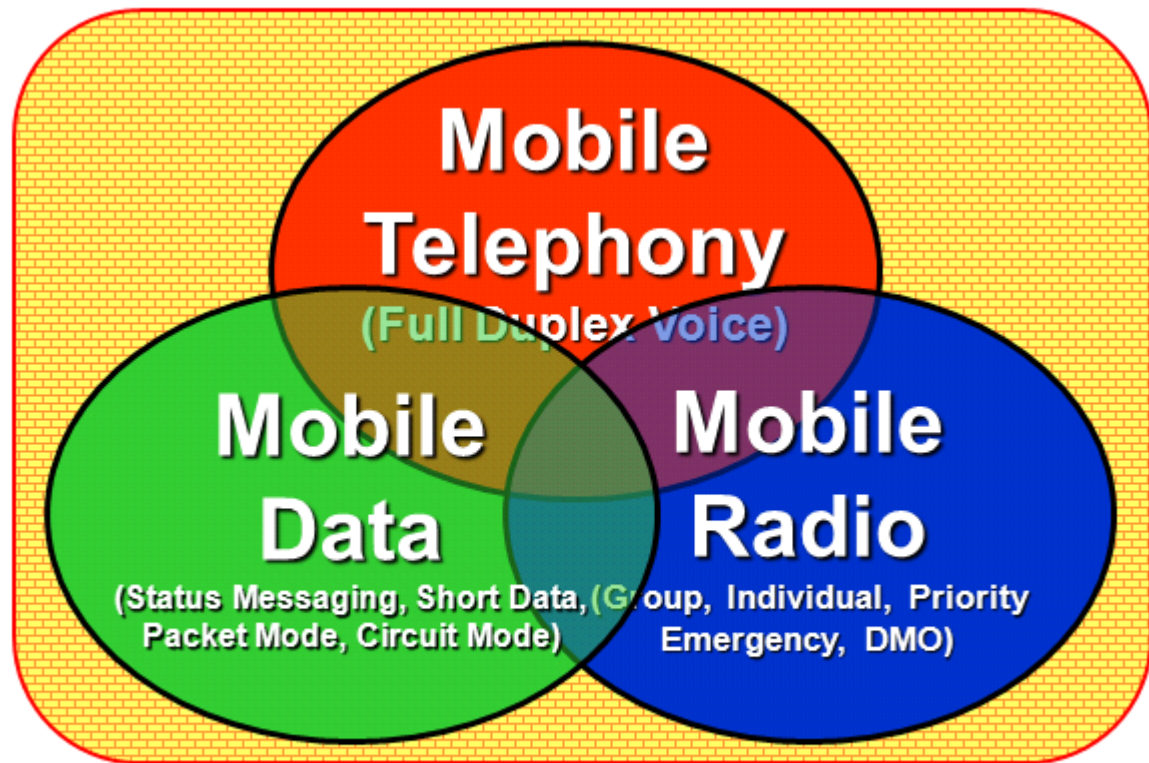
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TETRA (TDMA)

- 4:1 TDMA (Time Division Multiple Access)
- 25 kHz carrier spacing
- Digital modulation, $\pi/4$ DQPSK at 36 kbits/s
- Speech calls use one channel
- Data calls can use up to 4 channels (Data transfer rates up to 7.2 kbit/ s per channel)



TETRA Release 1



All in a secure environment

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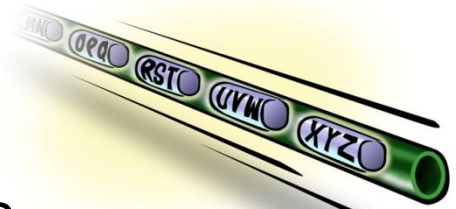
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High Speed Packet Data

- Evolution of TETRA, which allows Packet Data at speeds more than 10 times that available in TETRA 1
- Two phased approach to meet conflicting market needs:
 - TETRA Advanced Packet Service – TAPS
To meet PAMR Operators' need for rapid deployment
 - TETRA Enhanced Data Service - TEDS
To meet need for backward compatibility
- Test equipment should be capable of testing all of this features!!



