SCTE ISBE CABLE-TEC EXPO® '16

SEPTEMBER 26-29 PHILADELPHIA

Decision-Making & Business Modeling for Selection of Gigabit Service Delivery Solutions

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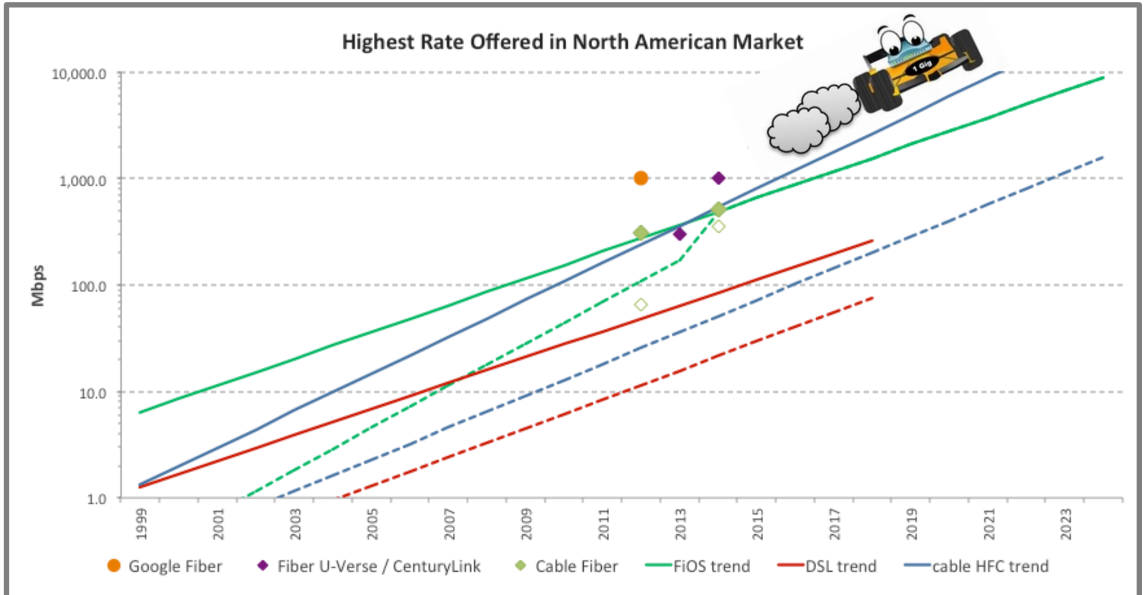
#CableTecExpo

Essential Knowledge for Cable Professionals™

The “Need for Speed”

- Access network upgrades are required for operators to meet rapidly increasing consumer data demand for 1 Gbit/sec and higher Internet speeds
- Efficient, data-driven decision-making is necessary to meet consumer demand for faster speeds



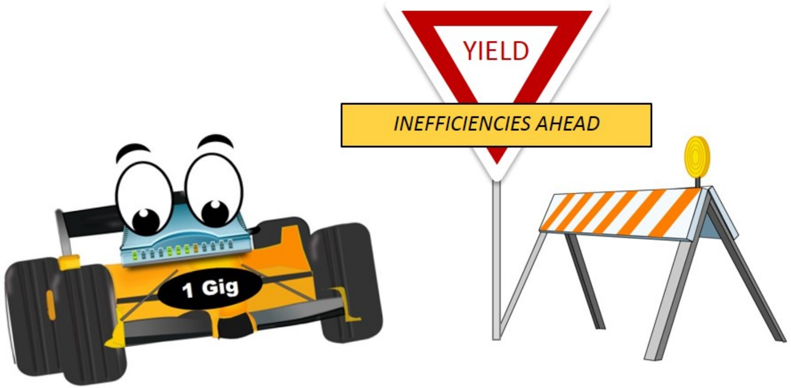
- *Solid lines indicate DS speed demands*
- *Dotted lines indicate US speed demands*
- *Points indicate speeds delivered by various service providers*

Decision-Making Inefficiencies

Due to rapidly changing consumer demands, increasing demand for higher speeds, and faster technology cycles; adopting a standardized decision-making and data modeling process can reduce inefficiencies.

