

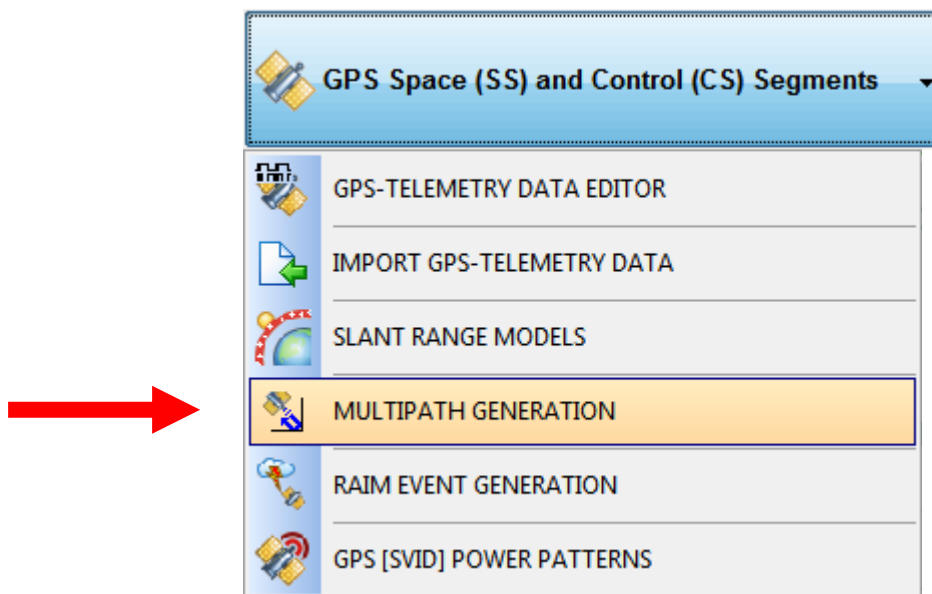


USING HARDWARE MULTIPATH

This document provides the details for hardware Multipath modeling. The Multipath model uses vacant physical hardware channels for implementation. Both code and carrier, and power are modeled.

HARDWARE MULTIPATH

To access the Multipath Setup Form, use the main menu pulldown,



The multipath event starts at the Time of Applicability.

PROGRAMMABLE MULTIPATH EVENT

MULTIPATH CHANNEL EVENT

CURRENT TIME Seconds ΔT

Construct a Channel Event

EVENT TIME ΔT 186.3 Seconds into Simulation

CHN	SVID	OVERRIDE	CODE BIAS				ATTENUATION					
			meters	m/s	m/s ²	m/s ³	L1CA	L1P	L2P	MOD1	MOD2	BIAS RATE (dB/s)
1	10	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
2	12	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
3	15	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
4	18	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
5	21	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
6	24	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
7	29	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
8	30	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
9	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
10	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
11	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
12	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
13	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
14	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
15	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
16	0	0	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0

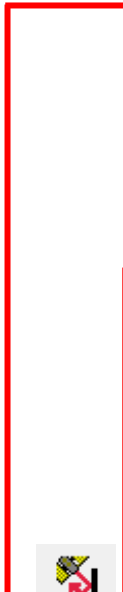
EVENT DURATION ΔT Seconds Apply until Simulation Termination

EVENT FILE ACCESS: CLEAR EDIT REFRESH

EVENT LIST [Click #Time to Select]

INSERT EVENT CANCEL FINISHED

Physical Hardware Channel #



These are "vacant" channels. You may assign any SVID to one of these slots (or override the direct slots). These are the INDIRECT Signals.

These are the nominal channel assignments. They are the DIRECT signal.

ENTER Delay (\pm) to be applied to this Channel

ENTER Slew dynamics (\pm) to be applied to this Channel

(APRIORI) ATTENUATION to be applied to this Channel

ATTENUATION RATE to be applied to this channel (note resolution 0.3 dB)

Channel Assignment

To assign satellites to vacant channels, simply enter the SVID to generate. For example, let's assume SVID = 7 is selected for multipath.

