

Brief introduction on China Cable network and requirements

China Radio & TV association technical committee

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Supporter

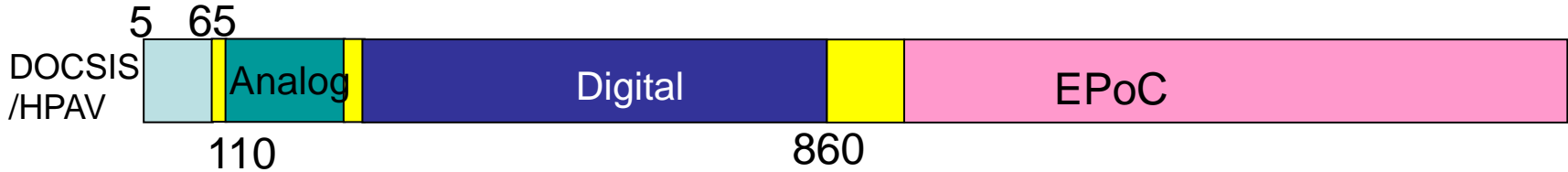
- Jiangming Shi - Gehua
- Xiaojun Gao - JSCN
- Tao Yang - SXBCTV
- Jun Xu - GZCTV
- Huafeng Zhang, Wei Chen,
- Henan Cable
- Xiaoping Hu - XFBN
- Ling Han - Guideline
Research
- Shubin Wu - Fiberhome
Network
- Baobin Hu - YOTC
- Wenhao Li - Raisecom
- Alex Liu, Jeff Chan -
Qualcomm
- Chengguo Xiong – CRTA
- Ling, Luan - Entropic

Basic information

- Collected Chinese MSO questionnaires from 9 provincial MSOs (Jiangsu, Guangdong, Guizhou, Shanxi, Gehua, Guangxi, China Cable, Hebei, Washu), and one city MSO (Xiangyang)
- Brief info of these MSOs
 - 59.41M total subscribers, among which the bi-directional coverage user number is 24.56M, and the penetration user number is 6.4M
 - 1.796M subscribers are with internet access
 - 50-350users per fiber node.
 - The coaxial cable distances are 5-300 meters
 - The average FTTB ratio is approximately 30%, but not equivalent. Some MSOs can reach 90%, but also MSOs without FTTB.

Spectrum applications and planning

- Different cities have different frequency planning.
- 5-65MHz spectrum are almost occupied, mainly for DOCSIS and HPAV.
- Analog TV channels are basically in the range of 110-360MHz, according reserved channels to allocate bandwidth, but also few MSOs assign analog TV channels above 360MHz.
- DVB-C/DOCSIS Downstream/VOD IPQAM occupy spectrum above analog TV channels.
- **750M~1006MHz is planned for HiNOC in China.**



- EPOC can only use spectrum above 860MHz
 - The spectrum below 750 MHz in all MSO's network have been occupied.
 - The spectrum below 860MHz in most of MSO's network have been occupied or planned for future services.
- If the upper limit frequency is 1200MHz and remove 100MHz isolation band the available bandwidth for EPOC is 240MHz
 - FDD UP 120MHZ and DN 120MHZ,
 - TDD 240MHZ for both UP and DN.
- Select 860-960MHz as the isolation band is more reasonable, because this segment spectrum has the GSM signal interferences.
- According to network measurements, the 1.2G-1.3GHz performance decline sharply, but the SNR can also reach about 30dB and without interferences. So 1.2G-1.3GHz spectrum is available, and the modulation order can be adaptively reduced.
- With 3GHz splitter/tap and fiber even deeper, the spectrum can be extended to 3GHz at cable network.

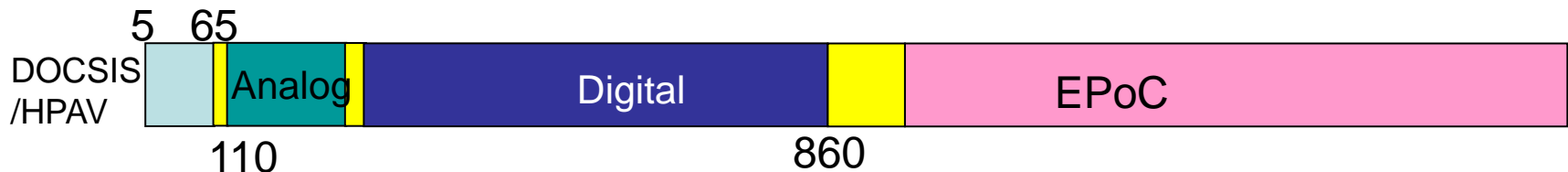
Spectrum Efficiency Requirements

- Maximum spectral efficiency should reach 8-12bit/s/Hz.
- Minimum spectral efficiency should reach 2-8bit/s/Hz.
- Adaptive modulation is a common requirement.

