Fiber to the Home:
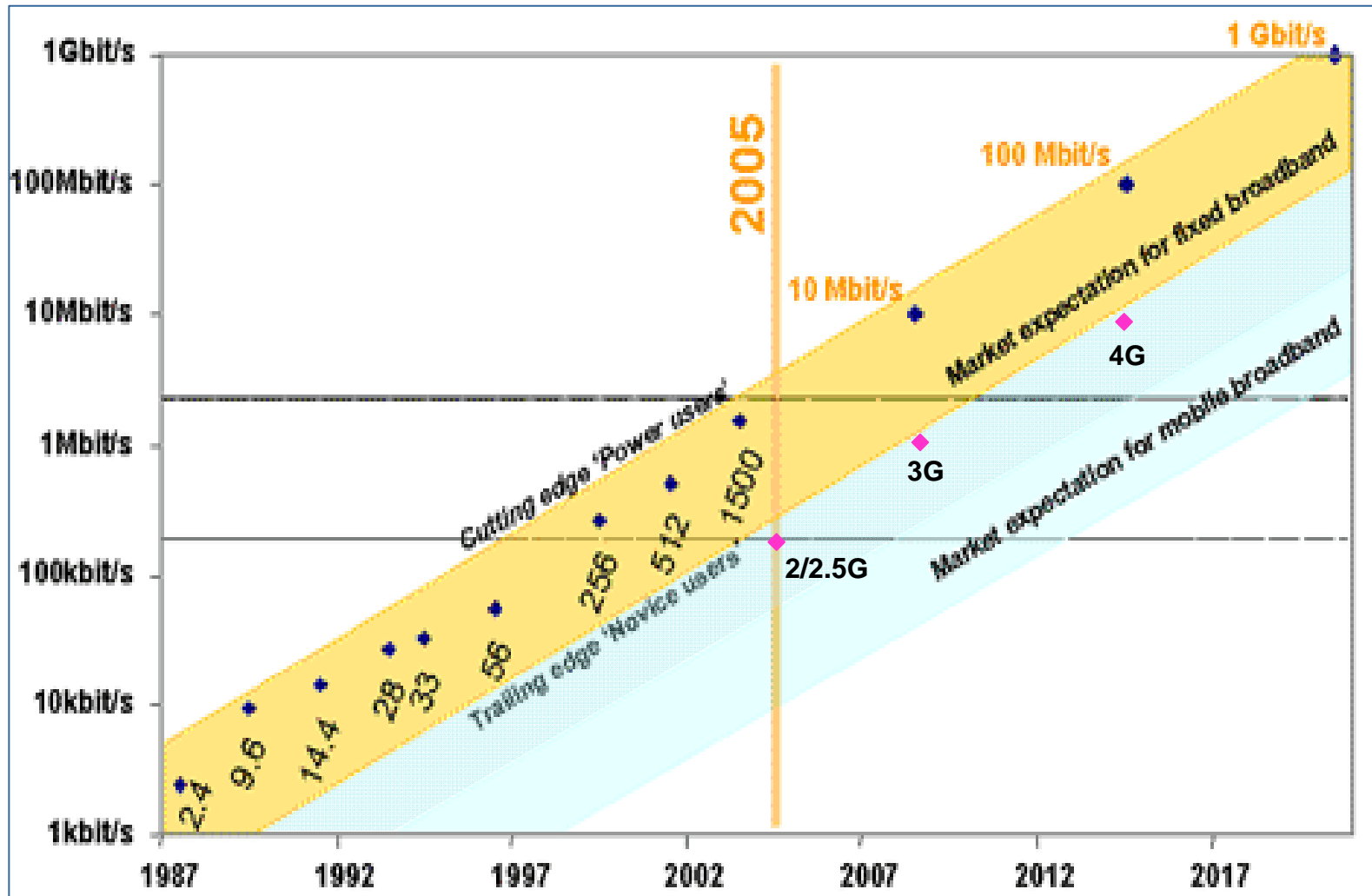## Enabling Innovation & Growth
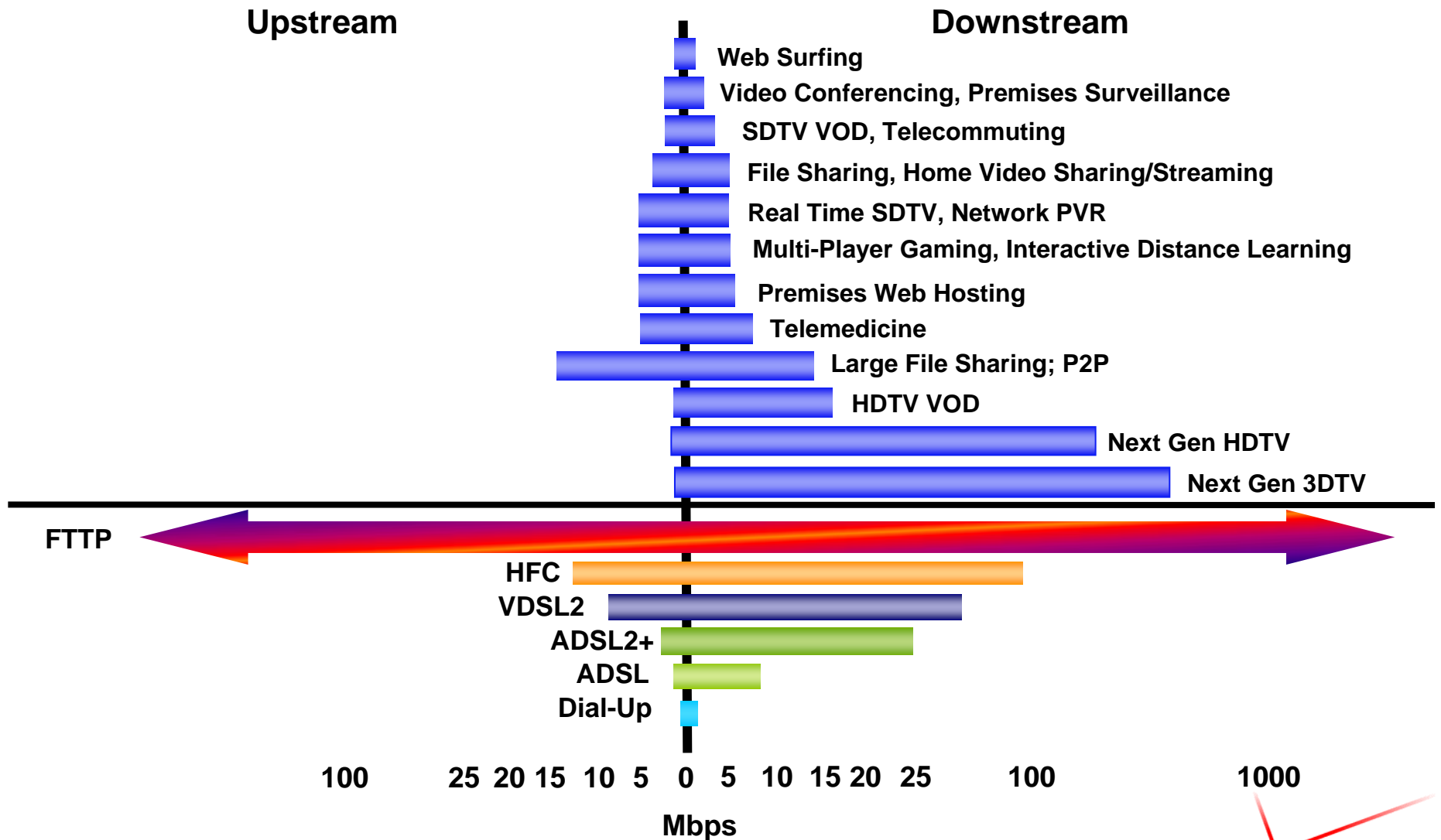
Stuart Elby, PhD
Vice President -- Technology