Inefficient decision-making processes may lead to decisions which:

1) Do not meet requirements
2) Over-meet requirements
3) Exceed budget
4) Prolong timeline
5) Have unexpected & unintended impacts
    a. additional costs
    b. service loss
    c. equipment compatibility issues

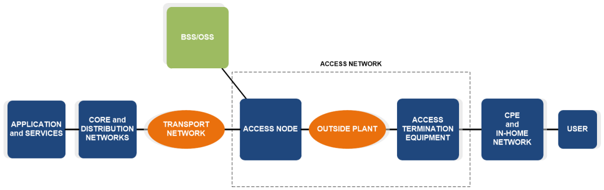


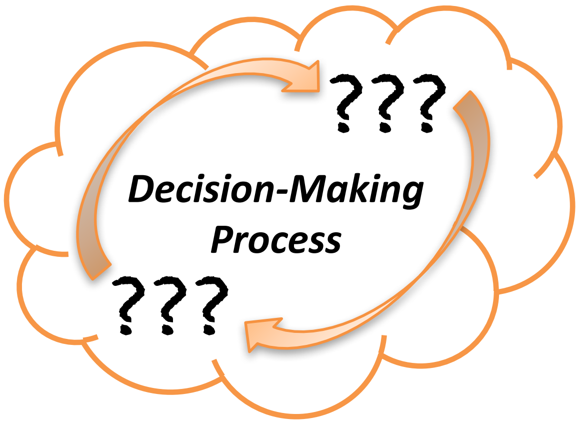
Decision-Making & the "Need for Speed"

1. How can an operator determine which Access Network solution is most cost effective, given a particular set of requirements?

2. How can the capabilities and costs of different Access Network technologies and different vendor solutions be ***<u>normalized for comparison in a way that is understandable across functional areas</u>*** (by both engineers and non-engineers alike) for the purposes of more efficient and effective decision-making?

Network Upgrade Options





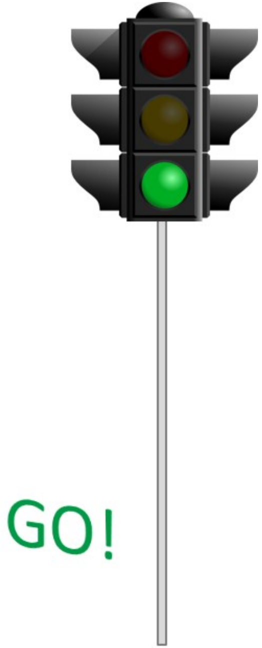
Satisfied Customer

Efficient & Effective Decision-Making Processes

An effective and efficient decision-making process will be:

- ✓ Cross-functional & collaborative
- ✓ Founded on an analysis using a standardized cost modeling methodology that translates data, requirements, and constraints from 1) all impacted functional areas, and 2) all technologies under consideration for addition to the network, into metrics that are understandable by *all* functional areas involved

Results → A data-driven decision based on output metrics from a comprehensive model



Recipe for Building a Cross-Functional Team

To build an effective cross-functional decision-making team, you will need:

1) Representatives with ***decision-making authority from impacted functional areas*** Engineering, Finance, Operations, Supply Chain (and other company/project-specific functional areas relevant to the decision)
2) A ***project sponsor*** with the authority to weigh tradeoffs between functional areas and act as a "tie breaker" if necessary to make a decision that benefits the company as a whole
3) Someone who can own the data model and who ***understands/speaks the languages of multiple functional areas***

Note: This person doesn't need to be an expert in other functional areas or in data modeling, but they must have the drive, desire, and confidence to learn

Case Study Steps & Model – Step 0 (pre-work)