Analysis: Based on the channel test, the downstream modulation for Node+0/+1 can reach 4096QAM. But the interferences on some frequency are strong, need to reduce sub-carrier modulation order, until mute subcarriers.

Application Scenarios

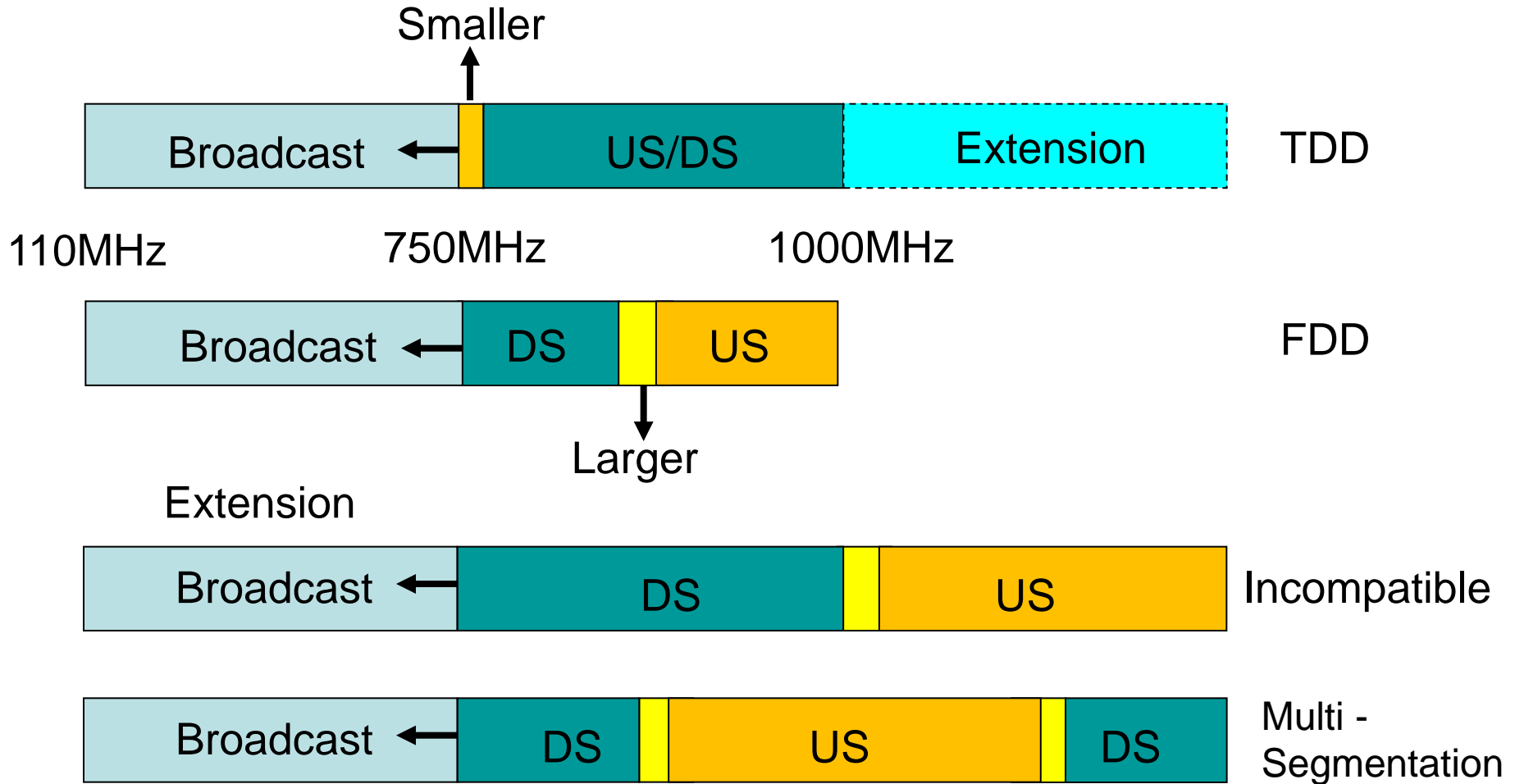
- All MSOs support EPOC works under N +0 scenarios.
- Few MSOs need N +1 scenario. Only one MSO considers Node+2 for EPOC. No MSO requires Node+3
- UP/DN split point must be changed to support EPOC
 - 5-42/65 is not enough for EPOC upstream
- Analysis
 - Change network, shift up UP/DN split point, and replace amplifiers. Is it cost-effective and reasonable?
 - Fiber deeper and remove amplifiers?
- Conclusion
 - The final application scenario is N +0 (CATV remains N + X)
 - Limited N+1 applications where fiber can not reach.



