

THE FUTURE IS ACCESS...™

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Deploying All-Optical Access Networks

Architectures & Implications

Ethernet in the First Mile - July 2001

IEEE 802.3 - Seattle, Washington

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Corning Cable Systems**

Agenda

- **Access Network Architectures & Designs**
 - *Local Convergence (LCP)*
 - *Distributed Splitting*
- **EFM Network Cost Modeling**
 - *Local Convergence Analysis*
 - *Distributed Splitting Analysis*
 - *Architecture Comparison*
- **EFM Leverage Points**
 - *Deployment 'Criteria of Success'*

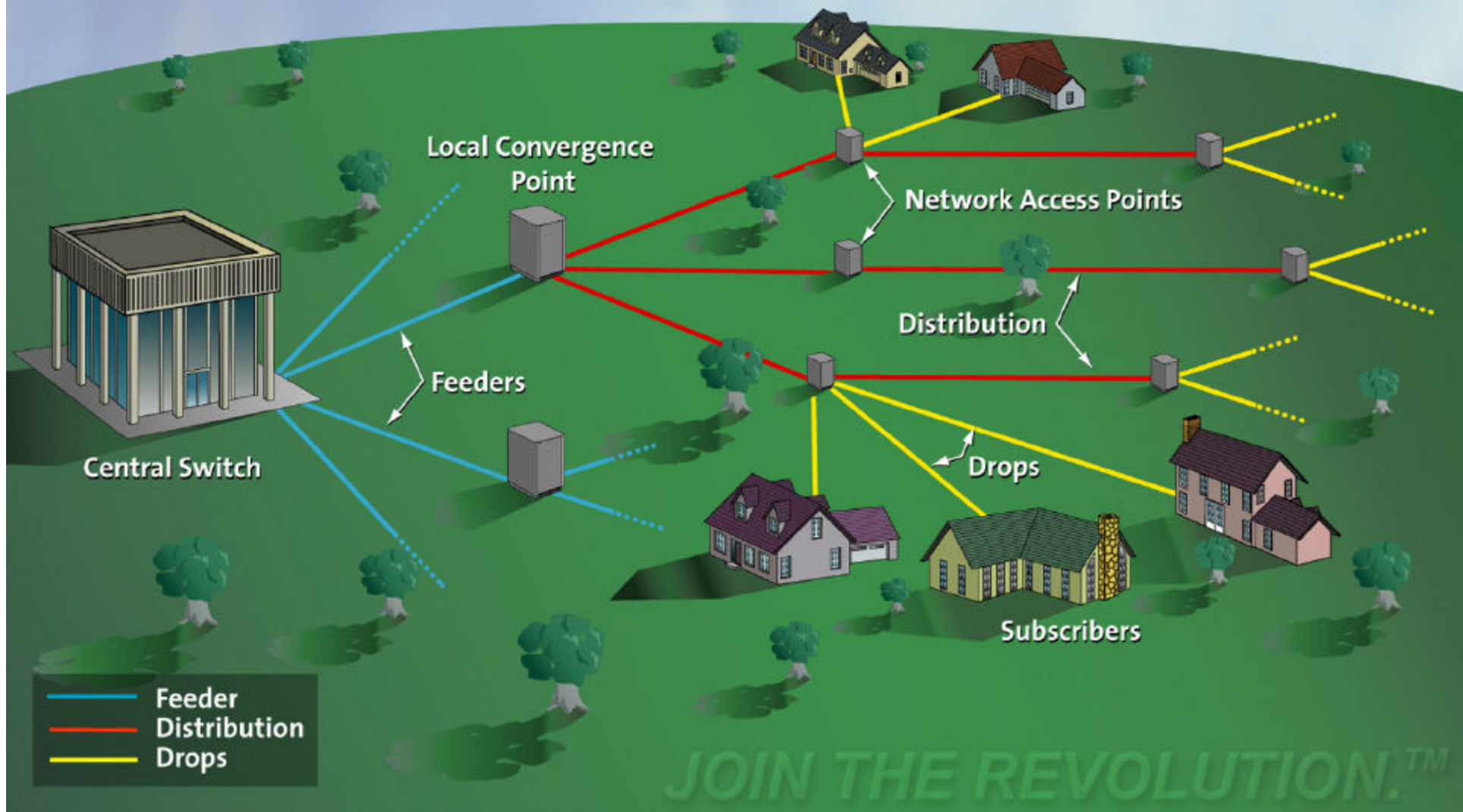
Objectives for Access Network Designs

- ***A Future-proofed OSP Network***
 - *Reliability*
 - *Scalability*
- ***Network architecture ubiquitous to Protocol***
 - *Adaptable to future equipment upgrades*
- ***Minimize network installation complexity***
 - *Pre-Stubbed Hardware & Equipment*
 - *Connector Technology (Hardware+Cable)*
 - *Mass fusion splicing*
- ***Minimize up-front CAPEX investment***
 - *Defer as much CAPEX to subscriber turn-up as possible*
- ***Reduce Life-Cycle Costs***
 - *Minimize powering costs*
 - *Reduce maintenance requirements & truck rolls*