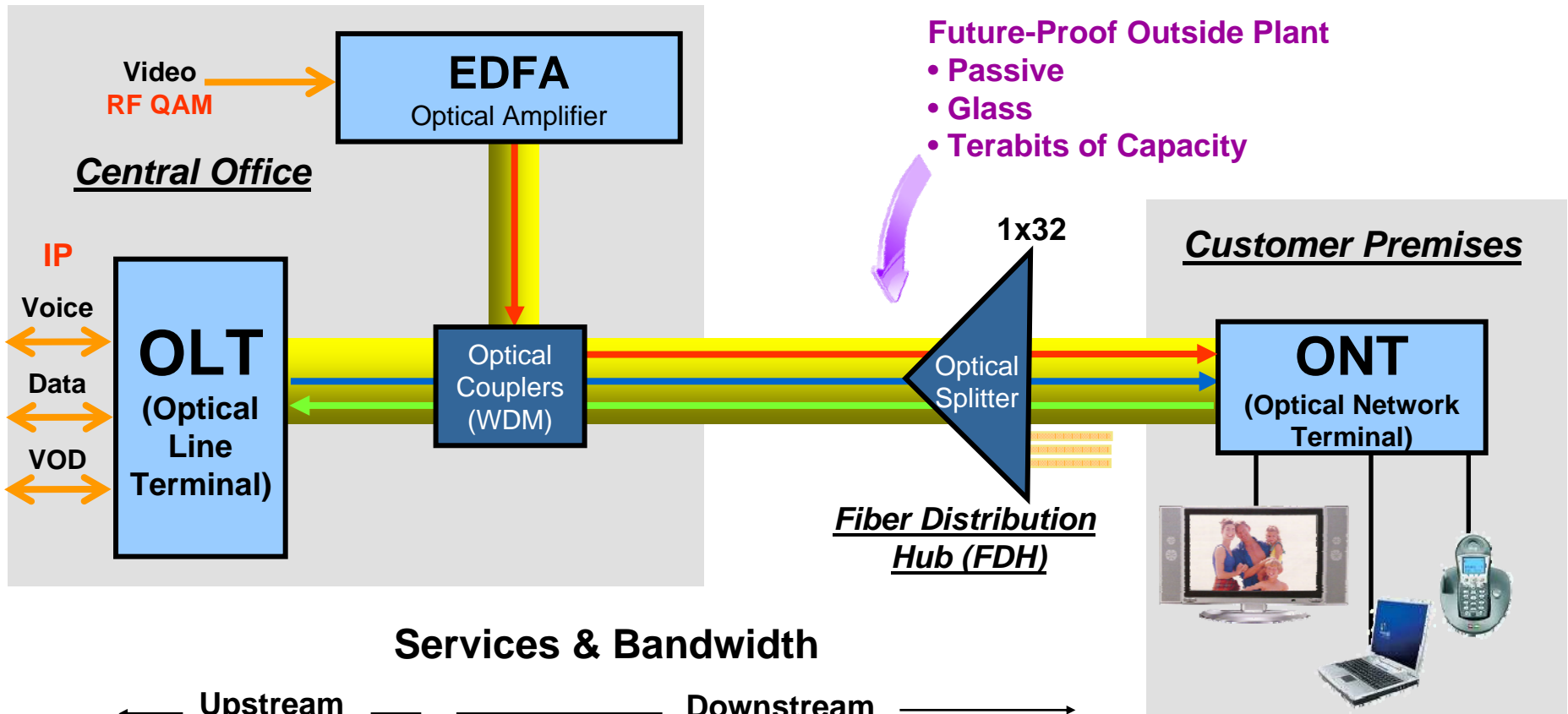# Communications Trends
Access Bandwidth Consumption
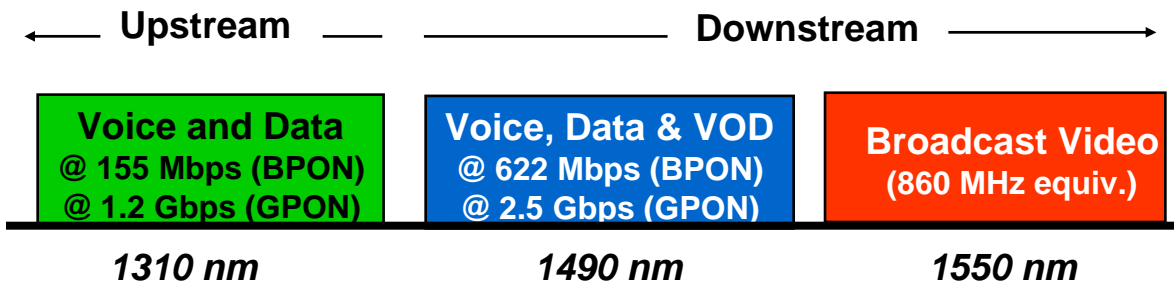
2

