Running 3GPP Conformance Tests including Moving Propagation and Birth-Death Propagation

Introduction

This App Note outlines the capabilities of the WAVE-3G to meet and exceed the 3GPP specification for today's demanding channel emulation conditions.

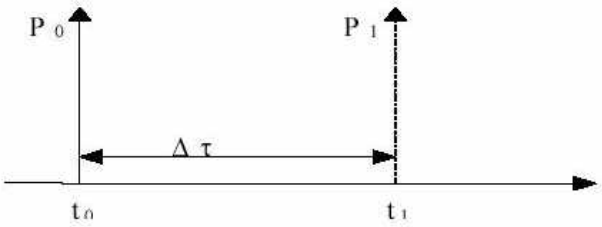
The WAVE-3G provides an elaborate API for controlling time-varying propagation profiles under real-time control of the WAVE-3G. Time varying changes to the following parameters are supported:

Path Delay	independently on all defined paths
Path Gain	independently on all defined paths
Fading	viewed as Vehicle Speed or Doppler

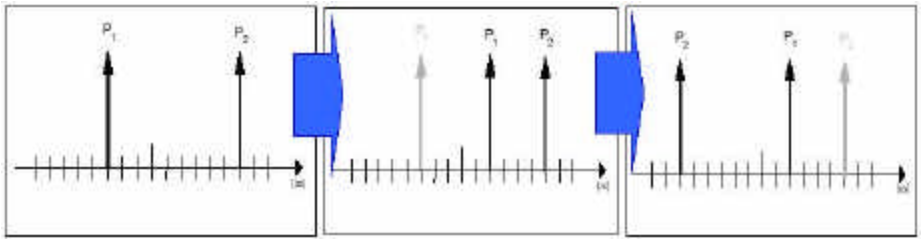
Additionally, birth-death propagation is supported under real-time control of the WAVE-3G.

3GPP Testing

Today's time-varying propagation conditions demand the ability to support moving and birth-death propagation conditions.



3GPP Moving Propagation Conditions



3GPP Birth-Death Propagation Conditions

The WAVE-3G provides built-in real-time support for these industry standards. By simply recalling the selected industry standard profile the user only needs to access simple API

calls to load and run the profile. Once executing, the time-varying profile can be paused and continued at the users request.

Moving Beyond Today's Testing Standards

With its flexible programmability, the WAVE-3G API supports today's standards and more. Moving propagation and birth-death propagation are simply a subset of the advanced profiles which can be configured through the API. Independent time-varying conditions can be programmed for each enabled path in terms of its relative delay and gain. Additionally, the over-all fade rate (as a function of vehicle speed or Doppler) can be varied.

Each of these Time-Varying parameters is separately configured to vary independently over user specified limits along linear or sinusoidal change curves. The API enables complete control of the channel emulation by enabling the user to Run, Stop, Pause and Continue – all through single API calls. All real-time control is handled internal to WAVE-3G, providing an ideal solution for ATE environments without taxing the central controller.

Time Varying Propagation

Time-varying parameters are specified in the channel model API calls. These time-varying parameters include the start and end values as well as the time period over which to effect the change. Additionally, the change can be defined to follow either a linear or sinusoidal curve.

Any combination of static or time-varying conditions can be programmed. Because of its completely digital implementation, identical repetition of a defined profile is guaranteed. The WAVE-3G's unique impulse response operating mode can be used to easily verify the setup of the user's complete profile.

Birth-Death Propagation

Birth-death propagation is realized by using one path as a shadow path which moves (while disabled) to its new birth location within the defined test set. When required the shadow path and the current path are simultaneously switched (enabled/disabled) to provide the birth-death condition.

The WAVE-3G API provides a flexible interface to the birth-death profile where the user specifies the number of points in the movement set, the distance between points in the set and the change rate of birth-death movements.

Examples of use

API commands can be sent to the WAVE-3G though GPIB or RS-232 interfaces. In the following examples, the *SendApiCmd* function is independent of the transport layer used.