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Generic Access Layout

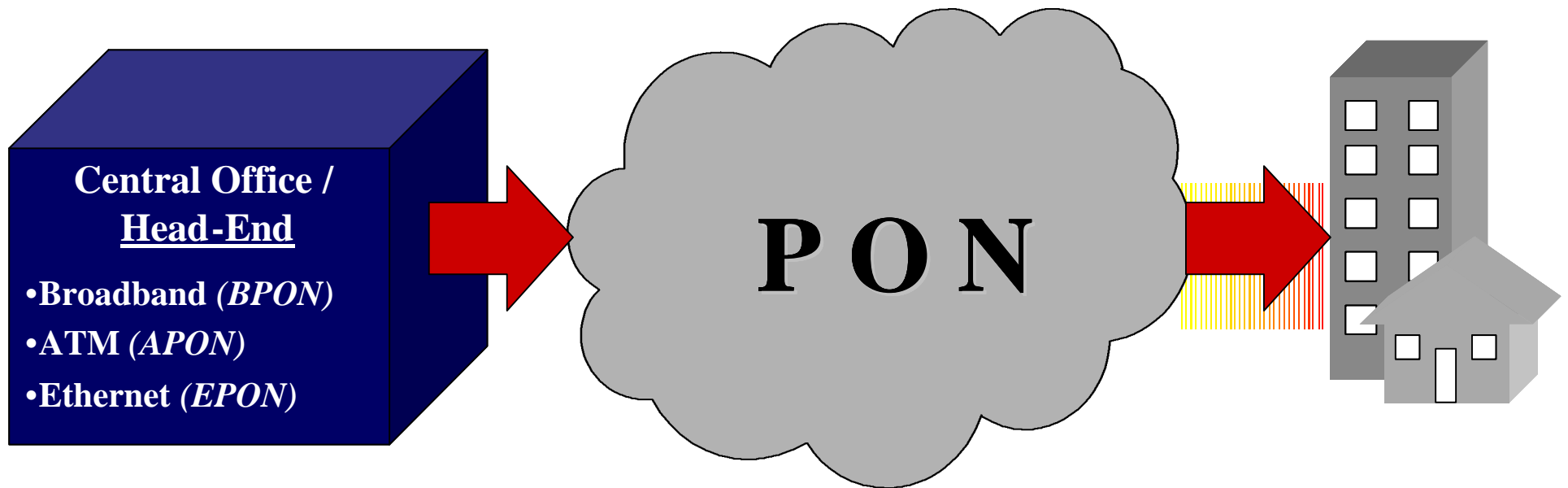
EFM Architectural Models



PON & P2P Architectural Models

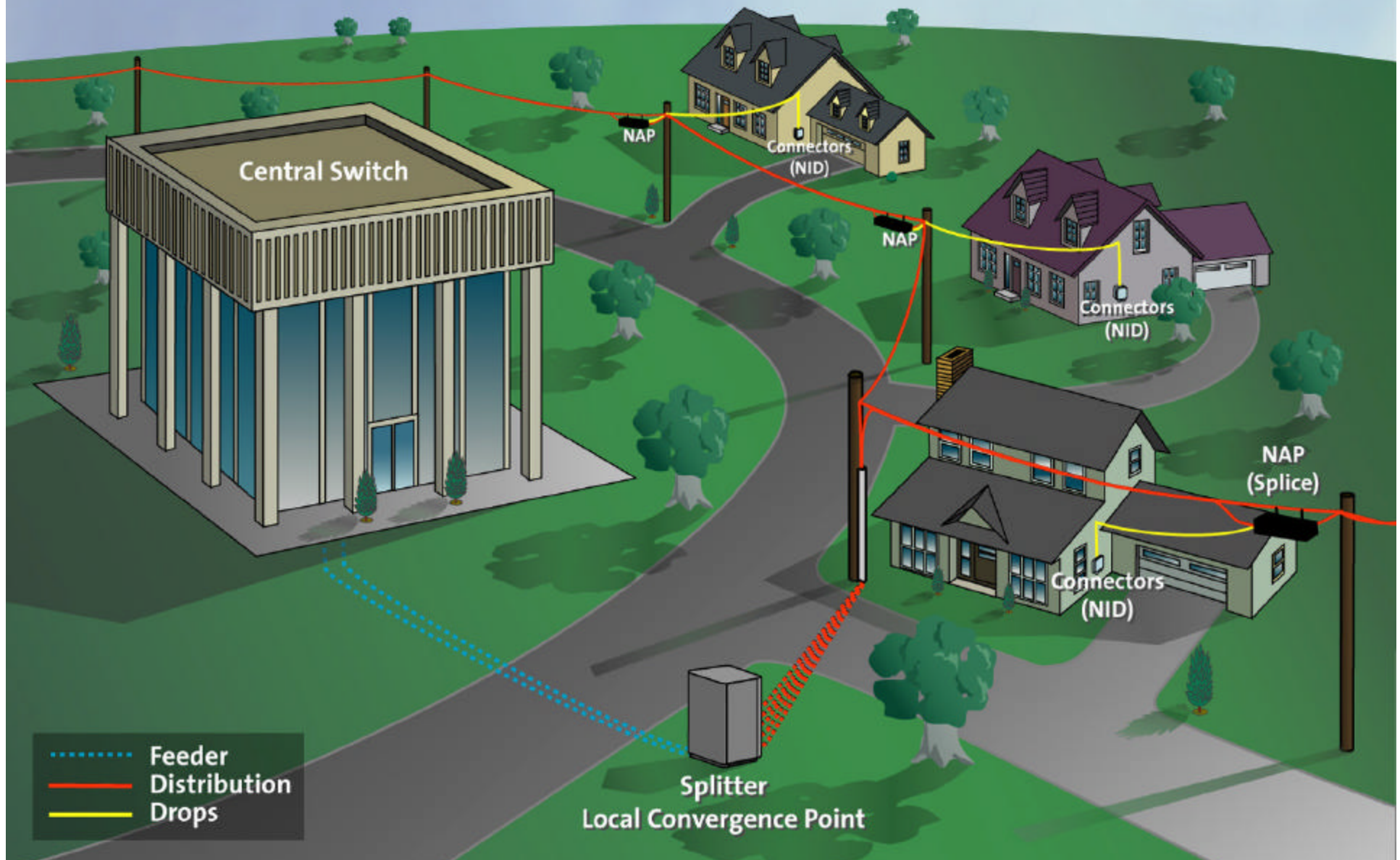
Two Primary EFM Designs

- 1. Local Convergence*
- 2. Distributed Splitting*



Architectural Models

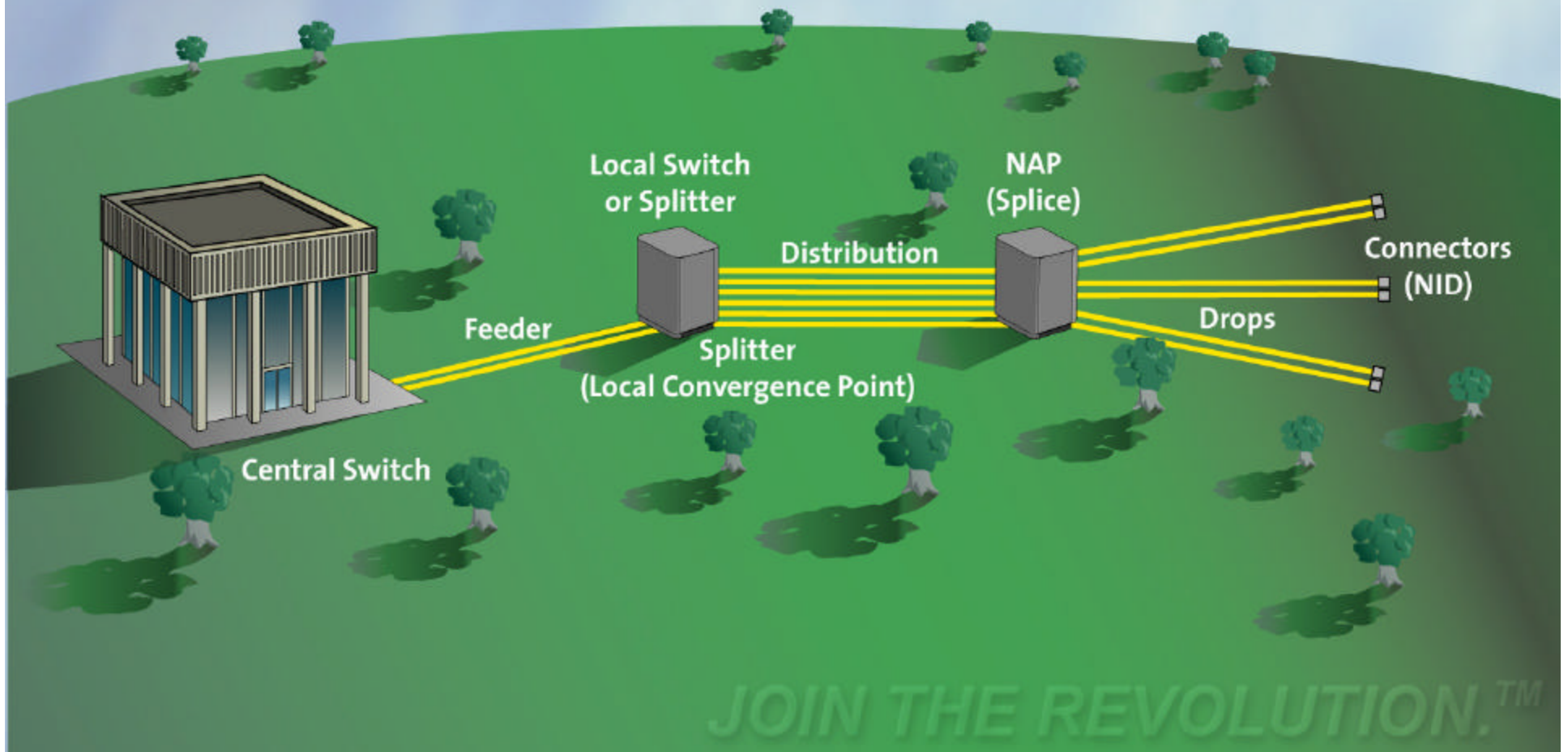
Local Convergence (LC)



