

HFC network introduction and EPOC requirements from ZSCN

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Network Overview

- CATV subscriber number – 0.66M
- Bi-directional covered subscriber number – 0.31M
- Bi-directional penetration ratio is improving.
- Basic topology – Fiber to the residential curb , with 1 amplifier and centralized distribution coaxial cable network.
- Accumulated nearly 10,000 records during per month test within 3years. User CNR is maintained at more than 44.5dB.

EPoC requirements

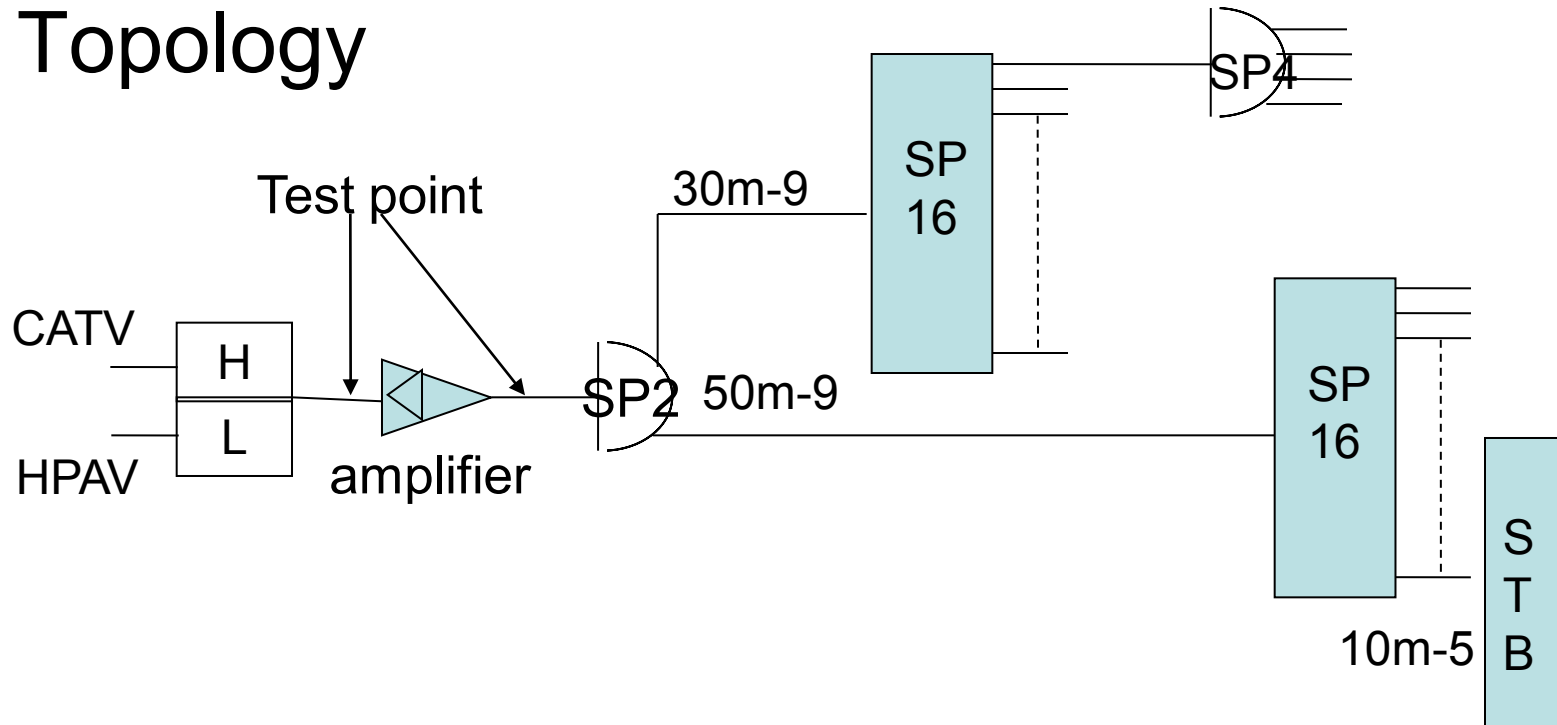
- Why EPOC?
 - Because FTTH is difficult. Zhongshan cable network is with fiber-to-the residential curb.
 - all IP and service development trends
- Spectrum for EPOC
 - 5-65MHz and 900-1200MHz
 - 5-65MHz spectrum requires to be co-existence with HPAV EOC.