Once your cross-functional team is in place, identify:

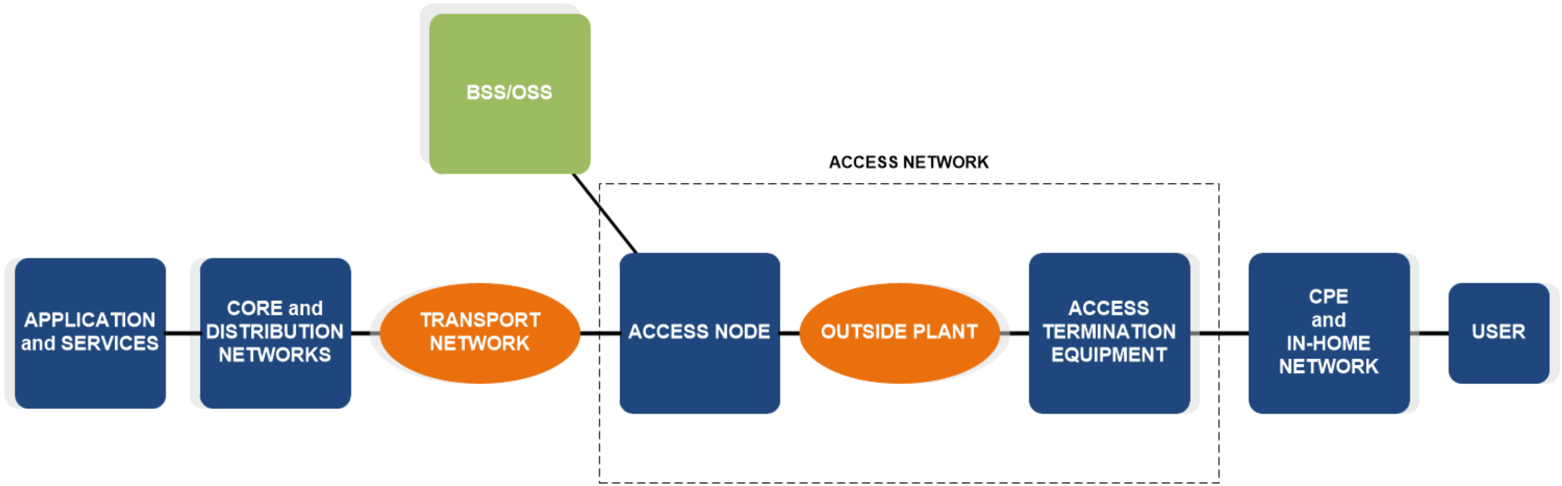
1) The decision to be made
2) The objective to be achieved by making this decision
3) An initial strategy for achieving this objective
4) Relevant decision-making criteria

Case Study Scenario:

- Small suburban greenfield deployment (150 subscribers)
- Goal: Build a 1 Gbit/sec capable network with the highest probability of technical success at a reasonable cost. Network must also be capable of delivering 2 Gbit/sec within the next 1-2 years, and 5 Gbit/sec by 2020 (3.5 yrs from now)

Case Study Steps & Model – Step 1

Step 1 – Document Network Architecture: Document the ***current state*** and ***future state*** network architecture to support transition to gigabit service delivery.



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Case Study Steps & Model – Steps 2 & 3

Step 2 – Document Technical Requirements: Document the technical requirements necessary to achieve gigabit service delivery.

Example Technical Requirements:

- Max Service Tier = 1Gbit/sec
- 5 Year Max Service Tier = 5Gbit/sec
- Max Tier: Network Capacity Ratio = 1:2
- Underground Construction

Step 3 – Identify Gaps & Document Future State: Identify and document the gaps/changes required to move from current state to future state network architecture, as well as any network constraints.

Case Study Steps & Model – Step 4

Step 4 – Identify Solution Technologies: Identify technologies to bridge gaps and meet technical requirements associated with upgrading the network.