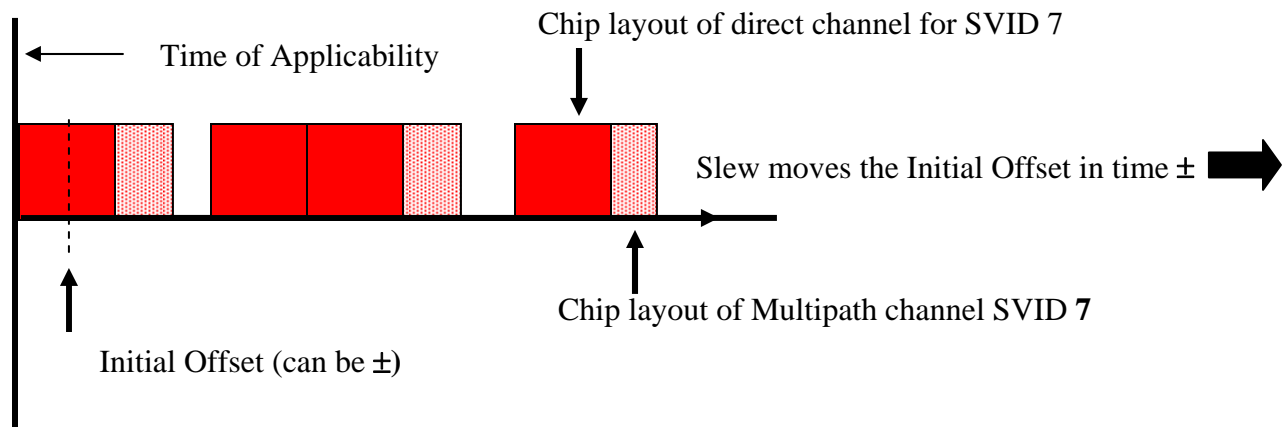
Channel / SVID	Code Offset (m)	Code Slew Rate (m/s)	Attenuation (dB)					Attenuation Rate (dB/s)	
			L1CA	L1P	L2C	L2P	L5	** Atten LSB = 0.3 db **	
1									
2									
3									
4	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	
5									
6									
7									
8									
9									
10									
11									
12	7	20.4	1.234	5	5	2	2	6	0.3

Channel 12 is assigned to SVID 7. In addition, a code offset, code-slew rate, and power profile is specified.

Pressing enters this record into the CHANNEL CONFIGURATION FILE with a Time of Applicability (**Event Time**) shown at the top of the form. If you want the multipath to start at a different time, enter it into the edit control and the GUI will be reset to the specified time.

Code Offset / Slew

In the code offset box, enter the offset of the replicated channel relative to the direct generated channel. The diagram below illustrates the effect of non-zero offset and slew values.



The offset of the replicated code phase signal relative to the direct is given by

$$\phi(t) = \phi_o + \dot{\phi}_o (t-t_o) + \frac{\ddot{\phi}_o (t-t_o)^2}{2} + \frac{\overset{\bullet}{\ddot{\phi}_o} (t-t_o)^3}{6}$$

Code offset Code Slew Code Acceleration Code Jerk

Attenuation Profile

Automatically, the composite direct and replicated signal experiences overall power perturbation due to the relative Carrier Phase. This can vary from in-phase, resulting in 6 dB power increase, or out-of-phase resulting in 0 output power for the SVID. The Code Phase applies similarly.

Additionally, you may specify an attenuation profile for all output links. The Attenuation rate can also be non-zero. Note however that we have a 0.3 dB LSB. The attenuation applied to the replicated signal as a function of time is given by:

$$A^L(t) = A_o^L + \overset{\bullet}{A}$$

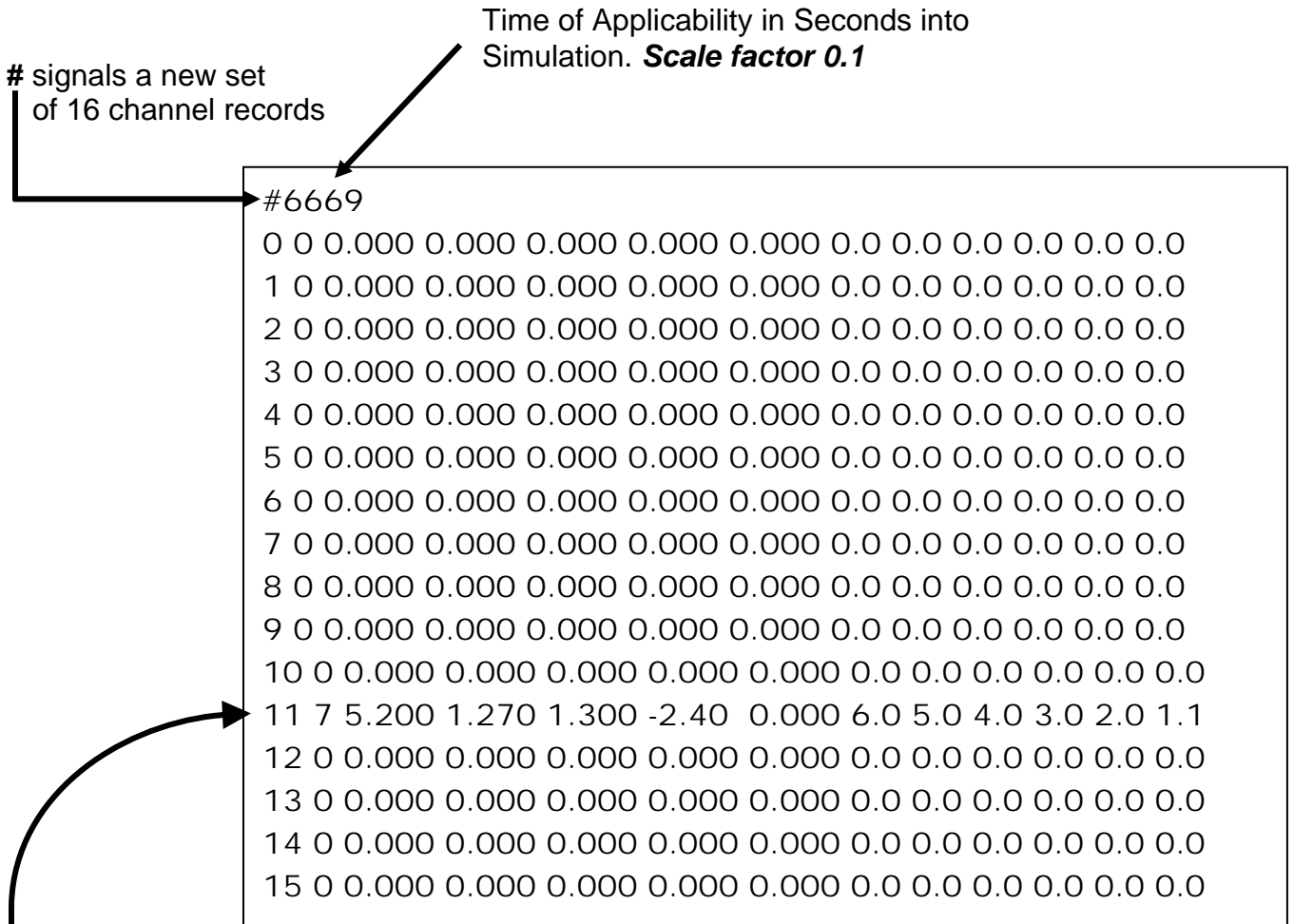
Initial Attenuation Attenuation Rate

Editing the Channel Configuration File

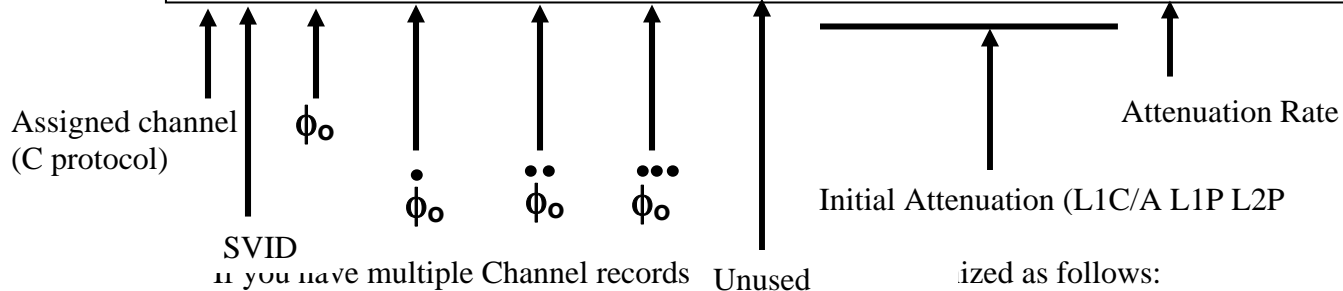
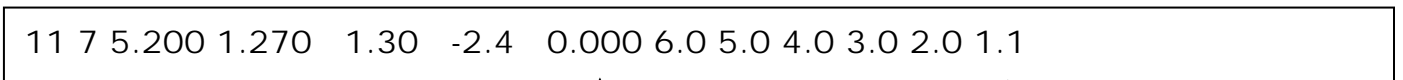
The SVID entries associated with Multipath control are stored in a (TX) file within the Scenario folder. **CHANNELEVENT.SCN**. Should you decide to edit or produce this file the format is given below. A quick summary:

- The # character signals a NEW channel configuration record. If you have multiple records separate each by a # sign.
- The Time-of-Applicability follows the # character with NO spaces. Units are seconds into simulation with a scale factor of 0.1.

- The channel configuration record MUST be 16 entries (channels) as shown in the example below. Note the channel ID is in “C” notation (0 based)



CHANNELEVENT.SCN



These values are applied 666.9 seconds into the simulation

```

#6669
0 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
1 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
2 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
3 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
4 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
5 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
6 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
7 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
8 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
9 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
10 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
11 7 5.200 1.270 1.3000 -2.40 0.000 6.0 5.0 4.0 3.0 2.0 1.1
12 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
13 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
14 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
15 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
    
```

These values are applied 821 seconds into the simulation

```

#8210
0 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
1 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
2 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
3 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
4 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
5 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
6 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
7 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
8 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
9 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
10 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
11 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
12 3 1.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
13 4 2.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
14 5 3.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
15 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
    
```

These values are applied 900 seconds into the simulation

```

#9000
0 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
1 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
2 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
3 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
4 0 0.000 0.000 0.000 0.000 0.000 0.0 0.0 0.0 0.0 0.0 0.0
    
```