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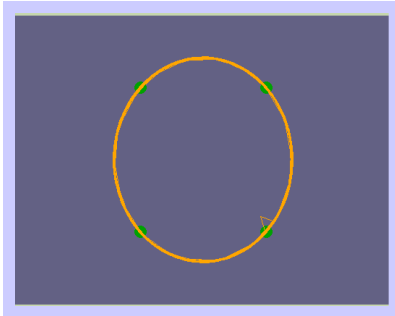
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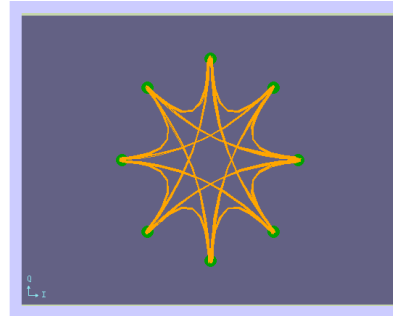
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Waveform Comparisons

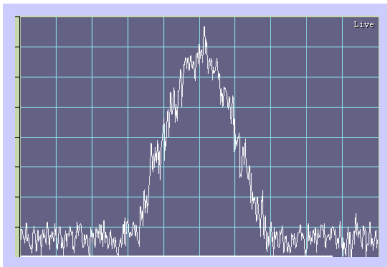
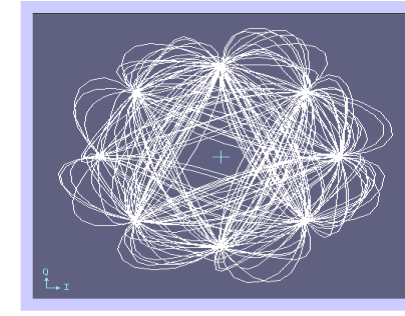
C4FM



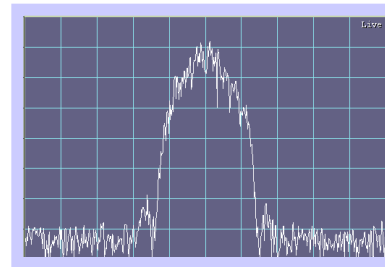
LSM



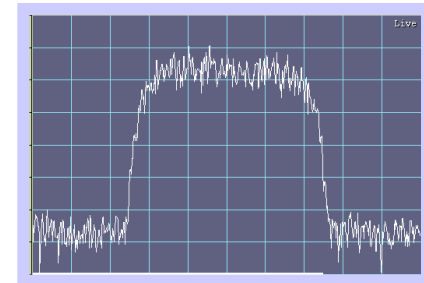
TETRA



1 CH / 12.5 kHz



1 CH / 12.5 kHz



4 CH / 25 kHz

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Testing Digital Systems

Here are some images of older analog type test equipment that met system requirements for many years until digital systems became more prevalent.

This type of instrumentation has capabilities to measure conventional analog systems but does not have the tools to properly align or diagnose the newer digital systems.

Everything is done in hardware which does not allow for new technologies to be incorporated.



Testing Digital Systems

Digital systems require new types of measurements to determine system performance. But most technologies require basically the same types of measurements.

C4FM, FSK and HCPM Modulation Measurements

- FSK Error / Modulation Fidelity
- Symbol Deviation
- Symbol Clock Error
- Bit Error Rate
- Frequency Error

TDMA Signal Measurements

- Slot Power
- TDMA Ramp

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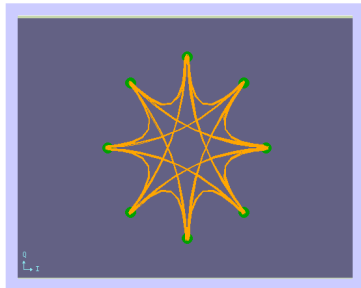
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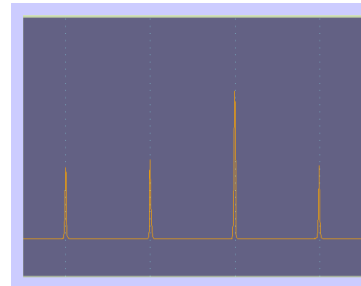
Graphical Displays

Graphical displays of demodulated digital waveforms provide quick evaluation of digital performance.

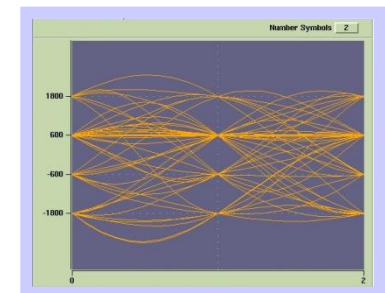
Trajectory Plot



Distribution Plot



Eye Diagram



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Improving Digital Performance

- Nearly all of today's digital radios are calibrated using the more conventional method of making standard FM Deviation adjustments.
- With more capable test equipment being available, some manufacturers are supporting adjustment in a digital mode as well.
- Today's test equipment must be able to both identify and correct digital modulation signal impairments.
- Digital signal impairments typically cause issues with coverage area.