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Architectural Models

Local Convergence (LC)



Architectural Models

Local Convergence (LC)

Pros:

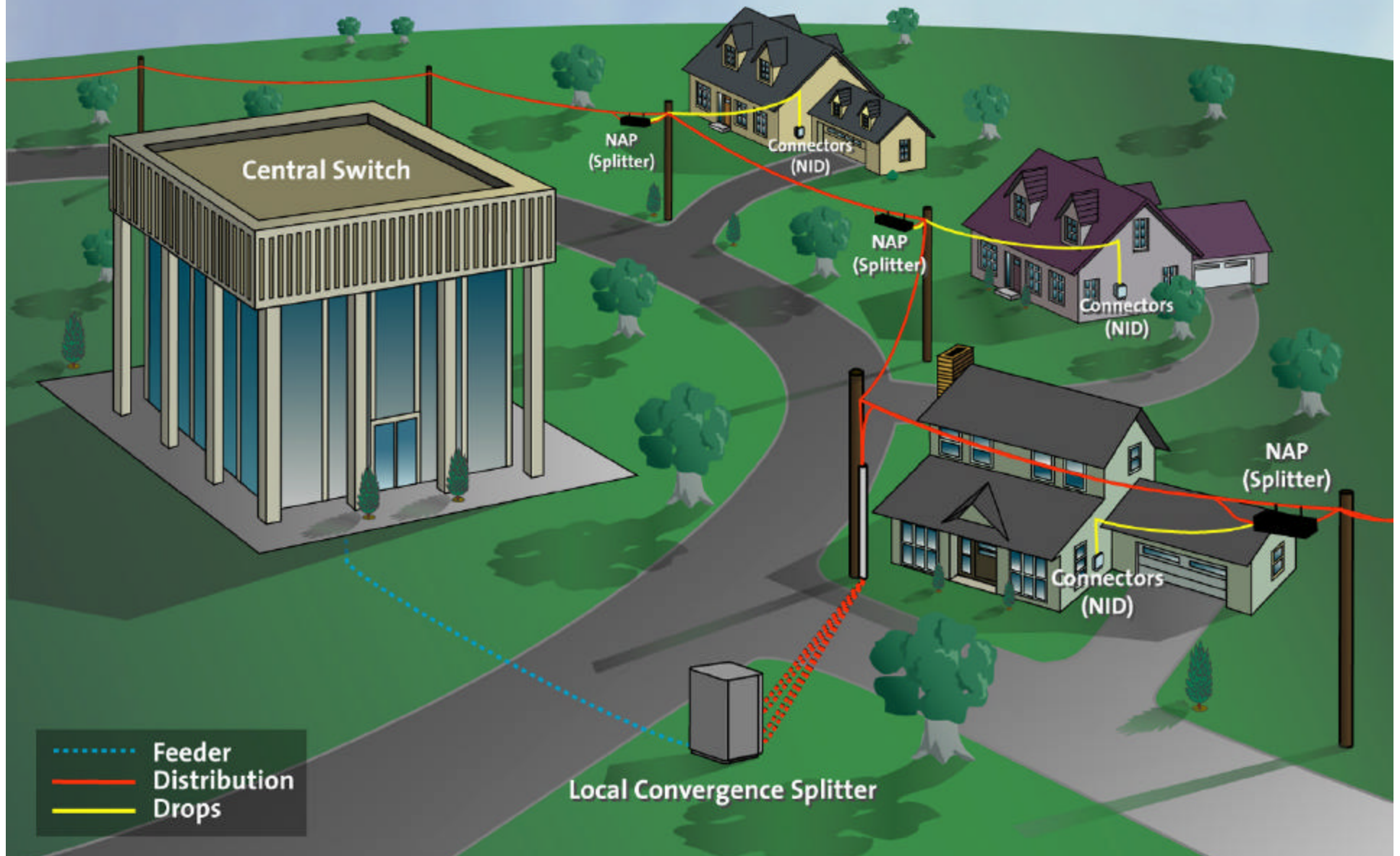
- **Local Convergence Consolidates Subscriber Configuration**
 - *Ability to service 32-1280 Subscribers per LCP*
 - *Ability to house Passive Splitters or Active Electronics at LCP*
- **Maximizes Port Utilization for low penetration rates**
 - *Enables port-by-port assignment of subscribers - minimizing couplers*
- **Balances network scalability with up-front CAPEX**
 - *Fiber-lean Feeder System - Fiber-rich Distribution & Drop System*
 - *Provides dedicated Optical Path from LCP to Subscribers*

Cons:

- **May cause fiber density / footprint issues for dense deployments**
 - *Can be negated by covering fewer homes per LCP*