Case Study Possible Solutions:

- DOCSIS 3.0 – DOCSIS 3.1 is preferred due to efficiency and long term capabilities
- DOCSIS 3.1 – Production-ready equipment just emerging, Capable of reaching short term capacity requirements, questionable path to 10Gbit/sec capacity
- GPON (and variants) – Meets short-term capacity, does not have adequate support for legacy cable OSS/BSS
- 10G EPON – Meets short-term and long-term capacity requirements, DPoE enables support for legacy cable OSS/BSS

Case Study Steps & Model – Step 5 (pre-work)

Excel Data Modeling Best Practices:

- **Structure** – ***Organize your workbook and data logically***, grouping like inputs & outputs together. Group and order the tabs of your workbook so information is easily accessible. Keep all your data and analyses for the project in ***one workbook***.
- **Labels** – Name your columns, rows, and tabs in a ***meaningful & easily understandable*** way.
- **Inputs** – To create a dynamic model, ***enter model inputs and quantitative assumptions only once***, then reference these inputs in formulas throughout the model. This will enable you to easily change an input or assumption and calculate an updated output.
- **Assumptions** – ***List all assumptions*** in the model (quantitative & qualitative). It is best to have all assumptions and inputs near each other in the model for rapid retrieval and ease of updating.
- **Identification** – Use pre-determined ***text colors to indicate the source of information in a cell***. For example, use text colors to indicate when a cell:
  - Contains a ***hardcoded*** number
  - Pulls from or ***references*** another sheet
  - Results from a ***formula*** or calculation*

** Note: choosing black for formulas/calculations is recommended, since most cells will be formula driven in a model*

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Case Study Steps & Model – Step 5

Step 5 – Develop Model: Enter technical requirements, assumptions, and other inputs to data model.

- ✓ Structure your model so it is easy for you to use and also easy for decision-making process stakeholders to understand and locate information.
- ✓ Assumptions & general inputs for model calculations are on a single tab.
- ✓ Formulas link to inputs and assumption values. Don't retype the same input multiple times!

	A	B	C	D	E	F
37			**Inputs**			
38				**EPON**	**DOCSIS**	
39			Max active cards per chassis	8	10	
40			Max active cards per chassis - DS		6	
41			Max active cards per chassis - US		4	
46			Ports per card - DS	8	8	
47			Ports per card - US	8	16	
49			Max ports per chassis - DS	64	48	
50			Max ports per chassis - US	64	64	
52			Port capacity - DS	10	1.216	*Gbit/sec*
53			Port capacity - US	10	0.044	*Gbit/sec*

Example inputs tab: Organized, well-labeled, and color coded inputs for use in formulas

Example workbook structure & tab color coding

Summaries -->> | Executive Cost Summary | Metrics - Access Node (AN) | Data -->> | Reqs, Inputs, Assumpt's | CCAP BOM

Case Study Steps & Model – Steps 6 & 7

Steps 6 & 7 – Create Bills of Material (BOMs): Identify the relationships between equipment components and requirement fulfillment. Based on requirement fulfillment and technology/equipment-specific constraints, create a BOM to represent the "standard configuration" for each technology, use case, and vendor option under consideration.

Part Number	Component Type	Description	Unit Price*	Qty	Ext Price*
123 Chassis kit	Chassis Bundle	*<fill in with supplier description>*	1,000.0	1	1,000.0
123 Linecard	Linecard	*<fill in with supplier description>*	350.0	1	350.0
123 Pluggables	Pluggables/Cords	*<fill in with supplier description>*	50.0	8	400.0
					1,750.0

**All costs are shown in terms of DOCSIS cable modems*
1 cable modem = 1 unit

BOM quantities are calculated using values from inputs tab.

Sample Excel formula:
=ROUNDUP(SubsInDeploymentArea/SubsPerPONPort/DSPortsPerPONCard,0)

Case Study Steps & Model – Steps 8, 9,10

Step 8 – Calculate Units of Capacity: Identify, quantify, and ***calculate the units of capacity*** provided by the standard configuration (e.g., gigabits per chassis).

