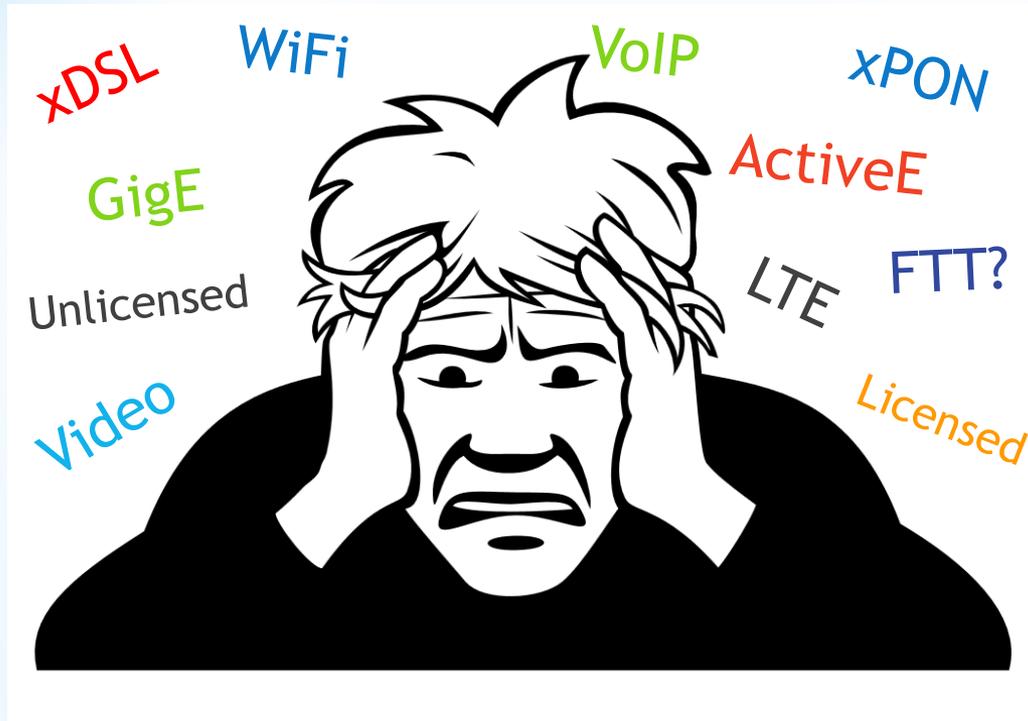


* How To Select Your Broadband Technology



“Making Communities Better with Broadband”



So Many Choices!!!!!!
Where Do I Even Start?

*Where to Begin

*Start With Your Community

- *Demographics

- *Current Needs

- *Vision for the Future

- *Strengths and Challenges



*Where to Begin

- *Evaluate the Current Communications Landscape
 - *Who are the existing service providers, and what technologies are they using?
 - *What types and levels of services are available?
 - *Are the services reliable, sufficient, and affordable to residents and businesses?
 - *Is the technology Infrastructure scalable and evolvable?

*Selecting Technologies

- *Technology is rapidly evolving to keep up with the uses of broadband
 - *Acronym “de jour” list expands exponentially - 3G, 4G, LTE, 5G, WiMax, WiFi, DSL, VDSL, PON, GPON, VOD, SVOD, OTT services, 4K video, VoIP,
- *What do You want, what do You need?
- *How important is the choice of one over the others?