Channel test

- Tested at lab environment , with Node+1 topology and all kinds of tap/splitter/ cable/amplifier
- Selected 2 sites at real network, and tested noise/interference, etc.
- Mainly tested downstream/upstream Node+1/+0 cable network characteristics, including signal level, C/N(SNR), MER, loss - frequency response, group delay, and calculated micro-reflections accordingly.

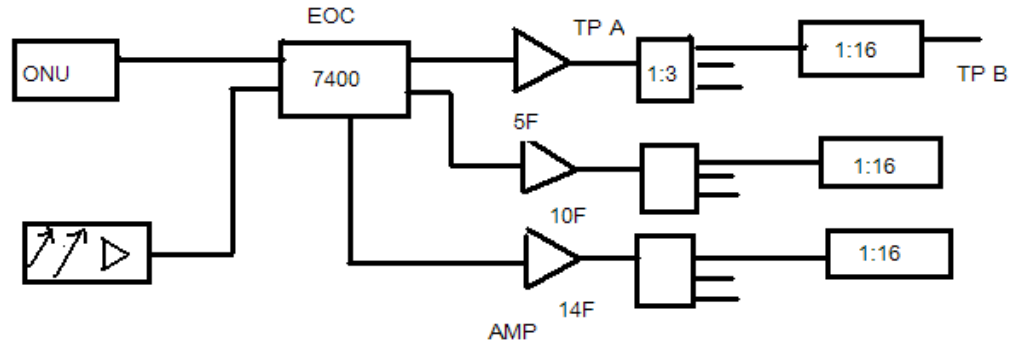
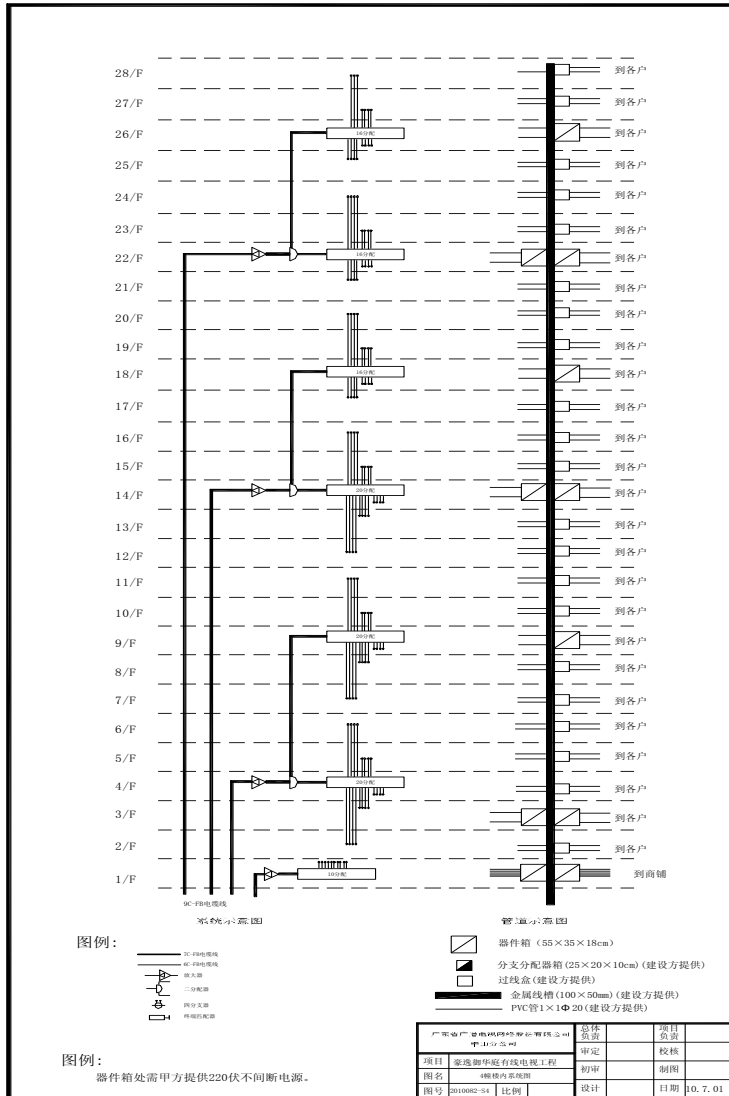
Lab test

- Topology



- Connected 31 STBs, and separately tested parameters under different conditions, e.g. STB connect/disconnect, STB power on/off.