Example 1

The first example outlines how a typical setup and execution of the WAVE-3G is realized using an Industry standard 3GPP channel model. The User resets and configures the IO, UUT CHANNEL and NOISE parameters for the required profile and then executes.

```
//====================================
//      Reset and configure System configuration
//====================================
SendApiCmd("*RST");                              // Reset WAVE-3G
SendApiCmd("SYSTEM:UNIT 1");                     // Configure as WAVE-3G #1
SendApiCmd("SYSTEM:IMPULSE OFF");                // Disable Impulse response

//====================================
//      Configure I/O interfaces
//====================================
SendApiCmd("IO:INTERFACE:INPUT ABB");            // Analog Base-band Input
SendApiCmd("IO:INTERFACE:OUTPUT ABB");           // Analog Base-band output

SendApiCmd("IO:DCOFFSET:INPUT 11, -27");         // Set DC offsets
SendApiCmd("IO:DCOFFSET:OUTPUT –34, 88");

SendApiCmd("IO:GAIN:INPUT 32767, 32660");        // Set Gain Adjusts
SendApiCmd("IO:GAIN:OUTPUT 32456, 32767");

//====================================
//      Configure Unit Under Test (UUT)
//====================================
SendApiCmd("UUT:OFFSET 0");                      // Freq Offset (Hz)
SendApiCmd("UUT:BITRATE 256");                   // Bitrate (KHz)
SendApiCmd("UUT:NEBW 4");                        // NEBW (MHz)
SendApiCmd("UUT:TRUNCATE 12");                   // 12-bit

//====================================
//      Configure Channel Model
//
//      Here we are selecting one of the predefined
//       3GPP industry  standards
//====================================
SendApiCmd("CHANNEL:INDustry 3GPP_MOV_PROP");
      or
SendApiCmd("CHANNEL:INDustry 3GPP_BIRTH_DEATH");

//====================================
//      Configure Noise Parameters
//====================================
```

```
SendApiCmd("NOISE:TYPE:RANDOM");                    // Noise type
SendApiCmd("NOISE:SNR:CN –10");                     // Noise SNR
//=====================================
//      Load Profile,
//      Measure input level with Digital Power
//      Set SNR
//=====================================
SendApiCmd("LOAD");

//=====================================
//      Run Profile,
//      All real-time control of time-varying
//      delay (position) is processed and controlled
//      internal to the WAVE-3G
//=====================================
SendApiCmd("RUN");

//=====================================
//      At any time the profile can be paused
//      and continued by simply calling the
//      STOP and RUN command
//=====================================
SendApiCmd("STOP");                                 // Pause Simulation Changes
SendApiCmd("RUN");                                  // Resume Simulation

//=====================================
//      Paramerters can be changed on-the-fly
//=====================================
SendApiCmd("STOP");                                 // Stop
SendApiCmd("NOISE:SNR:CN –12");                     // Change Noise SNR
SendApiCmd("LOAD");                                 // Load profile, measure input, set SNR

SendApiCmd("RUN");                                  // Start execution
```

Example 2

The second example shows how a standard profile can be easily modified to provide test conditions which surpass standardized testing.

```
//=====================================
//      Stop the previous example
//=====================================
SendApiCmd("STOP");                                 // Stop

//=====================================
//      Reconfigure the Time-Varying (TV)
//      parameters of the Channel Model.
//
//      Here we set the Fade rate to simulate
//      a vehicle moving from 0 to 100 km/hr
```

```
//        over 60 seconds along a linear curve
//
//        The Gain of Path1 is set to change from
//        0dB to –20dB over 30 sec along a linear
//        curve which cycles continuously between
//        the defined end-points.
//
//        The Delay of Path2 is set to change from
//        1000 to 4000ns over 3000 seconds along
//        a sinusoidal curve which cycles continuously
//        between the defined end-points.
//====================================
SendApiCmd (“CHANNEL:TV:FADING:VEHICLE 881.5,  0, 100, 60 LINEAR”);
SendApiCmd (“CHANNEL:TV:GAIN 1, 0, -20, 30, CYCLIC_LIN”);
SendApiCmd (“CHANNEL:TV:DELAY 2, 1000, 4000, 3000, CYCLIC_SIN”);

//====================================
//        Load Profile,
//        Measure input level with Digital Power
//        Set SNR
//====================================
SendApiCmd(“LOAD”);

//====================================
//        Run Profile,
//        All real-time control of time-varying
//        delay (position) is processed and controlled
//        internal to the WAVE-3G
//====================================
SendApiCmd(“RUN”);
```