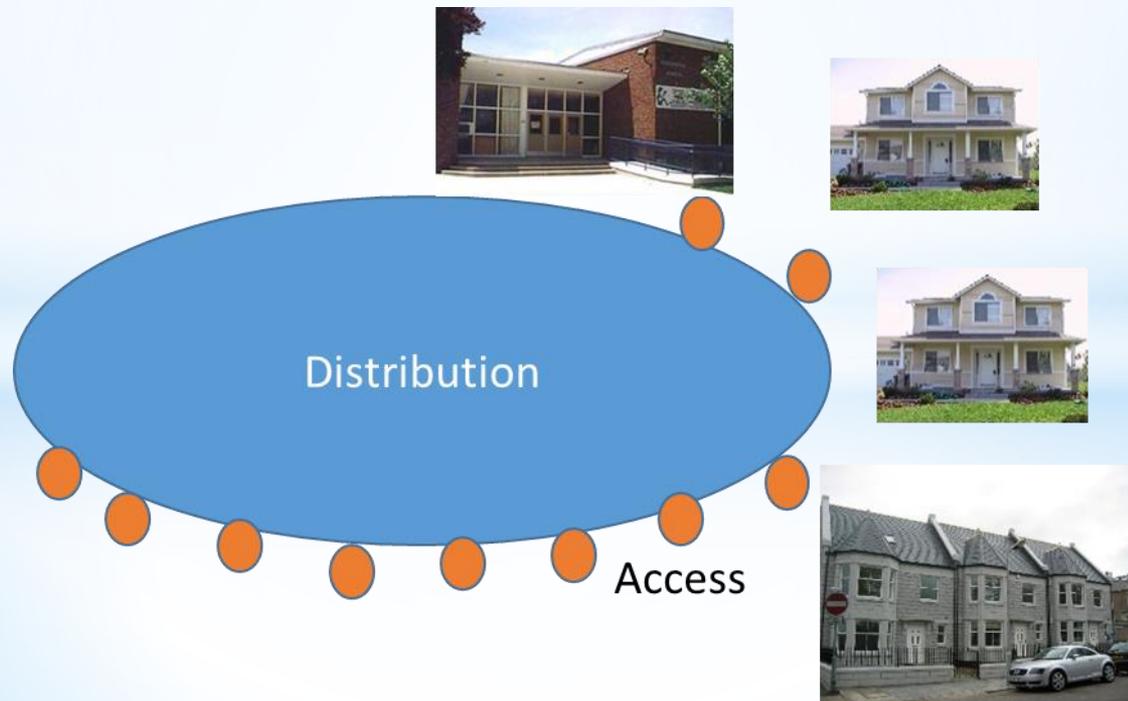
*The Right Technology

- *Selecting the “right” Technologies for your Network
 - *Coverage - Subscriber Density, Location
 - *Service Capabilities - Data, Video, Voice
 - *Construction - Geography and Topography
 - *Budget and Resources - Construction and Operations

* Segment Technologies

* Network Segments

- * Access - How the customer is physically/virtually connected to your network
- * Distribution - How content/data/voice is delivered to the Access Network



*System Performance

*The Technology Choice Is Specific To Your Project

* Service Questions: Performance Requirements

- * Data Services - Internet access, Tele-Medicine, Distance Learning, VPN, Gaming
- * Voice Telephony - VoIP, POTS
- * Video - Linear Programming, On-Demand, Over The Top (OTT)

* Infrastructure Questions: How to support the performance requirements considering:

- * Population Density - dense neighborhoods, long distances between residences.....
- * Geographic Characteristics, distances, hills, valleys, forests, flood plains, etc..
- * Existing Network Infrastructure Assets - Starting from scratch or able to reuse existing assets?