Applications and Media Bandwidth

Upstream

Downstream

Web Surfing

Video Conferencing, Premises Surveillance

SDTV VOD, Telecommuting

File Sharing, Home Video Sharing/Streaming

Real Time SDTV, Network PVR

Multi-Player Gaming, Interactive Distance Learning

Premises Web Hosting

Telemedicine

Large File Sharing; P2P

HDTV VOD

Next Gen HDTV

Next Gen 3DTV

FTTP

HFC

VDSL2

ADSL2+

ADSL

Dial-Up

| 100 | 25 | 20 | 15 | 10 | 5 | 0 | 5 | 10 | 15 | 20 | 25 | 100 | 1000 |

Mbps

verizon

Fiber to the Premises

Central Office

Video
RF QAM → **EDFA** Optical Amplifier

Future-Proof Outside Plant
- **Passive**
- **Glass**
- **Terabits of Capacity**

IP
Voice
Data
VOD

OLT (Optical Line Terminal)

Optical Couplers (WDM)

1x32

Optical Splitter

Fiber Distribution Hub (FDH)

Customer Premises

ONT (Optical Network Terminal)

Services & Bandwidth

← Upstream — ——— Downstream ——→

Voice and Data @ 155 Mbps (BPON) @ 1.2 Gbps (GPON)	Voice, Data & VOD @ 622 Mbps (BPON) @ 2.5 Gbps (GPON)	Broadcast Video (860 MHz equiv.)
1310 nm	*1490 nm*	*1550 nm*

verizon

FTTP Deployment

Overlay Build

ONT

ONT

ONT

ONT

Green Field Build

Splitter
Hub

Circuit
Switch

ONT

ONT

ONT

ONT

ONT

ONT

ONT

OLT

verizon
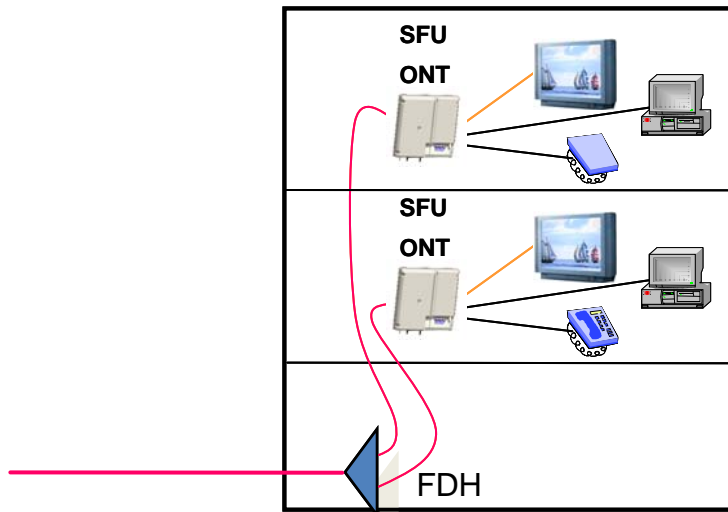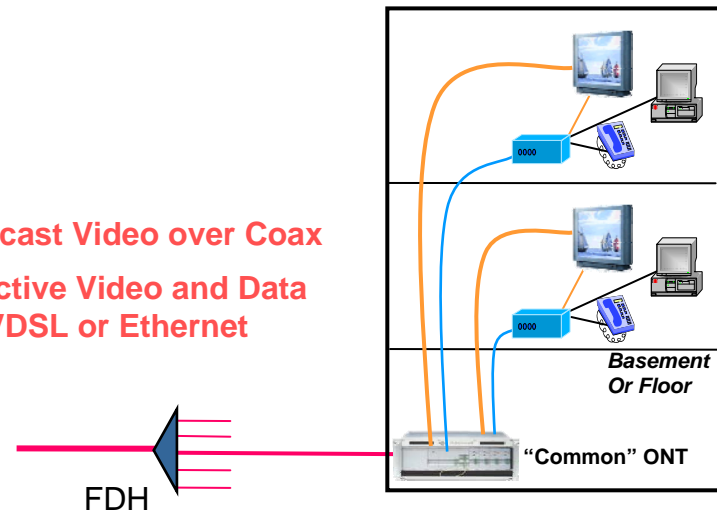
FTTP Architectures for Multi Dwelling Units

Fiber to the Living Unit

Fiber to the Building

SFU

ONT

SFU

ONT

FDH

Broadcast Video over Coax

Interactive Video and Data over VDSL or Ethernet

Basement Or Floor

FDH

"Common" ONT

LEGEND

Fiber Cable

VDSL/Cat3

Coax Cable

Optical Splitter

The Verizon Digital Home

CMS
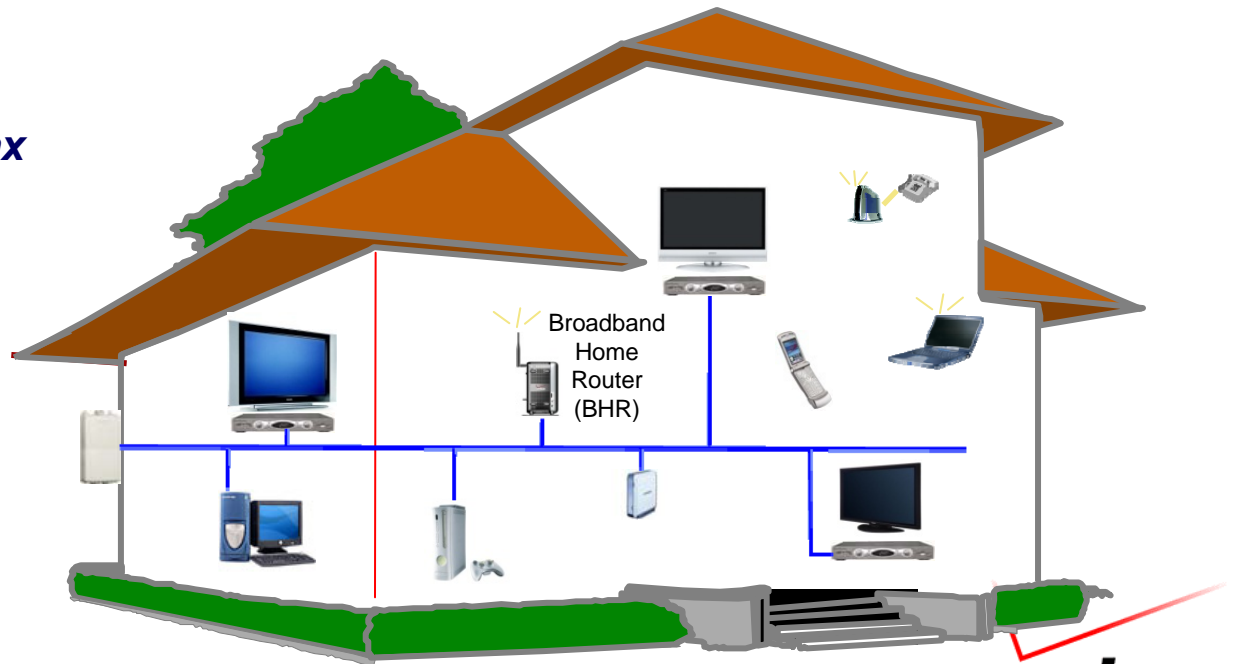**Customer Premises Management System**