Architectural Models

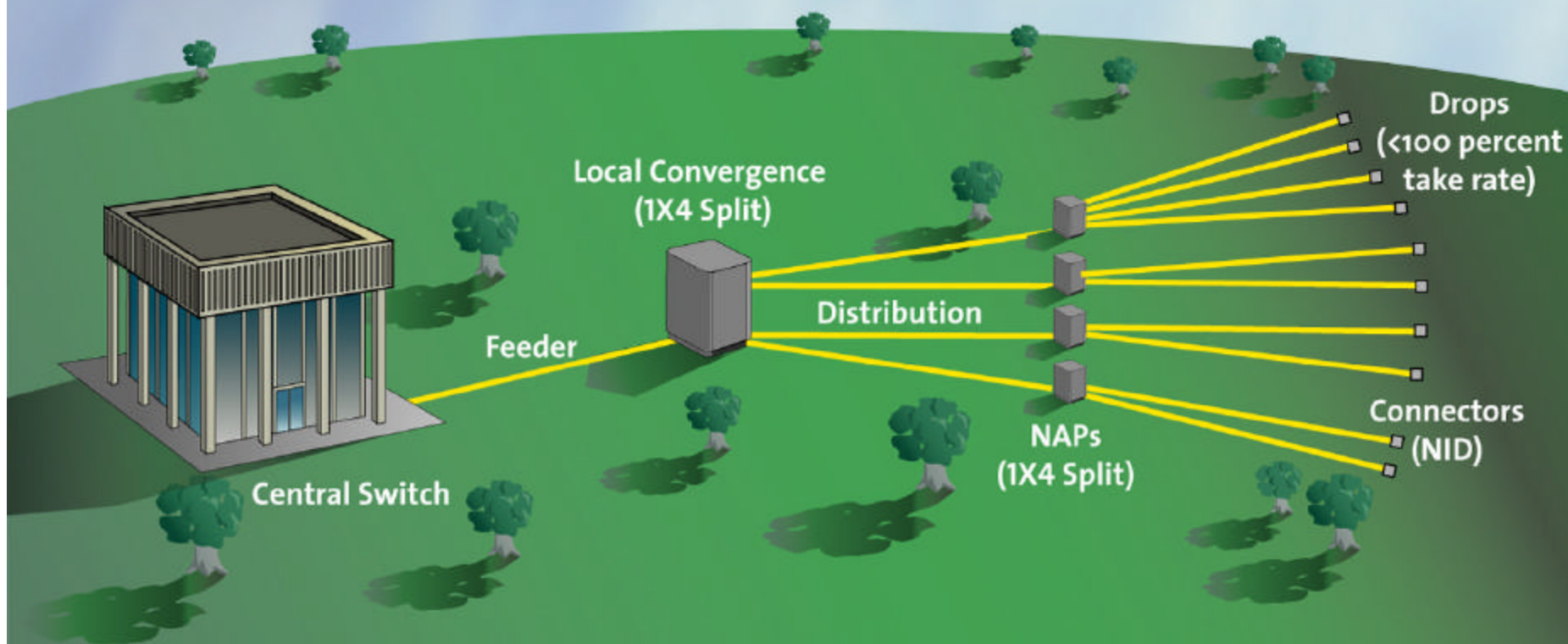
Distributed Splitting



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Architectural Models

Distributed Splitting



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Architectural Models

Distributed Splitting

Pros:

- **Minimizes amount of Fiber required to Deploy**
 - *Reduces up-front cable CAPEX requirements*
 - *Uses Fiber-lean Feeder and Distribution System*
- **Utilizes low-port count Couplers & Splitters**
 - *Two Tier Splitting in NAPs and LCPs*
 - *Reduces footprint requirements for splice closures/enclosures*

Cons:

- **Potential Limitations on Bandwidth and Scalability**
 - *No Single Configuration or Adaptation Point*
 - *High splitting ratio may limit future network scalability*
- **Reduced Port Utilization for low penetration rate areas**
 - *Increases requirements for couplers & splitters*
- **No cost-effective network migration path**

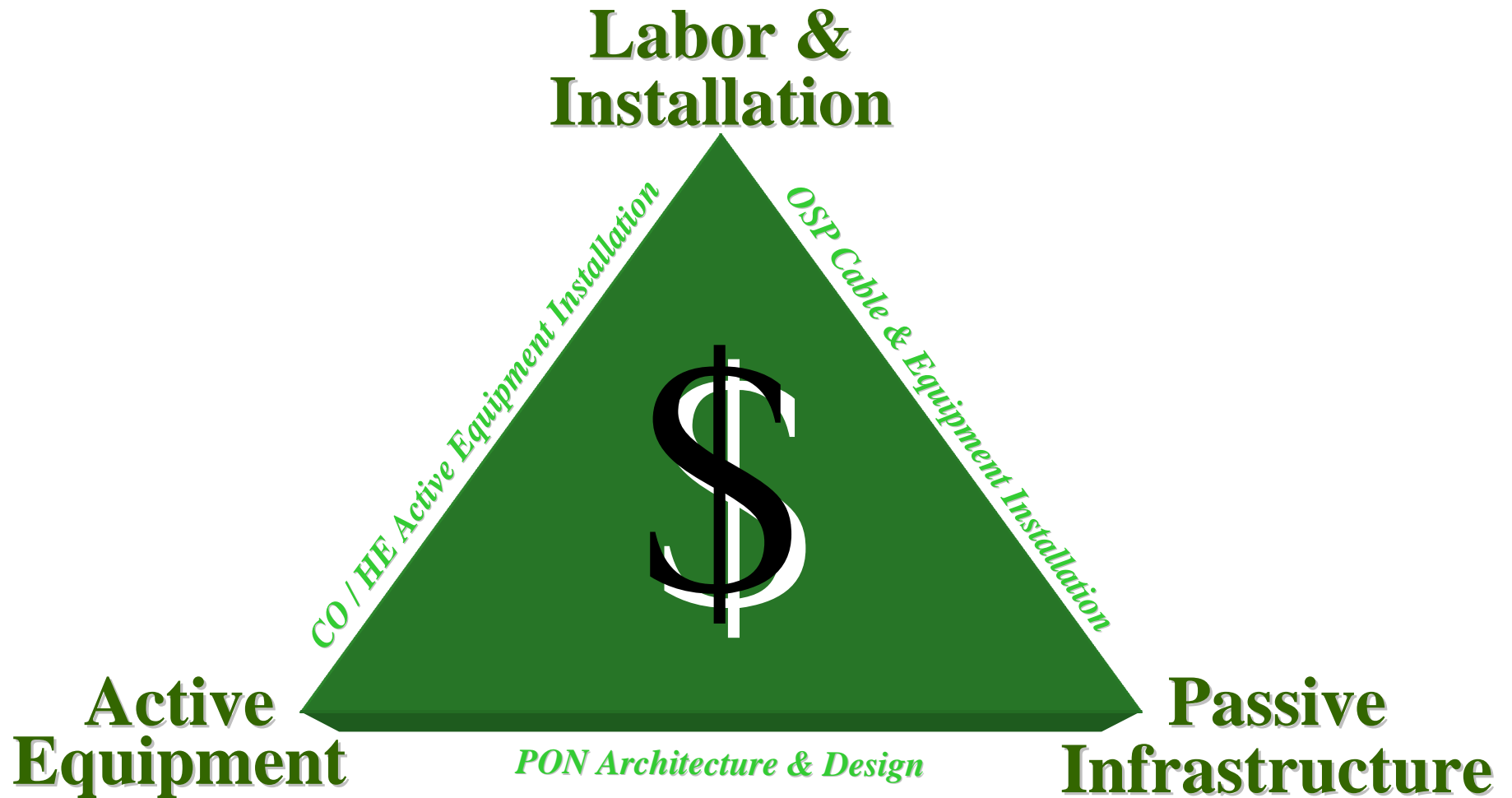
Access Deployment Cost Analysis

Cost Modeling Objectives

- **Analyze cost drivers for PON deployments**
 - *Cable + Hardware & Equipment*
 - *Installation / Labor Costs*
- **Understand in-direct cost relationships**
 - *Subscriber penetration rate*
 - *Homes per LCP; Homes per NAP*
 - *Varying splitter Architectures*
- **Compare costs/benefits of PON architectures**
 - *Identify cost trade-offs of LC architecture vs. Distributed Splitting*