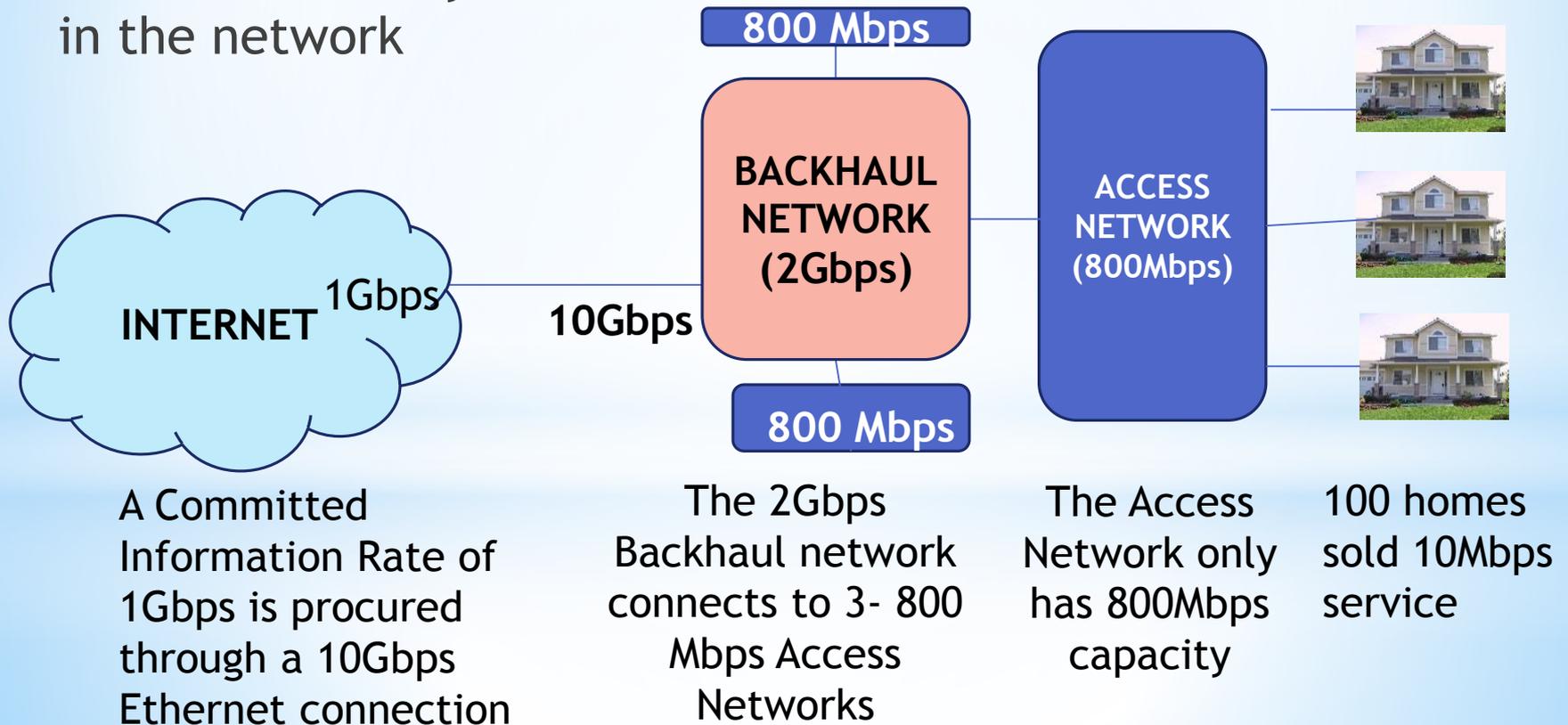
* System Performance

* Latency and Speed

- * Latency is the time it takes for transmitted data to be received.
 - * Critical for services such as telephony, gaming, and video conferencing services.
 - * Phone call degradation becomes apparent with approximately 200ms delay.
 - * A significant problem for Satellite Service.
- * Speed/capacity is the measure of how much data can be delivered per second
 - * Traditional voice service required 64,000 bits per second (64Kbps) per call.
 - * High Definition Streaming Video On Demand requires 10,000,000 (10Mbps) - 20,000,000 (20 Mbps) per program per subscriber.
 - * Adequate data rates need to be able to be provided to all subscribers as required by their applications.
 - * *Oversubscription of available capacity can degrade provided services*