Network sites



Test site 2 – with HPAV
EOC deployed

Test site 1

CNR test results

No	freq(MHz)	mode	power	C/N(dB)	MER(dB)	BER
Z01	112.25	PAL-D	-32	45		
Z02	120.25	PAL-D	-30	43		
Z03	128.25	PAL-D	-29.3	44.9		
DS06	168.25	PAL-D	-28.2	47.3		
DS08	184.25	PAL-D	-28	46.3		
Z19	331	64QAM	-27	43.3	42	0
Z37	482	64QAM	-26	43.4	42	0
DS22	538	64QAM	-26.7	42.3	40.7	0
DS23	554	64QAM	-26.3	43	41	0
DS25	607.25	PAL-D	-24	48.6		
DS31	751.18	PAL-D	-23.8	48.9		

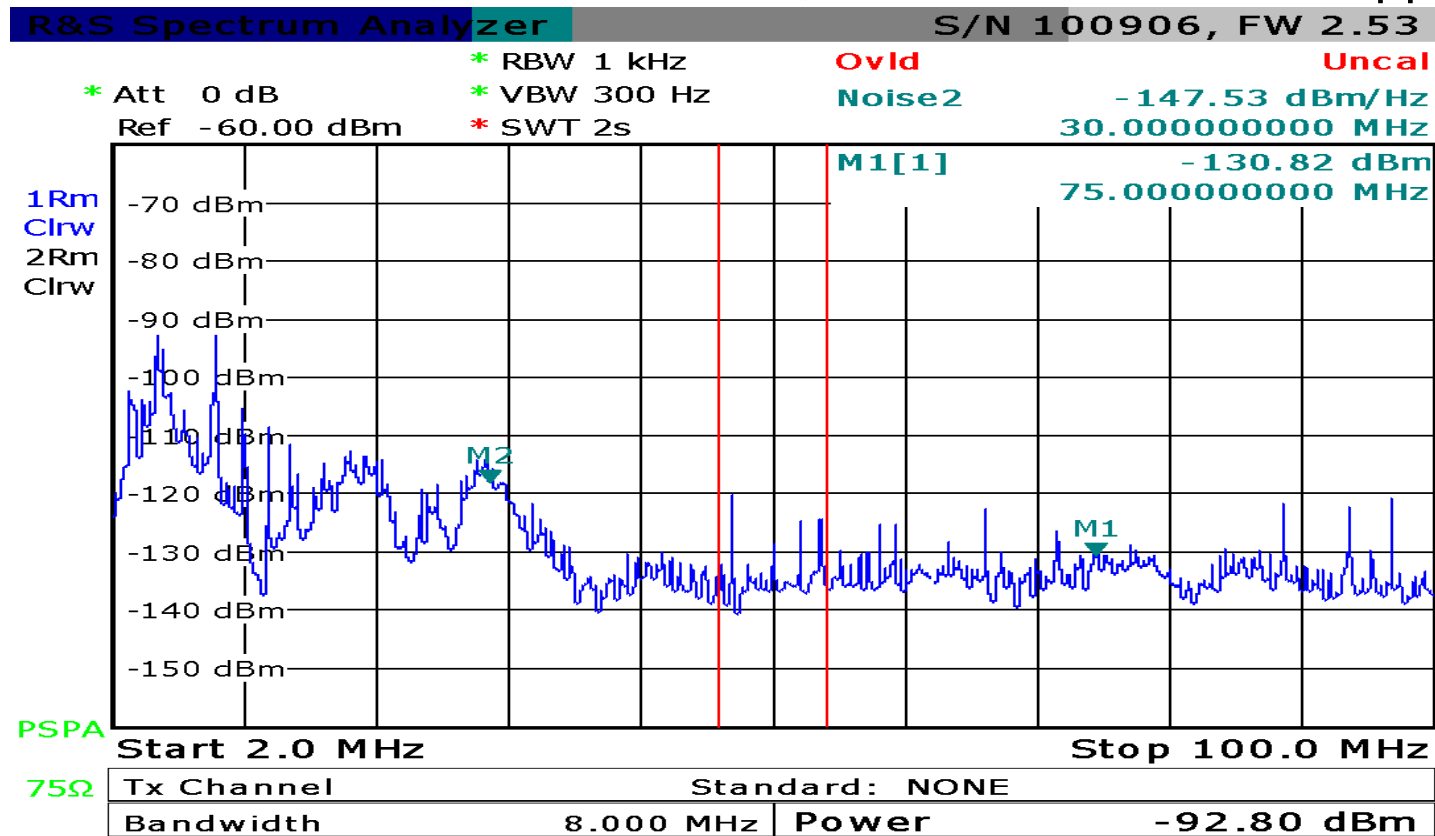
Under Node+1 scenario: almost all channels $C/N \geq 43$ dB.