TR-069 Home Network Management

Three Key VZ Investments:

BHR (Broadband Home Router): Robust network

MoCA (Multimedia over Coax Alliance): Inexpensive installation; operates in 50 MHz channels between 875-1525 MHz.

CMS: Remote management and configuration through standard protocol.

Broadband Home Router (BHR)

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Enabling Technologies

- Digital Signal Processors (DSP)
- Semiconductor Lasers
- Erbium Doped Fiber Amplifiers (EDFA)
- Passive Optical Components (WDM combiners, splitters, connectors)
- Bend Insensitive Optical Fiber
- Battery Technology

1995

2005

verizon
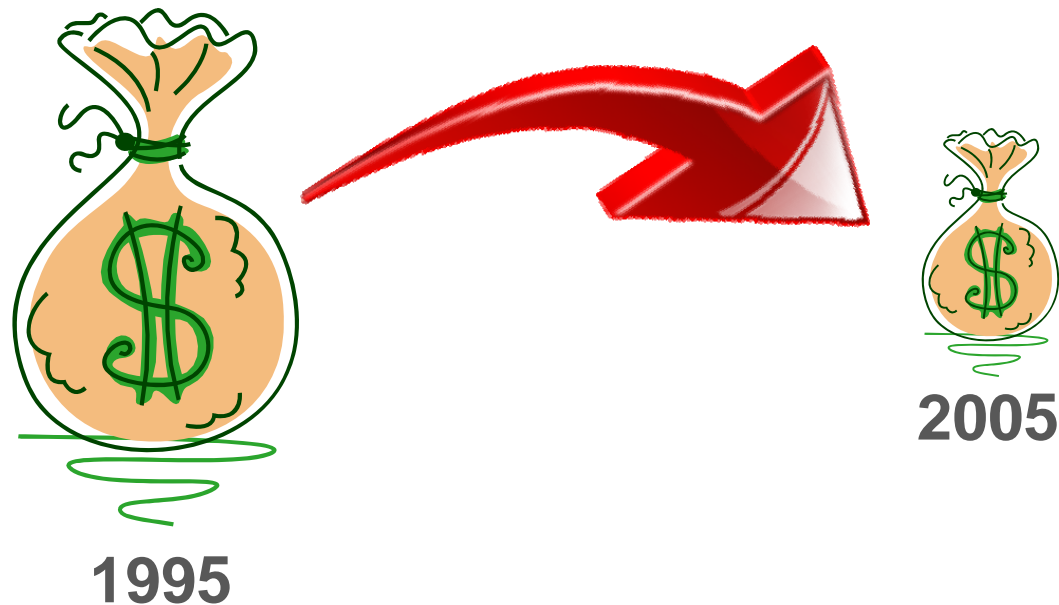
Business Rationale

- Some copper distribution areas require labor intensive rehab
- Outside plant active electronics have very high maintenance costs
- Aerial outside plant is less expensive to build than buried facilities
- Continuous Internet traffic growth of ~50% per year

Capital Cost Structure of FTTH

Total Cost to Connect

ONT Cost

Construction Cost to Connect

Allocated OLT Cost

Construction Cost to Pass

Total Cost to Pass
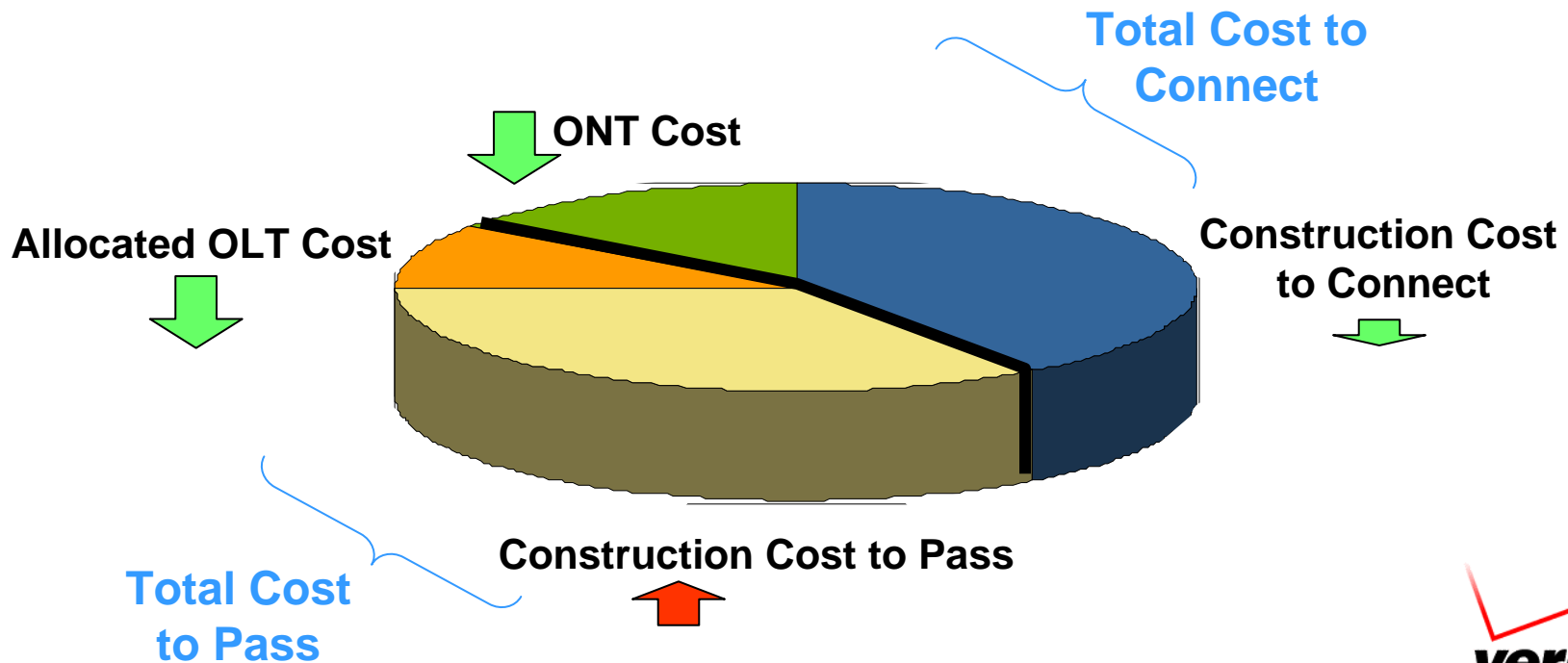
Total Cost of Ownership Savings

