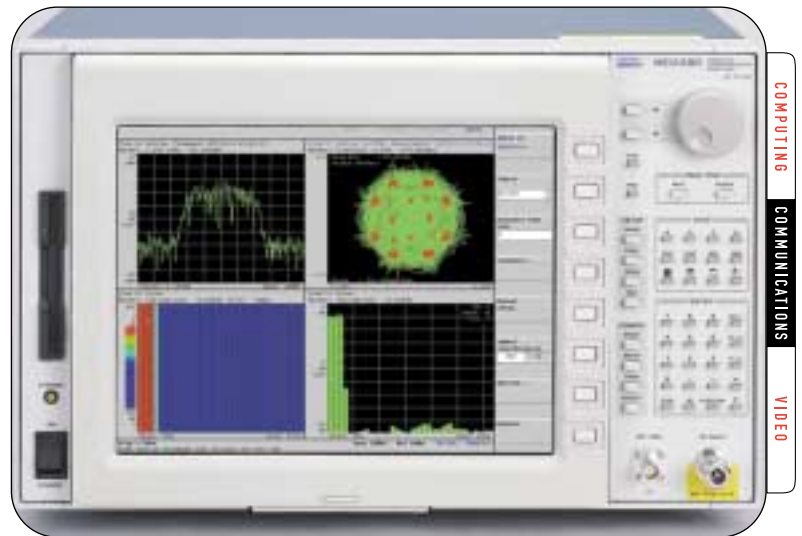


# Testing PRACH and AICH Signals to Ensure Reliable Mobile Connections



This application note illustrates how the PRACH and AICH signals can be captured and analyzed using advanced real-time measurement tools to ensure optimum designs and peak network performance.

In new generations of telecommunication systems, physical connections between mobile equipment and base stations are established through the UTRA air interface. UTRA includes the Physical Random Access Channel (PRACH) and Acquisition Indicator Channel (AICH), two new signals that have been defined by the 3GPP TSG-RAN Working Group 1. Signal quality and time correlations are essential to the establishment of reliable connections to the network.

## Measurement Challenges - Short Bursts, Critical Timing

The PRACH signal consists of a preamble and a message that are transmitted from mobile equipment as short bursts of coded information on an uplink broadcast channel. The AICH signal is an on/off-modulated pulse transmitted in a 16 symbol orthogonal signature on an ordinary downlink channel from the base station. When operating properly, the base station recognizes a PRACH preamble and responds with an AICH to establish a communication link.

Incorrect data in the PRACH preamble or problems with the signal quality can cause missed connections or lack of response from the base station. To fully evaluate the PRACH preamble, we must be able to capture the signal bursts in real time, acquire 100 milliseconds of data in a 100MHz span, demodulate the signal and perform an Error Vector Magnitude (EVM) analysis.

The time relationship between the PRACH and AICH signals is also critical to the establishment of reliable call connections. Processing time for both the mobile equipment and the base station are affected by propagation delays that must be precisely determined to prevent degradation of system response.