HPAV EOC signals exist at 5-67MHz spectrum.

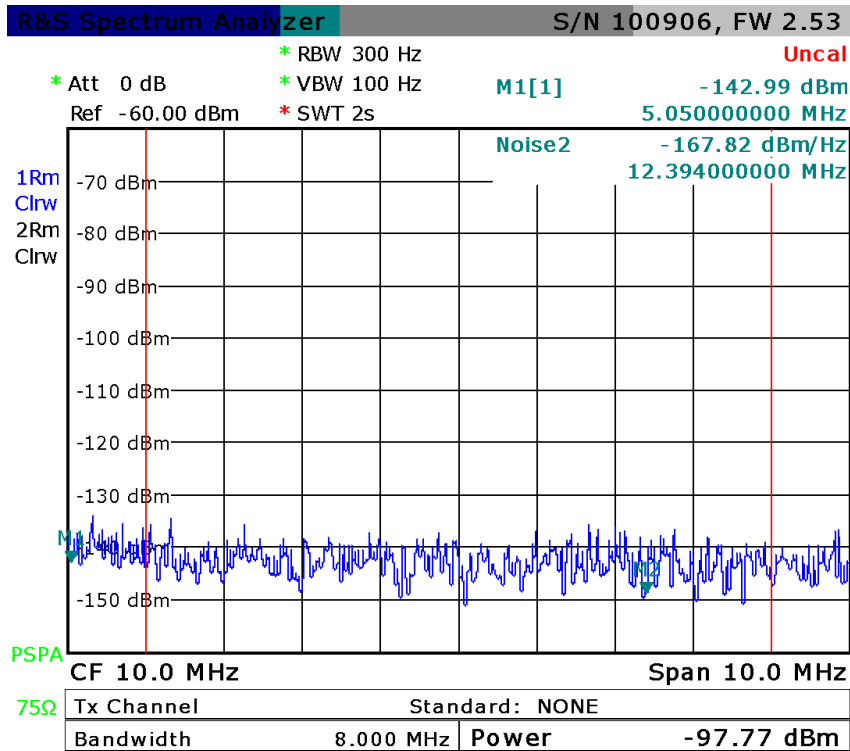
All test sites are almost the same, without significant interferences exist.

Poor connection may cause false noise/interferences.