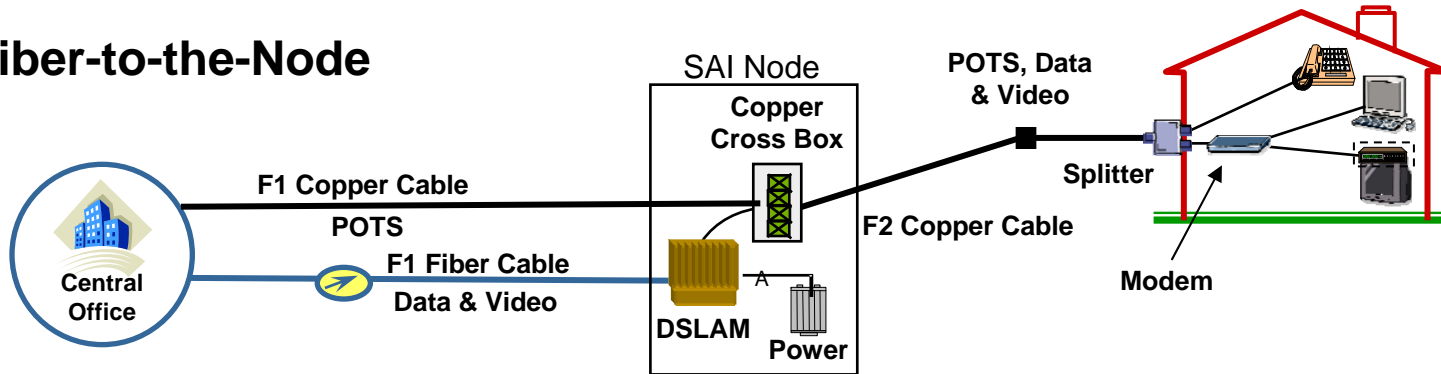## Fiber-to-the-Node

SAI Node

Copper Cross Box

POTS, Data & Video

F1 Copper Cable

POTS

Splitter

Central Office

F1 Fiber Cable

Data & Video

F2 Copper Cable

DSLAM

Power

A

Modem

Fiber-to-the-Home

Splitter Cabinet

ONT

POTS,Data & Video

Central Office

F1 Fiber Cable

Optical Splitter

Fiber Terminal

F2 Fiber Cable
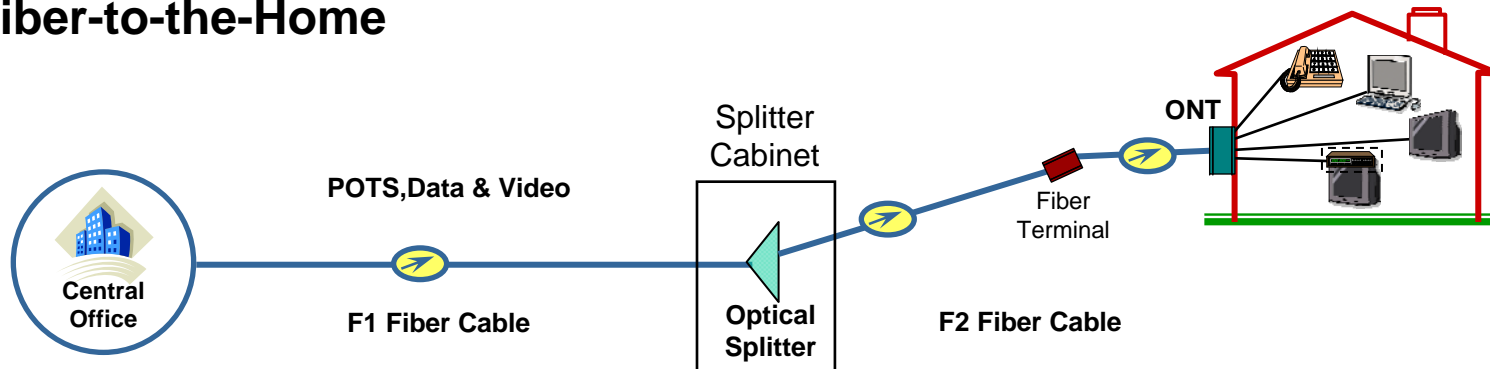
FTTH End-to-End Savings totals **67%**

verizon

FTTP Maintenance Costs Savings

- **Fewer Reported Troubles in the Outside Plant (F1 & F2)**

  – **The POTS & DSL Outside Plant NRR is more than 5 times higher than FiOS Voice & Data**

NRR Outside Plant	2005 YTD
Combined DSL + POTS	1.05
FiOS NRR - All	0.20

- **When Troubles are Reported, dispatches occur less often**

  – **DSL & POTS Average daily dispatched load rate is almost 2 times higher than FiOS**

  – **FTTP network detects troubles and self heals**

Dispatch Out Rate	2005 YTD
DSL & POTS	0.17%
FiOS Voice & Data	0.09%

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Deployment Status of FiOS (3Q09)

(Millions)

Chart categories (x-axis): EOY2010 Target Homes Passed (~18), 3Q09 Homes Passed (~14.5), TV Subscribers (~2.5), Internet Subscribers (~3)

Penetration of homes open for sale

25%   28.5%

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FiOS Architecture Today

SHE
(Super Head End)