*System Performance

*Oversubscription/congestion can occur anywhere in the network



* Access Technologies

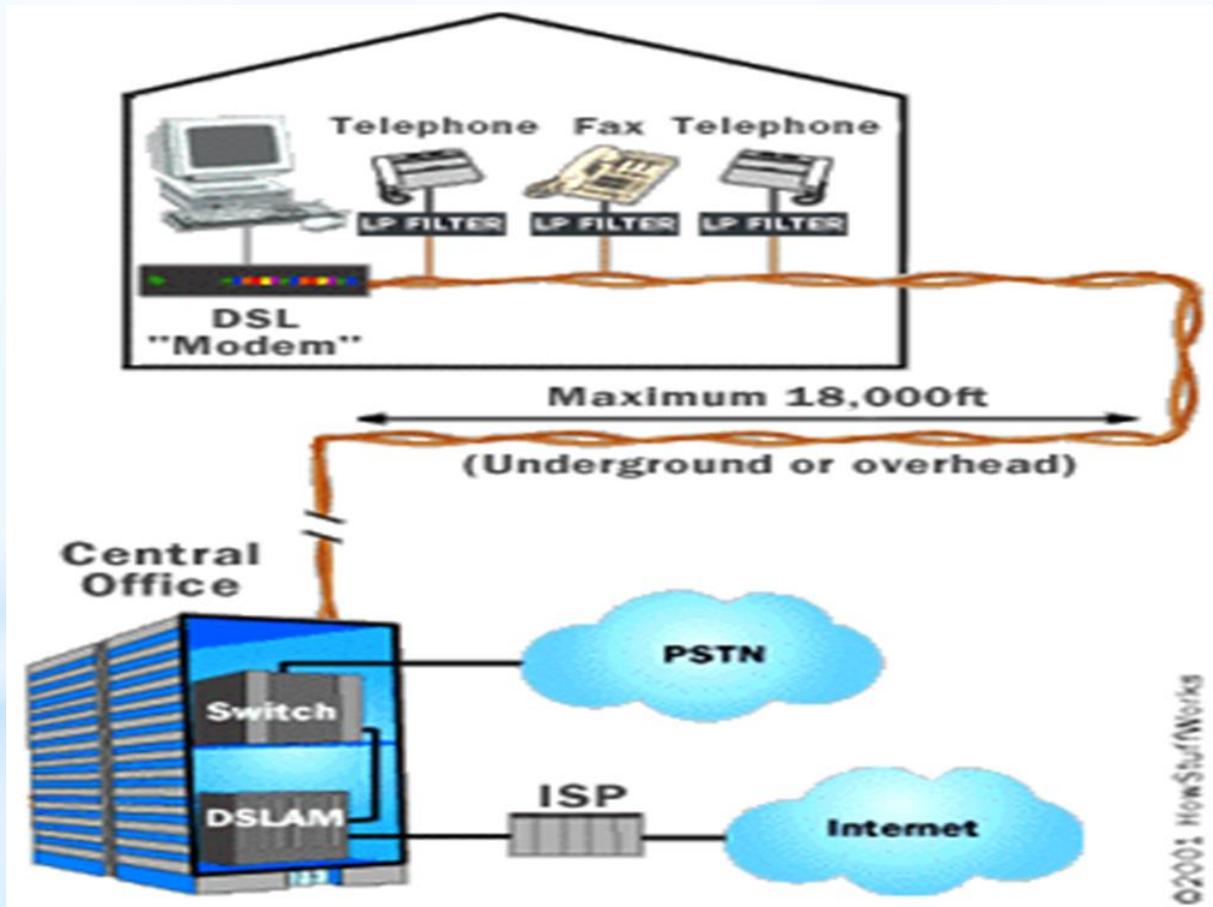
* Wireline Technologies:

- * Copper Based Digital Subscriber Line Technologies (DSL)
 - * Deployed using traditional twisted-pair telephony access lines.
- * Coax and Hybrid Fiber-Coax (HFC)
 - * Deployed using traditional cable TV distribution and access cabling
- * Optical Fiber
 - * Fiber to the premises (FTTP) or home (FTTH)
- * Broadband over Powerline (BPL)

* Wireless Technologies:

- * Licensed spectrum based
 - * LTE Cellular, WiMAX
- * Unlicensed spectrum based
 - * WiFi, WiMAX, LTE-U is coming!