# Testing PRACH and AICH Signals

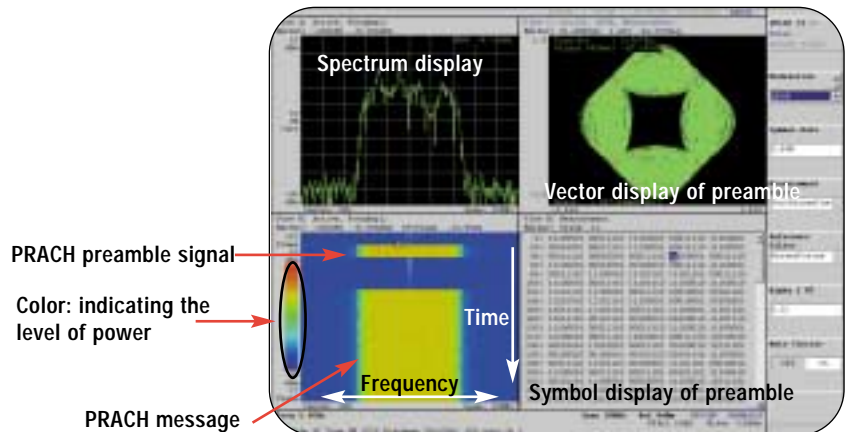
▶ Application Note

## Measurement Solutions - Real-time Capture, Precise Measurements

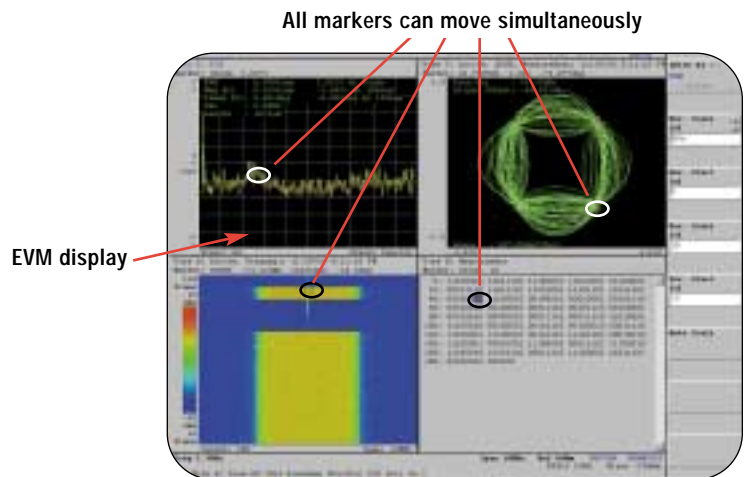
The WCA380 Wireless Communication Analyzer offers unique analysis solutions for PRACH and AICH signals. Designed specifically for the complexities of wireless signals, the WCA380 simultaneously captures

information in both the frequency and time domains in real time and stores the data for post processing, display and analysis. Here are some examples of the insight into PRACH and AICH signals provided by the WCA380.

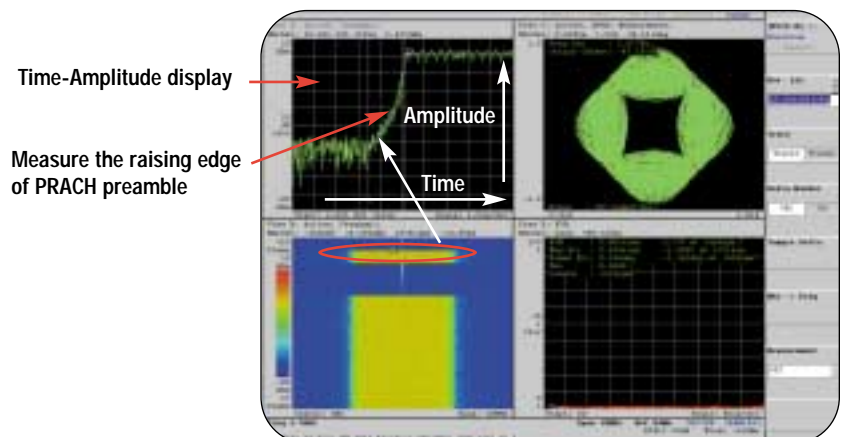
▶ **Figure 1. Spectrum characteristics:** Upper left: Spectrum display of PRACH signal. Lower right: Symbol display of preamble burst. Upper right: Vector constellation display of modulation on preamble. Lower left: Spectrogram display (straight line between preamble and message is carrier frequency).