Long Haul Network

IP Network/Internet

Video Cache

VoIP Softswitch

Broadcast LAN

VHO
(Video Hub Office)

Medium Haul Network

Edge Router

IP→QAM & EDFA
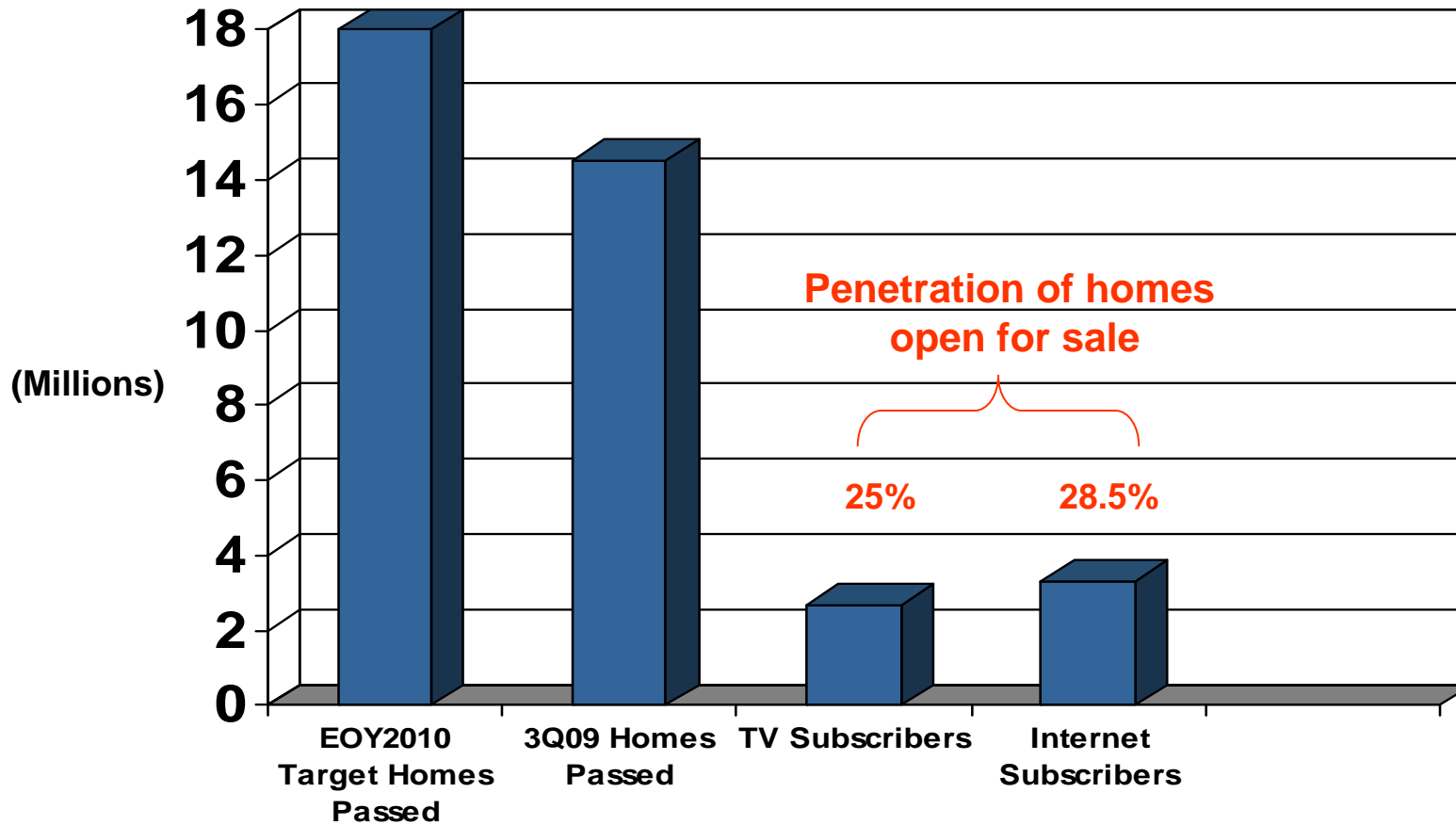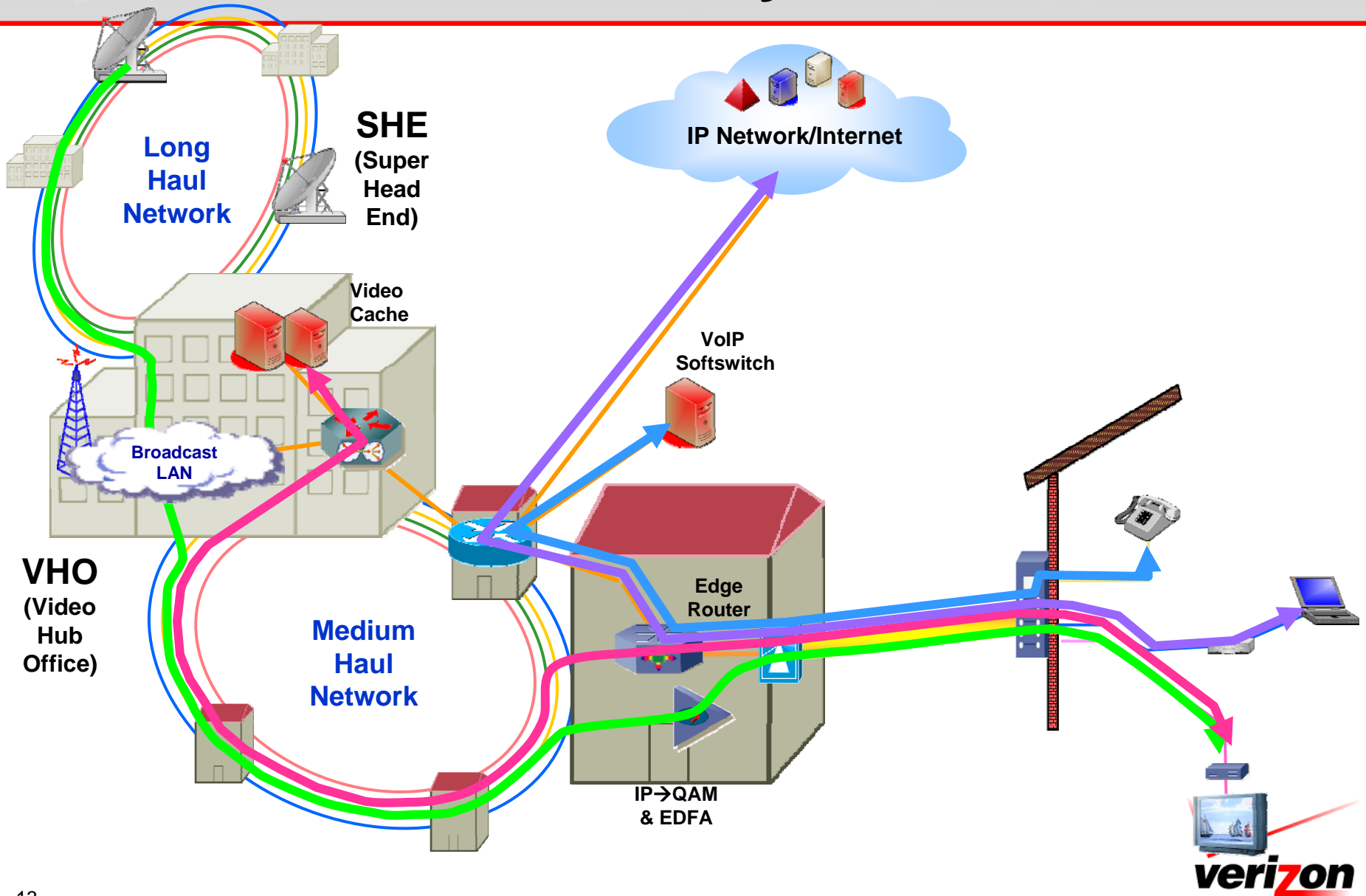
FiOS Architecture Future