* Wireline Access Technologies - DSL



* Wireline Access Technologies - DSL

* DSL

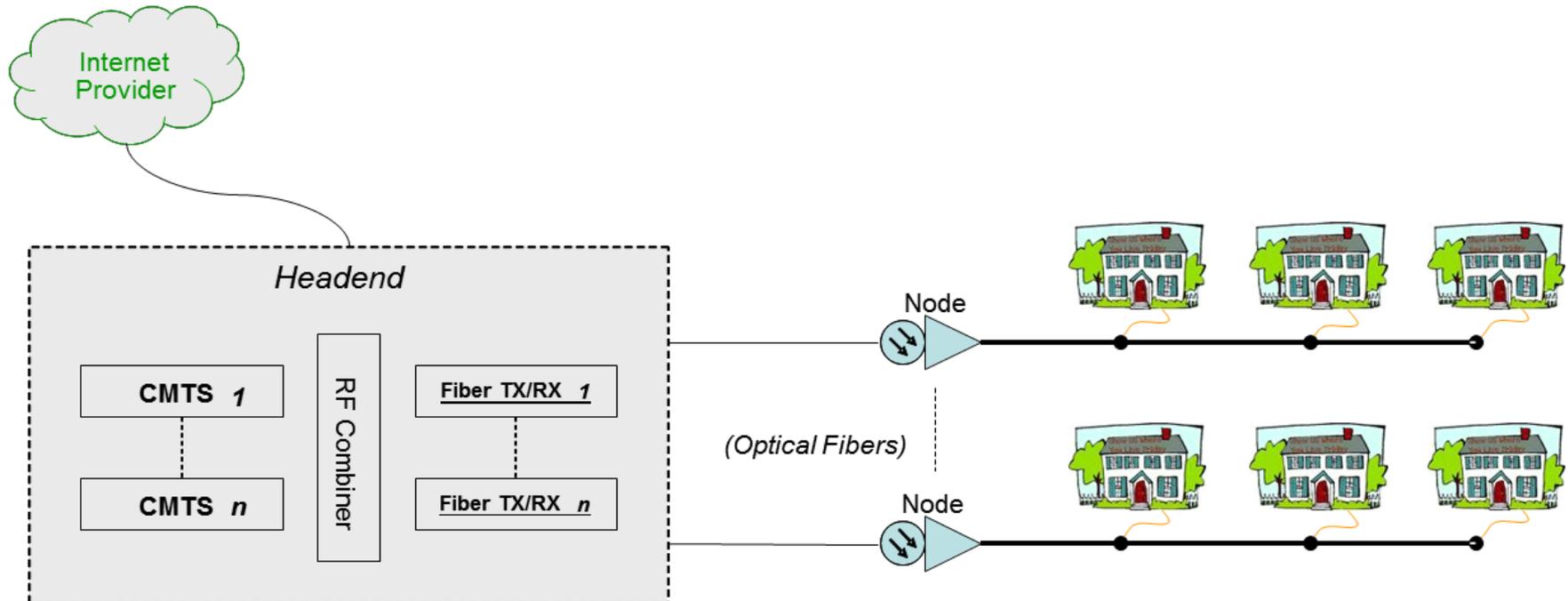
* Benefits:

- * Incumbent carriers can use their embedded telephony cabling to offer high-speed data services.
- * Quickest and least cost deployment for incumbent carriers.
- * Supports both traditional POTS as well as data services
- * Access lines are not shared among multiple subscribers

* Challenges:

- * Performance is very distance sensitive
 - * ADSL: 7Mbps - 2.5Km, ADSL2+: 20Mbps - 1.5Km, VDSL: 150Mbps - 400m
- * Copper plant maintenance costs are high
- * Not very future-ready
- * Requires fiber-fed in-plant equipment to serve distant subscribers
- * Subscriber service performance is sensitive to distance from equipment.

* Wireline Access Technologies - HFC



* Wireline Access Technologies - HFC

* Benefits:

- * Incumbent CATV MSOs can use their embedded cabling to offer high-speed data services.
- * Very high capacity, supporting video, voice (VoIP), and data services - can exceed 100Mbps

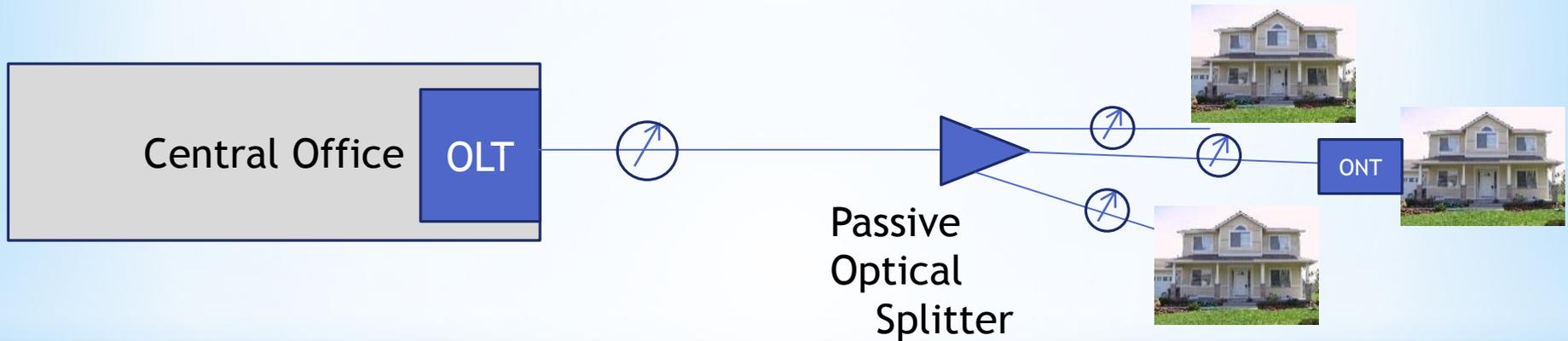
* Challenges:

- * Access bandwidth is shared among multiple subscribers complicating operations management
- * Active in-plant network elements are required for optical-electrical conversion and electrical re-amplification increasing maintenance, scalability, and upgrade costs.
- * Subscriber service performance sensitive to network use by other subscribers

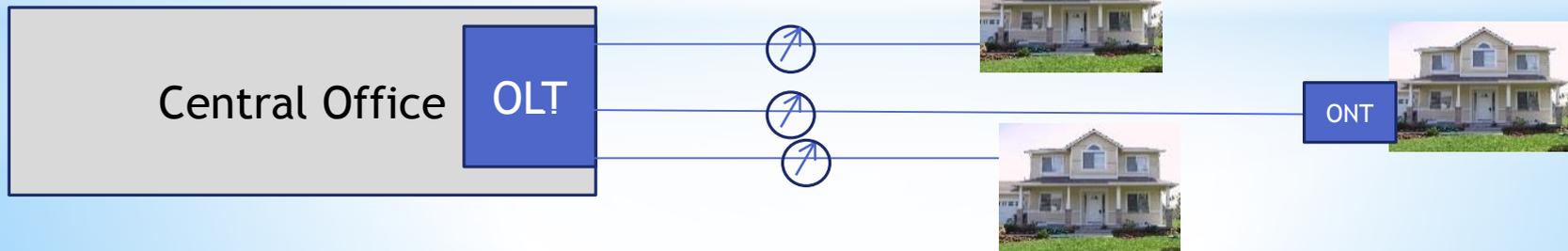
* Wireline Access Technologies - Optical

* Passive Optical Networking (PON)

* Passive splitters are used for branching distribution fibers to access fibers.



* Active Optical Networking



* Wireline Access Technologies - Optical

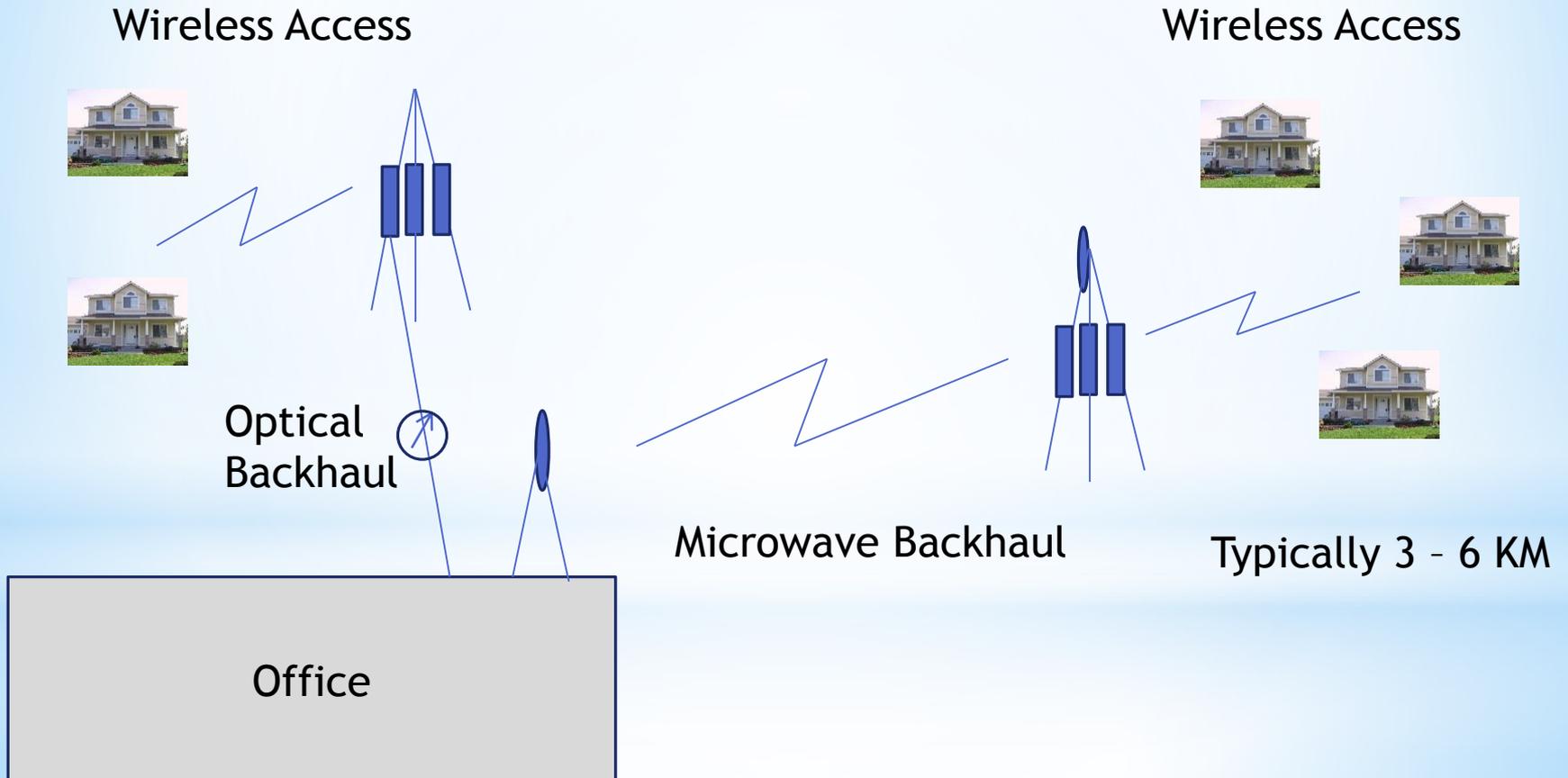
* Benefits:

- * Extremely high capacity provides “future-proofing” - Can exceed 1Gbps
- * Long cable life and Passive Networking Mode reduces maintenance costs.
- * High degree of scalability
- * Can support triple play

* Challenges:

- * Since typically new-build/over-build construction , it can be the most expensive deployment option
- * ONTs at the subscriber’s premises require operating and back-up powering
- * Management and troubleshooting of PONs is complex

* Wireless Network Technologies



* Wireless Technologies - Spectrum

* Licensed Spectrum: LTE, WiMAX

* Benefits:

- * Provides protection from RF interference from other broadcasters using the same spectrum.
- * Typically 5 - 30Mbps provided by LTE and WiMAX

* Challenges:

- * Licensing costs
- * Spectrum availability

* Unlicensed and “Lightly Licensed” Spectrum: WiFi, WiMAX

* Benefits;

- * Low or no cost to use spectrum

* Challenges:

- * No protection from RF interference from other broadcasters using the same spectrum
- * WiFi has very limited coverage ranges (300m)

* Wireless Access Technologies

* Benefits:

- * For new-build/over-build deployment wireless can be the quickest and least costly technology option.
- * Unlicensed and “lightly licensed” spectrum is free or inexpensive to acquire.

* Challenges:

- * High coverage sensitivity to terrain and path obstruction
- * Licensed spectrum can be expensive and difficult to obtain
- * Tower siting can be difficult due to local and municipal regulations
- * Capacity sensitivity to distance.
- * Access capacity is shared by the subscribers within the coverage area
- * Scalability can be difficult
- * Depending on spectrum, terrain, distance and desired performance may require “Line of Sight” (LOS) antenna placement

*Technology Summary

Technology	Typical Rate	Typical Range	Strengths	Weaknesses
DSL ADSL, ADSL2+, VDSL2	7 - 100Mbps	2Km - 400m	Where copper is installed. Supports voice and data	Distance Sensitive. High maintenance.
HFC	100Mbps	2Km - 50Km (w/amplifiers)	Where HFC CATV is installed. Supports Triple Play	Expensive where CATV doesn't already exist
FTTP	1Gbps	10Km - 60Km	Triple play, future proof	High 1 st costs
Wireless - Unlicensed WiMAX and WiFi	4 - 300Mbps	60Km - 300m	Greenfield, Voice and data. Cost effective coverage	Susceptible to RF interference
Wireless - Licensed WiMAX and LTE	4 - 100Mbps	60Km - 6Km	Voice and data. Rapid broad coverage	Limited scalability. Tower siting can be difficult

* Other Technology Considerations

- * Network Management and Maintenance

 - * Keeping the network working.

- * Back-Office Operations

 - * Getting paid for your product

* 21st Century Networks



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 **Questions?**