The requirement for TDD

- Questionnaires collected
 - Most of Chinese MSOs expect EPOC can support . Few MSOs without need of TDD.
 - Part MSOs without FDD spectrum planning for EPOC.
- Analysis
 - MSOs have no preference on FDD and TDD, the only requirement is to meet services application, simple and flexible.
- Like the NA MSOs hope to unify DOCSIS3.1 PHY and EPoC PHY, Chinese MSOs also hope to unify EPoC and HiNoC or existing EoC.
- The N +0 scenario does not exist bidirectional amplification requirements.
- FDD is more complex than TDD in deployment and application.
 - I think DOCSIS isn't deployed well in China is related with FDD
 - TDD is more flexible in spectrum assignment and extension.
 - Current available spectrum (860M-1200MHz) is more suitable for TDD
- NA MSOs want a unified PHY for both D3.1 and EPOC. Chinese MSO also expect that EPOC can be harmonized with EOC/HiNOC.

Frequency for FDD & TDD



EPoC Frequency Planning

IEEE P802.3bn> EPoC – October
2012 Additional Interim Meeting

Network Architecture

- Part Chinese MSOs require End-to-end architecture
 - E2Emanagement / scheduling / QoS.
- Part MSOs think two segment network is good at flexibility and system efficiency/spectrum efficiency
 - MSO can avoid to be bonded with one vendor. But unified network management is required.
- Analysis : CNU/CPE compatible is the most important requirement.
 - OCUs can have different architectures, but CNU must be unified.
 - Is it possible for compatible EPOC/HINOC CNU?
- Chinese MSOs have no common requirements on OCU/CLT
 - Some MSOs emphasize bridge architecture is more flexible , some MSOs prefer half-bridge/relay architecture
 - OCU should be as simple as possible, and with simple configuration/ maintenance.
- Conclusion: CNU should be compatible, OCU can have different design.

Requirement for CNU number and data rate

- Without common understandings on CNU number
 - 1GEPoC may be with 32-1000 CNUs
 - 10GEPoC may be with 128-10000 CNUs
 - CNU can support 3-256 LLIDs
- All MSOs thinks that CNU data rate should be lower than OLT
 - Expected CNU data rate is from 10Mbps to 1Gbps
- Analysis
 - 1GEPOC CNU number should be less than 128
 - 10GEPoC CNU number should be less than 512
 - There is no need for 1G data rate CNU, 100M~500Mbps CNU PHY data rate is reasonable.
 - It's better that each CNU supports 4-8 LLIDs

Network quality requirements

- SNR:
 - 5-30MHz: 15-30dB
 - Above 30MHz: 30-45dB
- Passive network (N +0) is very easy to reach more than 40dB
 - Given Noise floor $\leq -165\text{dBm/Hz}$ (or $12.5\text{dB}\mu/8\text{MHz}$)
 - if the receiver level is $\geq 52.5\text{dB}\mu/8\text{MHz}$, then the $\text{SNR} \geq 40\text{dB}$
- Based on the theoretical analysis and measurement, the SNR of the N +1 network can easily reach 40dB.

Interferences

- Terrestrial TV and mobile signals are the main interference sources. Adaptive modulation is very important.
 - Interferences are different in different sites.
 - Interferences may change from time to time.
- The echo power/delay of micro-reflections is much weak in Node+0/1 networks.
 - The strongest echo power in 0.2us is -20dBc at 1GHz spectrum
 - The micro-reflections are serious at 1G~1.3GHz spectrum, but is also about -10dBc
 - We did some measurement and had similar results.
- The connector caused problems are very common. And the in home networking qualify is still need to do further investigation.

Service provisioning

- The application of EPoC is the same with EPON+EOC
 - Mainly for residential services in China
 - Not used for business services.
- Main services need to support
 - Interactive TV, Internet access, and related service including online games, IPTV, network video
 - Small amount of VoIP services

QoS requirements

- Recommended
 - PER 0.1%
 - Delay \leq 20ms
 - Jitter \leq 10ms.

Rate (Mbps)	PER	BER
4	0.74*1E-6	0.56* 1E-9
10	0.29*1E-6	0.22* 1E-9
40	0.74*1E-7	0.56* 1E-10
80	0.37*1E-7	0.28* 1E-10

Conclusion

- common requirements from Chinese MSOs
 - Scenario: N+0/N+1, rarely with N+2
 - For residential services.
 - Available spectrum: 750/860M~1200/1300MHz
 - Data rate: CLT 1Gbps or beyond, CNU 100Mbps~1Gbps
 - Duplex: FDD+TDD
 - CNU number: 1GEPoC less than 128 CNUs, 10GEPoC less than 512 CNUs
 - CLT/OCU Architecture: Relay/bridge/half-bridge are all acceptable. The most important is compatible CNU and management.
 - DOCSIS/EPoC/HiNoC unify

Thank you!