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New technology test equipment

Modern technology equipment is software defined. Without changing hardware, new technologies can be implemented as field upgradeable software updates.

Signals are digitized and many measurement functions that used to be assemblies are now done in software.

Measurement functions and source signals are much more accurate than the earlier versions of test equipment. Even portable units can measure signals as low as -140 dBm.

Both Portable and Bench model units can be equipped to work with most technologies that are currently in use.



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Field Test

Failure in the field-what is at risk?

An extra truck roll or operator/passenger safety ?

Rugged portable platforms enable fast in vehicle testing before commencing ops.

Scripting makes the job easy.

Fast Radio alignment makes regular alignment a practical reality enhancing officer safety



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Remote Spectrum Management



3G network addressable
Weatherproof
Networkable for DF and Geo-location

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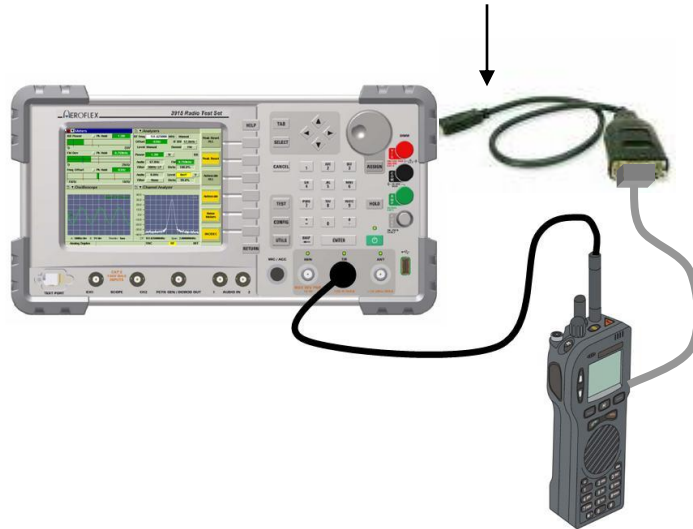
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Automated Radio Alignment

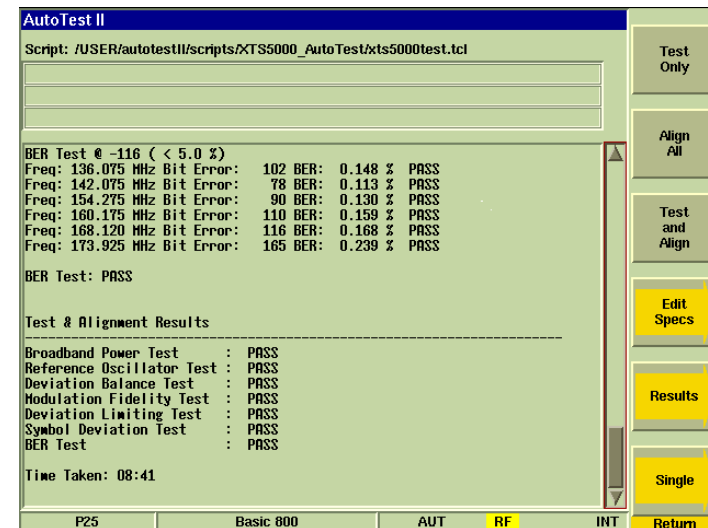
USB/RS-232/Ethernet Cable



Automation is moving forward for most radio manufactures to support accurate alignment in the field.

Radio alignment is very critical with today's radios. Close just isn't good enough anymore.

Automatic alignment features help to ensure that radios are calibrated accurately and to manufacturers specifications and verify digital performance.



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Future of Test Equipment

Test equipment is rapidly becoming more application specific and easier to use.

Automation of testing and alignment will provide consistent and optimum performance system wide for both infrastructure and subscriber equipment.

SW defined measurement functions allow support for future evolution of standards.

Modern Test Equipment provides payback:

- economy and safety in operation
- increased certainty of interoperability
- reduction of supply chain costs through avoidance of NFF returns

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Thank you for attending!



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