Long
Haul
Network

SHE
(Super
Head
End)

Video
Cache

Broadcast
LAN

VHO
(Video
Hub
Office)

Medium
Haul
Network

IP Network/Internet

IMS

IP Multimedia
Subsystem

NG-PON
10Gbps Up & Down

Edge
Router

Video
Cache

14
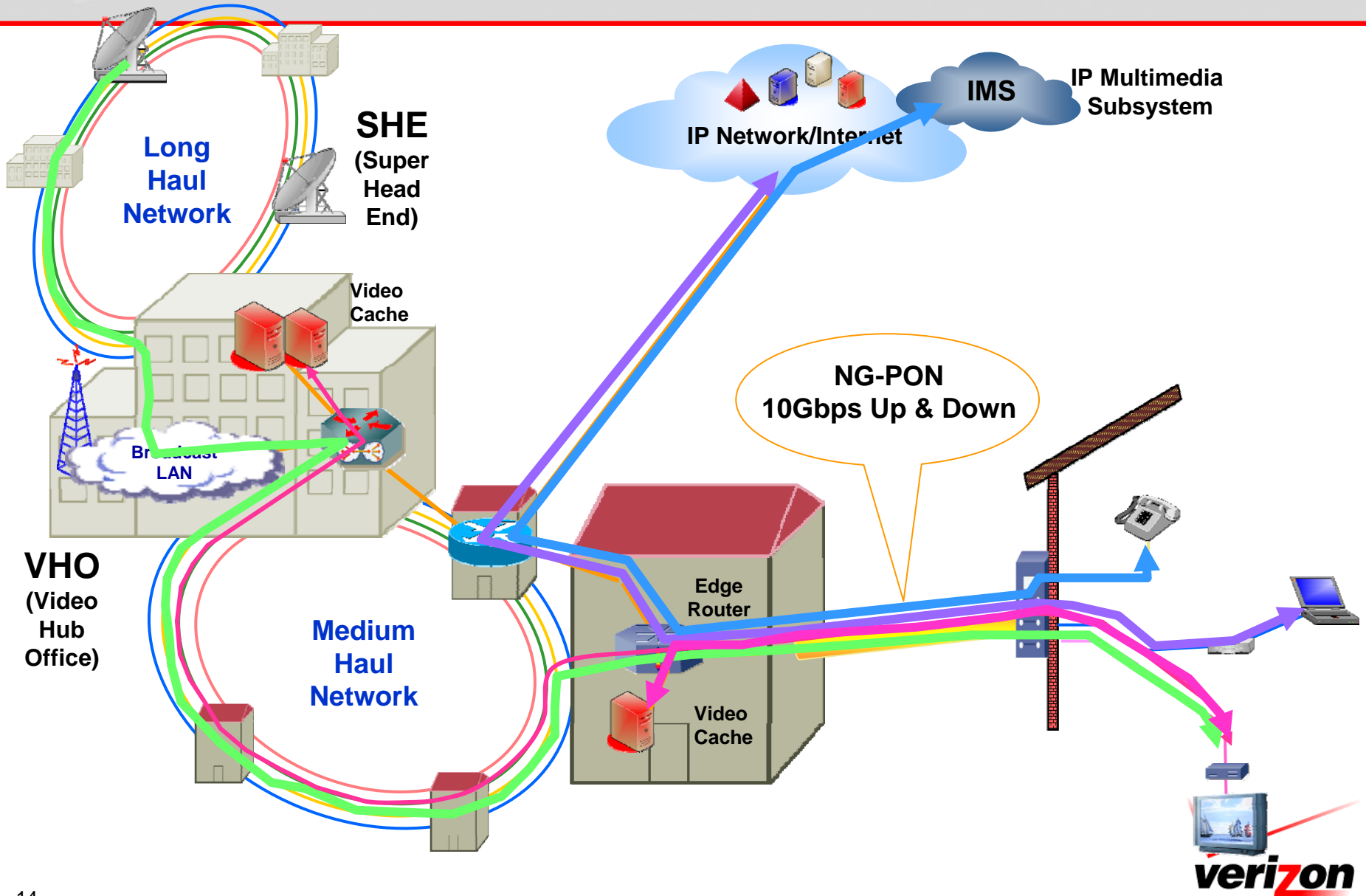
IP + Linear Broadcast

- **Set-Top Box merges IP channel with TV channel to create hybrid interactive experience.**