Step 9 – Create "Cost Equivalency" Metrics: Use solution-specific data to ***normalize costs between technologies and vendors*** and calculate an equivalency metric, such as cost per measure of capacity (e.g., cost per gigabit) to serve as a way to compare all technologies and vendors under consideration.

Step 10 – Enhance Model: Once a cost equivalency metric is created for the technology equipment under consideration to be the foundation of the access network upgrade the ***model can be expanded to include other costs***, including: Maintenance, Outside plant (OSP) buildout/upgrade, etc.

Case Study Steps & Model – Step 11

Step 11 – Summarize & Present: Summarize model outputs for presentation to facilitate decision-making.

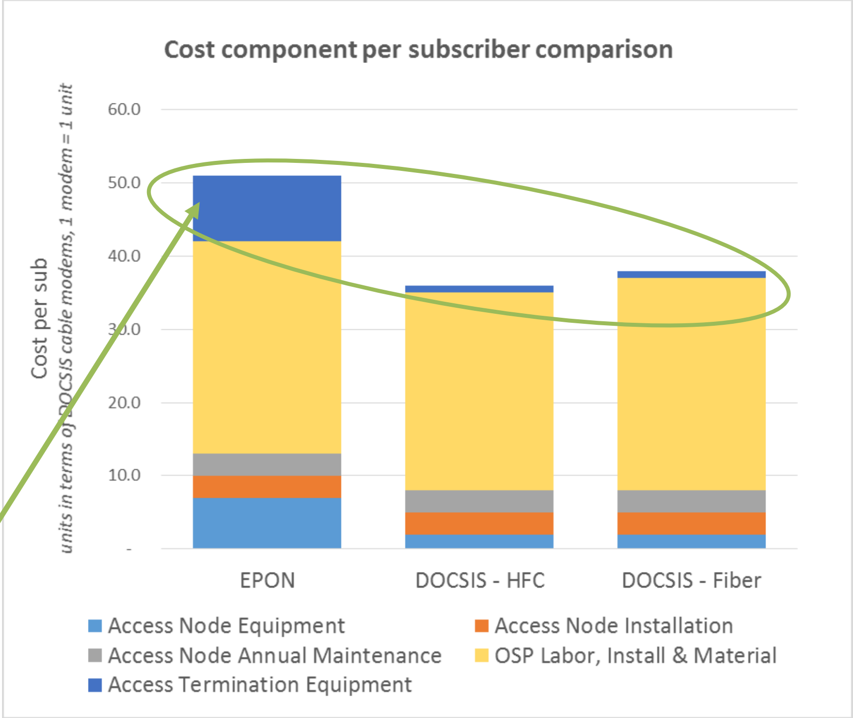
Cost Comparison

Total Cost* per Sub *(1 Gbit/sec service)*	EPON	DOCSIS
HFC		36.0
Fiber	51.0	38.0

**Costs are shown in terms of DOCSIS cable modems, 1 cable modem = 1 unit*

Comparing total costs for each technology shows deploying EPON is ~35% higher than deploying DOCSIS
Total = Access Node + OSP + ATE/CPE

Looking at a breakdown of cost by component, we see ATE pricing (EPON ONU) is a key driver of the cost difference between solutions



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Case Study – Decision Factors

Based on the case study model outputs, there are several questions to consider in making a final decision:

1) Which solution has the lowest cost to implement today?
2) Which solution has the lowest Total Cost of Ownership?
3) How long will the solution meet the requirements before an upgrade or replacement is necessary?
4) What level of oversubscription is tolerable today and in the future?