Access Deployment Cost Analysis

Initial Deployment Cost Drivers



Access Deployment Cost Model

Deployment Cost Driver Coverage

Model includes the following cost drivers:

- **Optical Cable Costs**
 - *Feeder, Distribution, Drop, Cable Assemblies, etc.*
- **Passive Hardware & Equipment Costs**
 - *Couplers/Splitters, Connectors, Enclosures, Splice Closures, Racks/Trays/Cassettes, etc.*
- **Installation & Labor Costs**
 - *Cable Prep & Installation, Hardware Installation, Splicing, Termination, etc.*

Model does not account for the following costs:

- **Active Equipment Costs**
 - *Switch, Opto-Electronics, Transceivers, Converters, etc.*
- **Rights of Way**
 - *Acquisition costs, Legal Fees, Insurance, Make Ready, etc.*
- **Life-Cycle Costs**
 - *Powering, Incremental Maintenance Calls, Truck Rolls, etc.*

EFM Cost Modeling

- **Understand Deployment Costs & Drivers for each Access network architecture & design**
 - *Cable, Hardware, and Labor*
- **Provide variable analysis for varying Demographics**
 - *Low-, Medium-, and High-Density Subscriber Areas*
 - *Varying Labor & Infrastructure Costs*
- **Compare Costs of LC & DS Architectures**
 - *Cost per Subscriber*
 - *Cost per Home Passed*

Deployment Scenario: 5,000 Home Residential Area

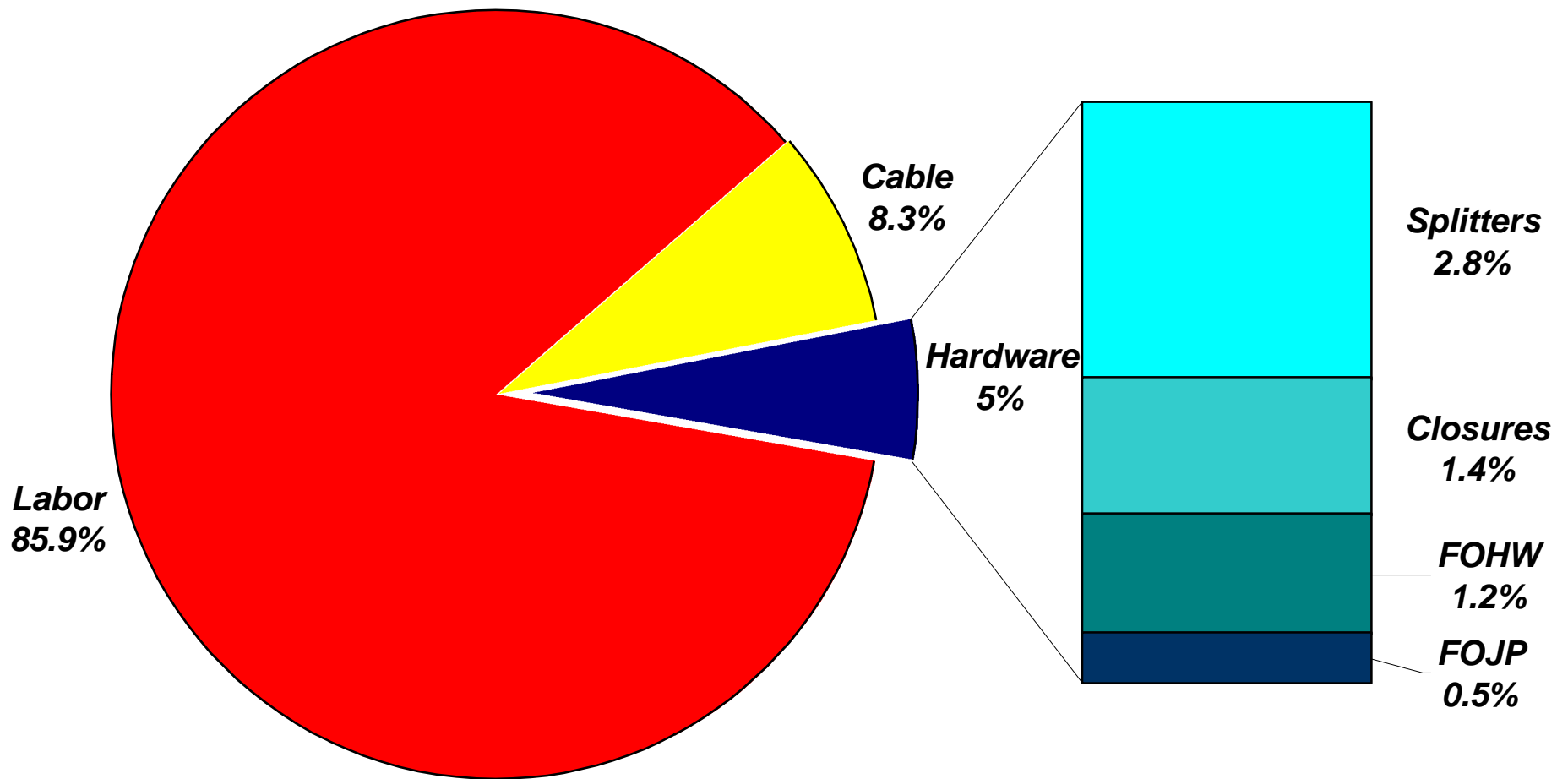
	Low Density	Medium Density	High Density
Feeder Length	4 miles	3 miles	2.5 miles
Homes per LCP	200 Homes	325 Homes	450 Homes
Homes per NAP	4 Homes	6 Homes	8 Homes
Average Lot Size	.74 Acre	.59 Acre	.39 Acre
Cable Installation Cost	\$7.50 / Foot	\$10.00 / Foot	\$12.50 / Foot