- **FiOS TV Widgets are small, Internet-enabled applications that run on a FiOS TV Set-Top Box. Widgets are written using the LUA scripting language.**
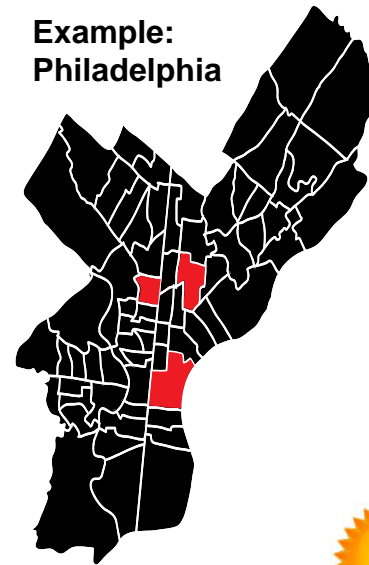
Emerging Advertising Opportunities

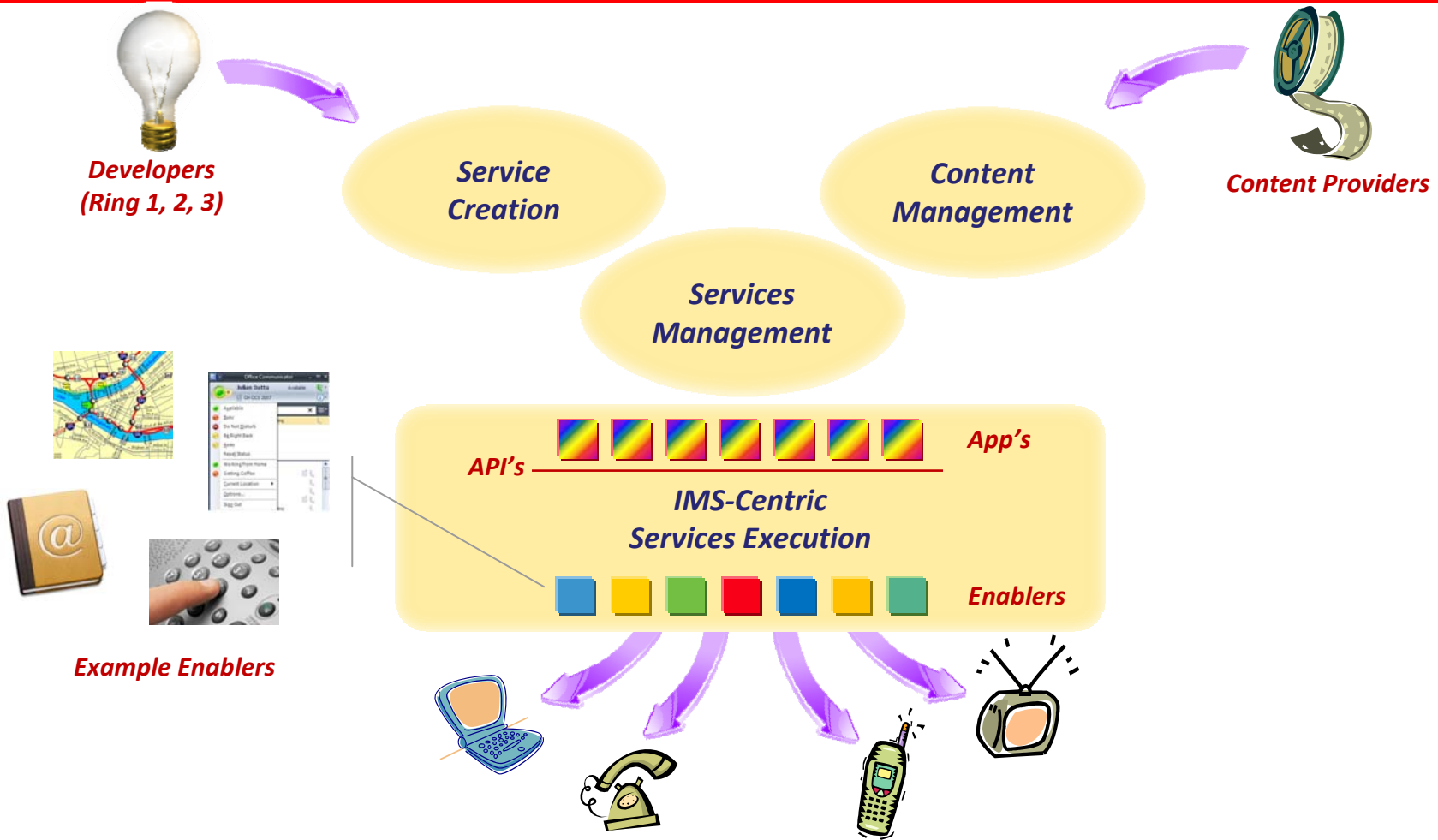- **Dynamic VOD Ads –** Dynamically served pre and post-roll ads accompanying Free VOD content

- **Interactive TV Ads –** EBIF-enabled nationally broadcasted TV ads with interactive capabilities

- **Hyper-Local Geo-targeted Ads –** zip code + 4 with better than the 60% accuracy of IP advertising

- **Sponsored Widgets –** Verizon Developer Network to 'skin' widgets

Example: Philadelphia

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A Platform for Innovation

Developers (Ring 1, 2, 3)

Service Creation

Content Management

Content Providers

Services Management

Example Enablers

API's

App's

IMS-Centric Services Execution

Enablers

FiOS Broadband + Open Platform + Enablers = Delivering Innovation to Customers

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Collaborative Intelligence

VZ VAS Portal

Mobile Handset

Java VM (J2ME)

Mobile Linux (LiMo)

Internet

EvDO, 4G

IMS-Enabled Verizon Network

FiOS

Network

Java VM (J2ME)

Mobile Linux (LiMo)

VZ Home Gateway (BHR)

Energy Mgmt	Media Sharing	VZ Connect
Health care	File Backup	PIM
Home Security	NAS	DECT/VoIP

Java VM (OSGi)

dlna UPnP   **IMS Stack**

Operating System

Web Camera

Game Consoles

VZ Home Network

TV / STB

Personal Storage

PC

HDD recorder

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Developer Website – open to all

Service Genres

- Communications

- Media Access (Including Internet TV/Radio)

- Media Sharing

- Home / Business Security

- Home Automation

- Utility Services

- Distribution/Delivery Logistics

- Advertising

- Gaming

- N-Screen

- Telemedicine

Your Companies will Shape the Services

verizon

Summary

- Fiber to the Home is the only technology to meet near term and long term fixed bandwidth demands without additional outside plant investment.

- We are evolving FiOS to continually enhance the user experience (bandwidth, video content choice and quality, services)

- We are opening our networks to accelerate service innovation

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