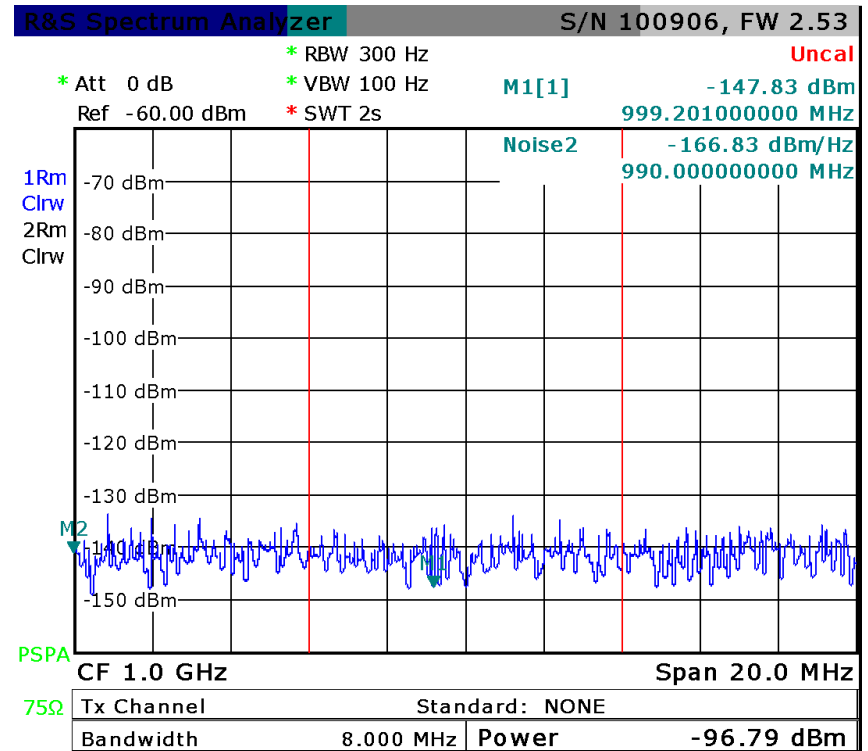
Below figure shows noise existed below 55MHz, but it was due to poor connections on a connector of one splitter-16. If all connectors are well connected, the false noise will disappear.



The noise floor for both downstream and upstream of N+0 is below test equipment noise floor (R&S ETL noise floor is about -165dBm/Hz), and no significant interferences found.

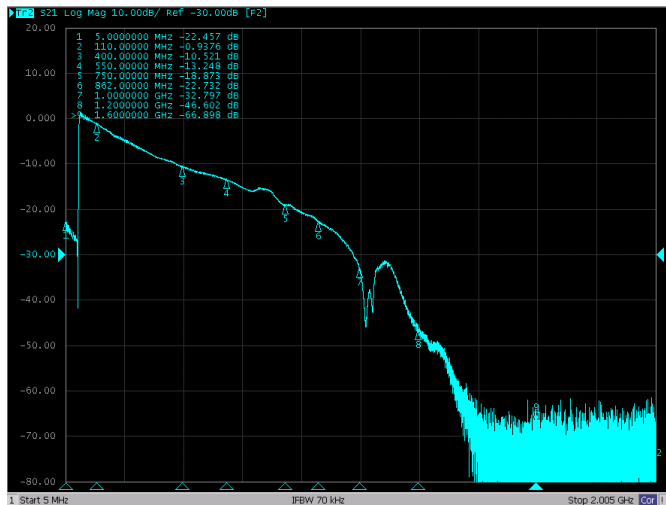


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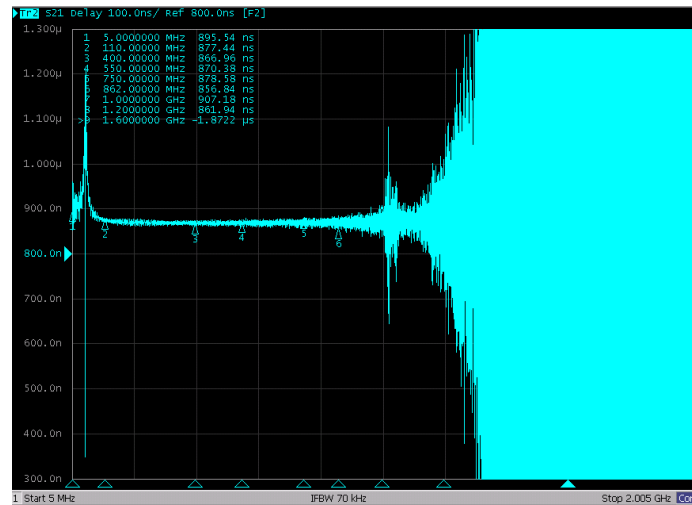