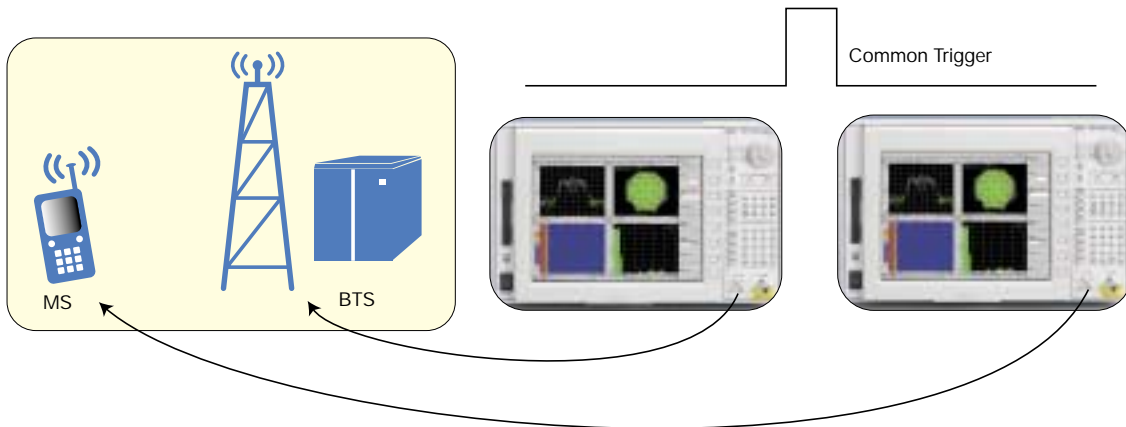


▶ **Figure 2. Signal quality:** EVM vs. symbol shown in upper left display window. Note: markers in all four windows that can be linked to move simultaneously.



▶ **Figure 3. Amplitude/time characteristics:** Amplitude versus time in upper left display showing rising edge of PRACH preamble burst.

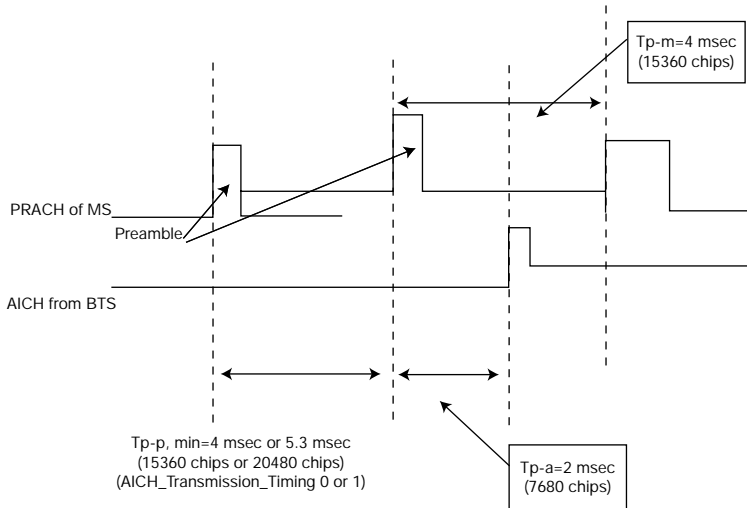




► **Figure 4.** Block diagram showing the relationship between PRACH and AICH signals: Using two WCA380 Wireless Communication Analyzers with a common trigger to measure timing relationships between a base station (BTS) and mobile system (MS).

Rising edge points: p = preamble,  
a = AICH pulse, m = message

Tp-p, min = 4 msec or 5.3 msec  
(15360 chips or 20480 chips)  
Tp-a = 2 msec (7680 chips)  
Tp-m = 4 msec (15360 chips)  
Timing resolution: 50 nsec



► **Figure 5.** Timing relationship of PRACH and AICH signals (Source: 3GPP TSG-RAN Working Group 1).

## Conclusion

Leading edge measurement tools are essential to the design of reliable systems that will conform to new wireless standards, operate at peak performance and get to market in the shortest possible time. Tektronix WCA330 and WCA380 Wireless Communication Analyzers provide clear and comprehensive insight into complex new telecommunication systems. These advanced seamless capture measurement tools record all of the information faithfully and display it in formats that are easy to interpret and analyze – leading to optimum designs and shorter development cycles.

Tektronix is committed to providing the most advanced measurement solutions. This paper is part of a library of documents for the wireless telecommunication designer and test engineer who are searching for measurement solutions. The library will grow as technology and standards continue to evolve. Complementary copies along with updates and related documents are available at the locations listed below and at our web site ([www.tektronix.com](http://www.tektronix.com)).

We welcome your comments and suggestions for improving these documents and your ideas for developing other tools to help you meet the measurement challenges of new wireless systems. Contact us at the nearest Tektronix location or through our web site.

# Testing PRACH and AICH Signals

► Application Note

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