Distributed Splitting Cost Analysis

Deployment Cost Analysis

Distributed Splitting Architecture

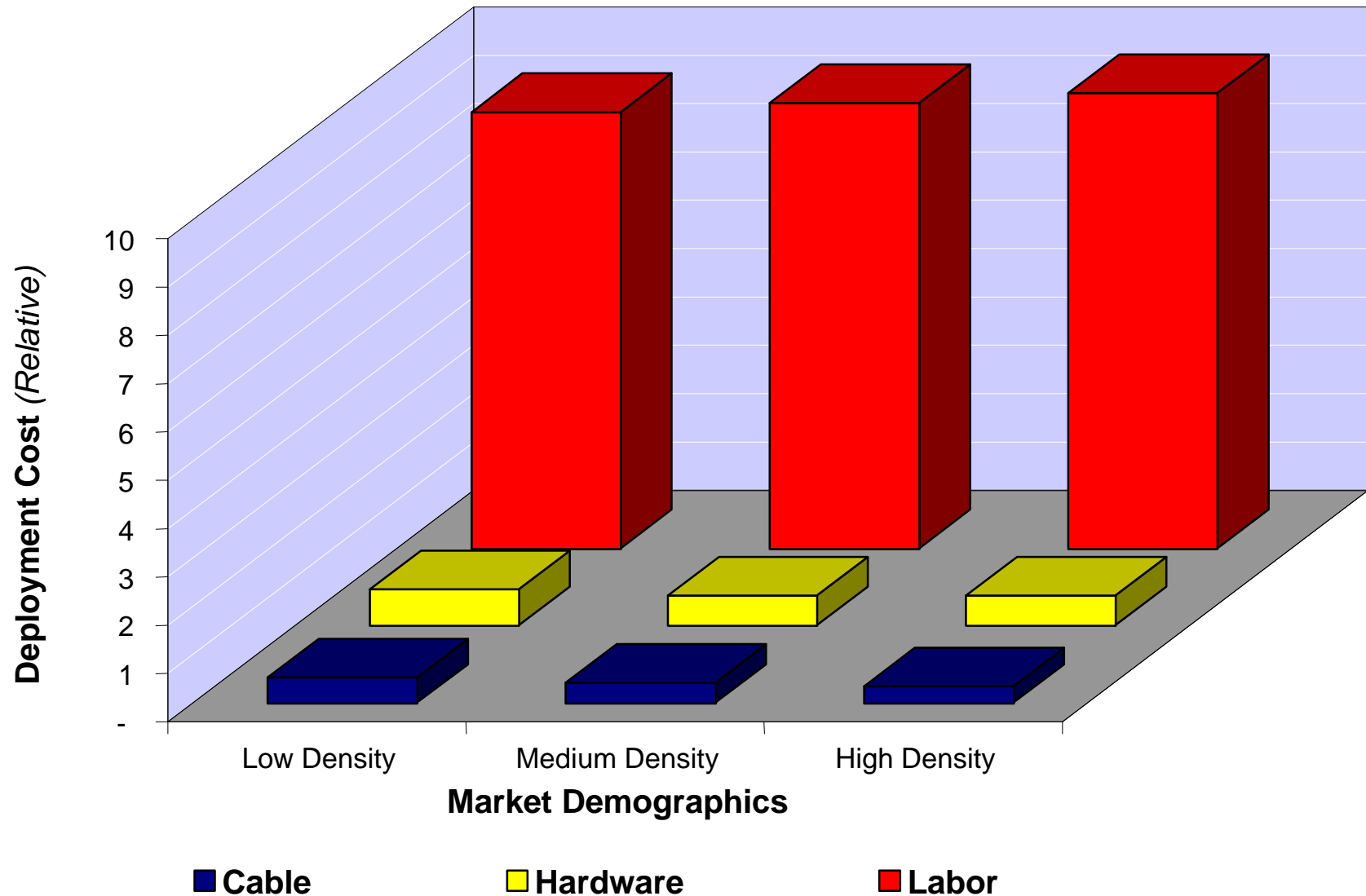
30% Penetration - Medium Density



Distributed Splitting Cost Analysis

Deployment Cost Analysis

Distributed Splitting - 30% Penetration

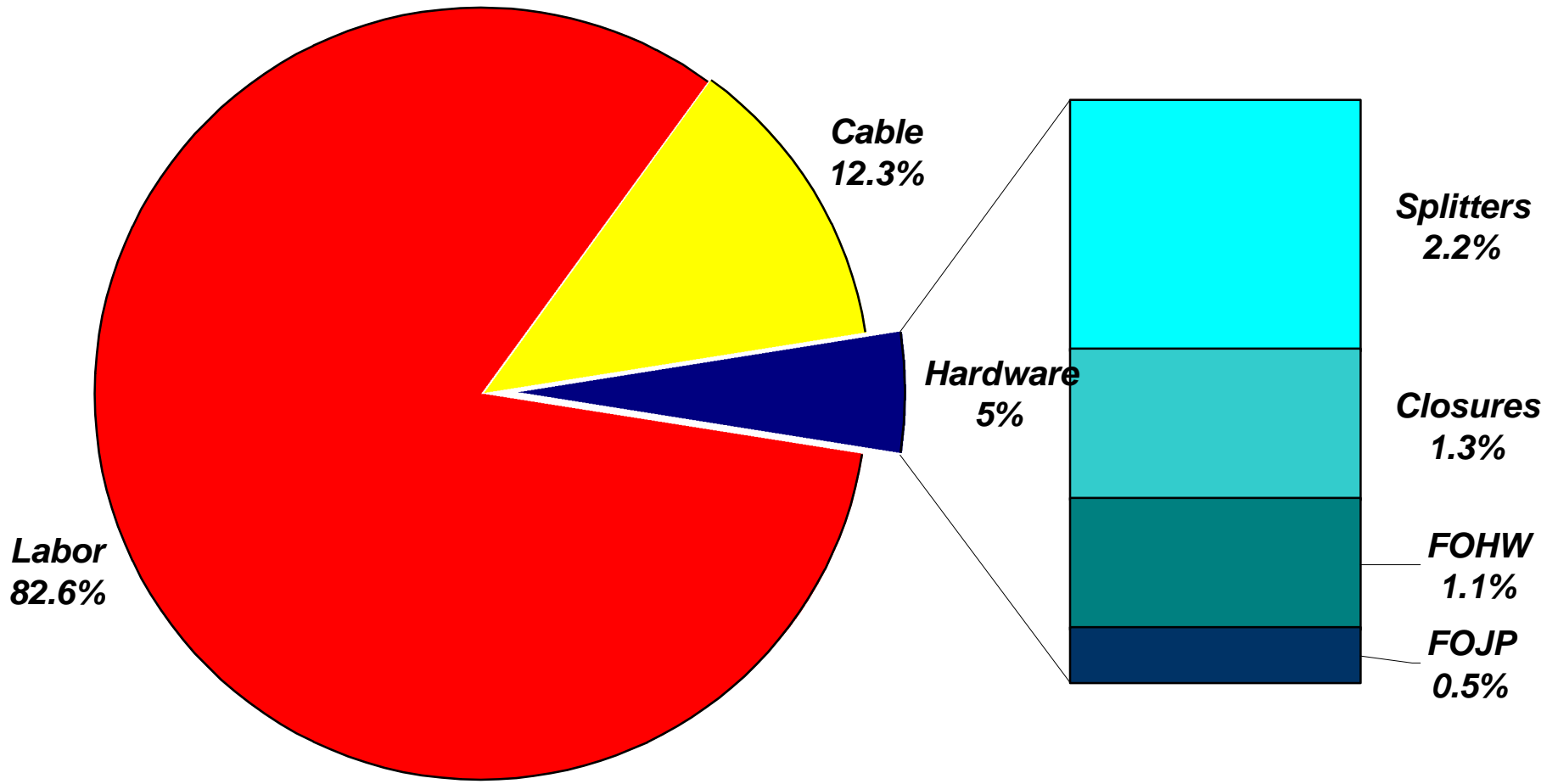


Local Convergence Cost Analysis

Deployment Cost Analysis

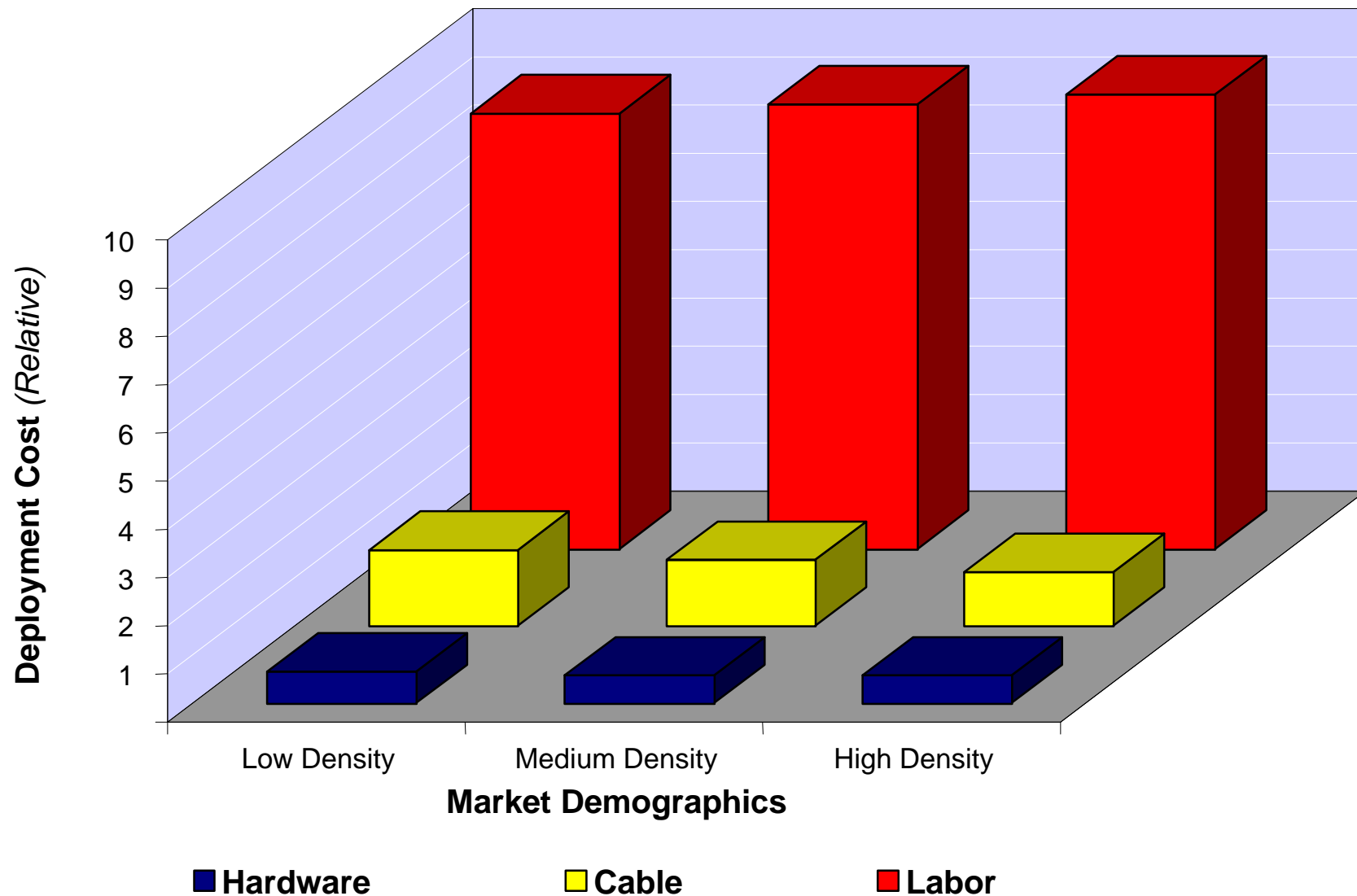
Local Convergence Architecture

30% Penetration - Medium Density



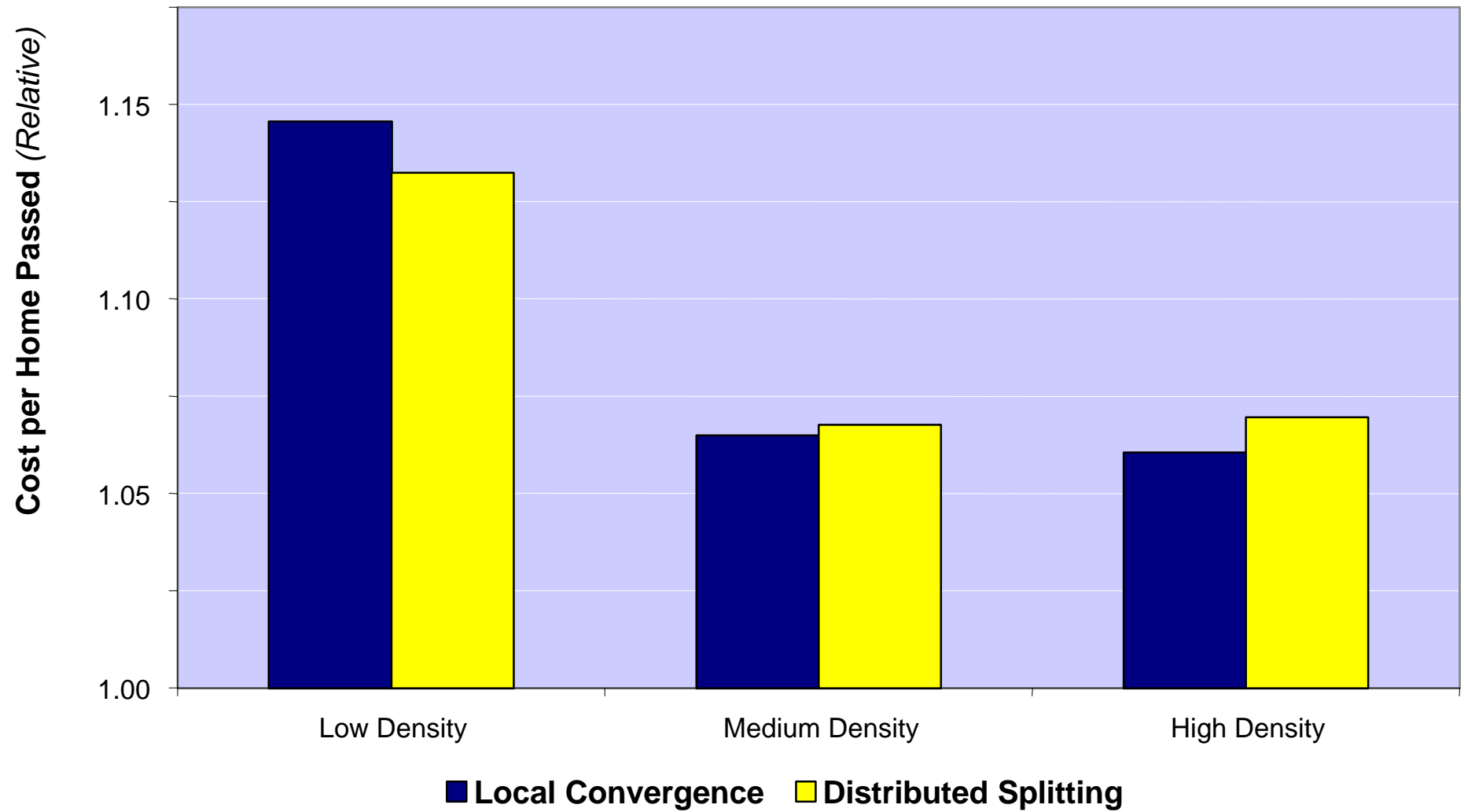
Local Convergence Cost Analysis

Deployment Cost Analysis
Local Convergence - 30% Penetration



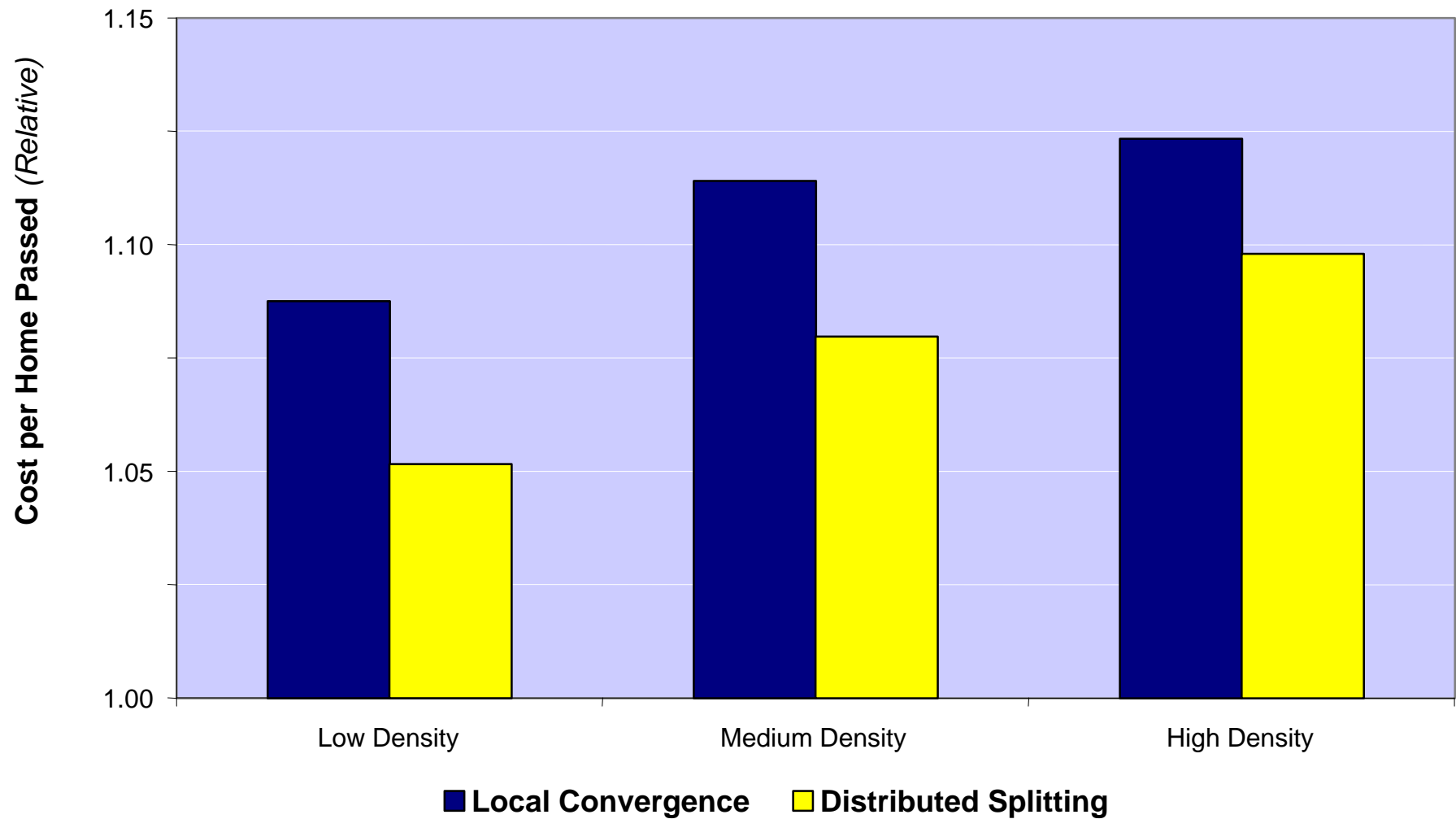
Cost per Home Passed