Case Study – Decision Factor Summary

Decision Factor	Solution (Access Node + OSP)		
	EPON + Fiber	DOCSIS + Fiber	DOCSIS + HFC
Cost per sub today to meet 1 Gbit/sec requirement	~35% higher than DOCSIS	Low	Low
Upgrade(s) required to meet 2 Gbit/sec w/in next 1-2 years?	None	Yes, upgrade to D3.1	Yes, upgrade to D3.1
Upgrade(s) required to meet 5 Gbit/sec w/in next 3.5 years?	None	Unknown	Unknown
Current oversubscription rate	Low	High	High
Future oversubscription rate	Low-Med	High	High

DOCSIS options require upgrading to D3.1 (additional cost) and involve several unknowns, which increases risk. There is also the potential the solution will not meet future technical requirements

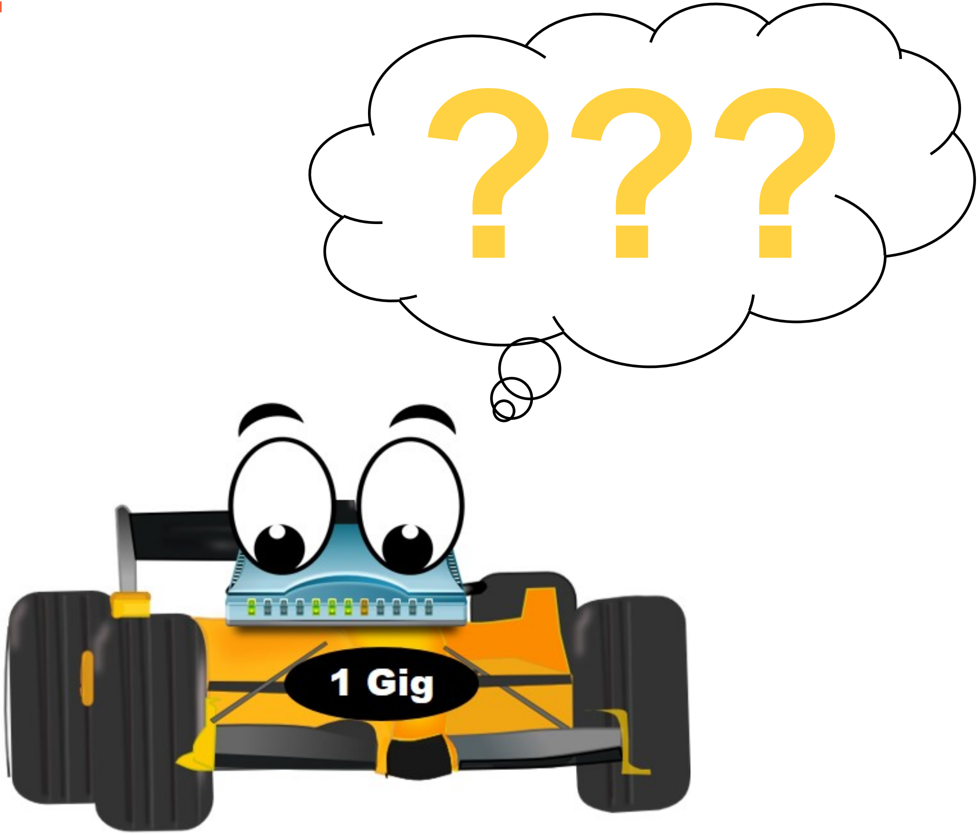
At its current price point, deploying EPON has a higher up front cost than DOCSIS; however, no upgrades are required to meet expected speed demands through 2020 and there are no identifiable uncertainties

Case Study – Decision Factor Summary

Our recommendation:
Balance today's cost with current & future technical requirements. Consider what it will cost to achieve future speed requirements and the uncertainties associated with each technology option.

- ✓ Select EPON due to its ability to meet both current & future technical requirements, low oversubscription rate, and lower risk due to fewer unknowns
- ✓ Negotiate with vendor(s) for lower ONU pricing. Leverage volumes and potential for additional future deployments to bring per unit pricing to a more reasonable level

Questions?



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