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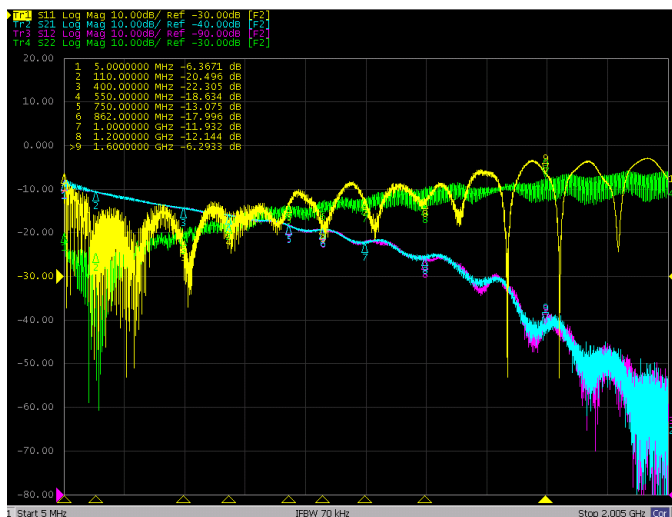
Lab test with network analyzer -N+1/+0



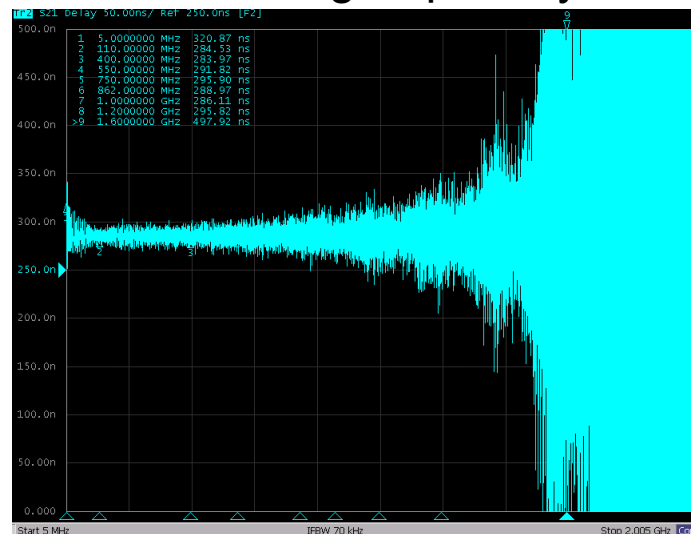
N+1 S21



N+1 group delay

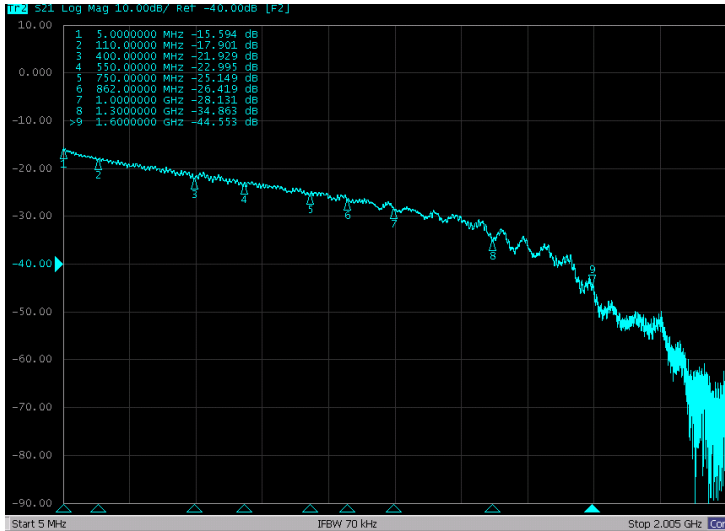


N+0 S parameters

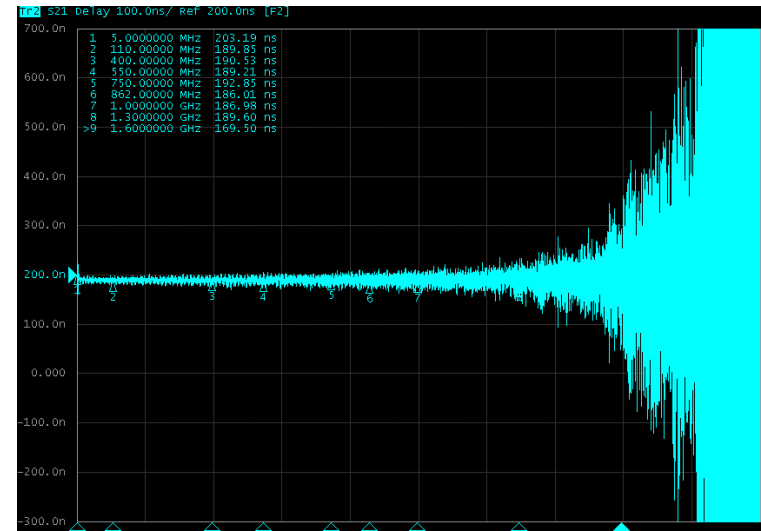


N+0 group delay

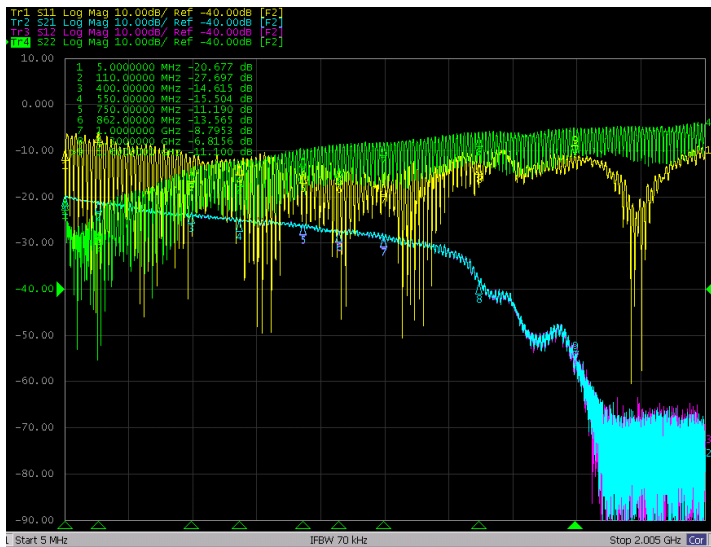
Real network test –N+0



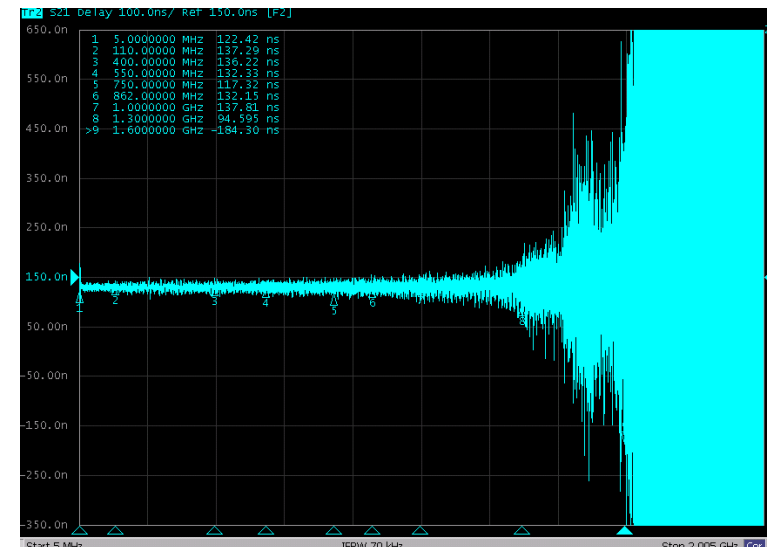
Test site 1 N+0 S21