30% Subscriber Penetration



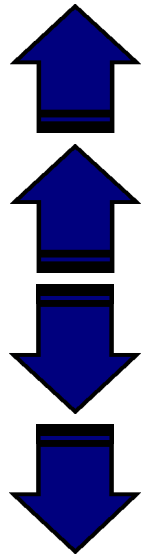
Cost per Home Passed

80% Subscriber Penetration



EFM Leverage Points

Our Customers' 'Criteria of Success!'



$$\begin{aligned} & \text{Subscriber Revenue} \\ & + \text{Miscellaneous} \quad (\text{Tax Credit, etc.}) \\ & - \text{Infrastructure Cost} \\ & - \text{Installation Cost} \end{aligned}$$

Return on Investment

Maximizing our Customers' Success!

Conclusion

- **EFM should not be distracted by the ‘*Tyranny of the OR*’**
 - *There is no single solution for all of our customer needs*
 - *Carriers may leverage several PON & P2P designs and architectures in deploying their Access networks to cost-effectively service their customers*
- **Choosing the ‘right’ Access architecture (or combination of architectures) is critical to our customers’ success!**
 - *Must analyze the costs & long-term implications of various PON/P2P architectures on a segment-by-segment and deployment-by-deployment basis*
 - *Help customers to make an informed decision - the success of their business and ours depends on it!*
- **EFM should help carriers maximize the effectiveness of their Business plans**
 - *Address as many leverage points as possible to maximize success!*

Contact Information



CORNING

Discovering Beyond Imagination

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