Test site 1 N+0 group delay



Test site 2 N+0 S parameters

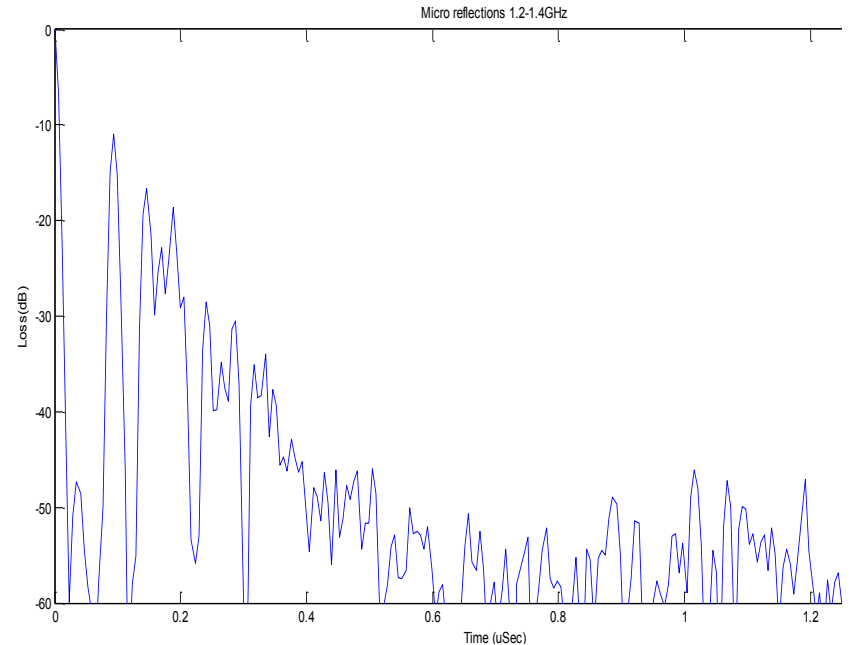
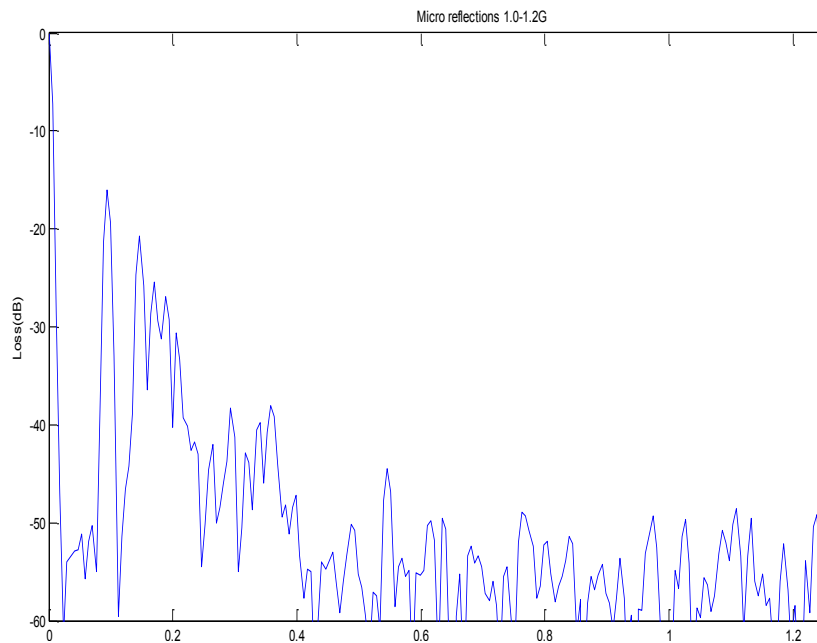


Test site 2 N+0 group delay

Micro-reflection analysis of test site1

Node+0

- Because all ports of the network are open, without 75ohm terminal match. There exist serious micro-reflections especially above 1.0GHz frequency.



Conclusion

- Under N+0 scenario:
 - Given EPOC transmitter power is equal to DVB-C (104dB μ /8MHz), and the transmission loss is approximately 40dB@860MHz, \leq 45dB@1200MHz, and CNU receiver signal level \geq 69dB μ per 8MHz.
 - The channel SNR can be higher than 56dB
- Under N+1 scenario: the test SNR is almost higher than 40dB.
- At Zhongshan cable network, with OFDM PHY, the modulation order can reach 4096QAM
- There are almost no users at two test sites, all network ports are open, micro-reflections is quite clear.

Thanks!