2nd Generation Business Model

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Market Opportunity

- T1/E1 and Fractional T1/E1 Replacement
- Higher-end complement to DSL & Cable
  - Freedom from the ILEC Facilities
  - Distribution & Provisioning Models, similar to Cellular; Accelerating Mass Deployment
- Public 802.11 Network Backhaul
- 3G / Cellular Network Backhaul
- Global Market

Why did 1G Business Models Fail?

- Coverage Limited
- Capacity Constrained
- Cost – Infrastructure & CPE
- Professional CPE Install Required
- Spectrum Constraints – FDD Separation
- Strict Line of Sight Limitation
- Lack of QoS Capabilities
- Leading with Consumer Services – negative margin

The Perceived "Holy Grail"

- Efficient Cellular Re-use of Spectrum
- Infrastructure Cost –> $100/subscriber
- CPE Costs ~ $150 - $350
- Indoor Self Install
- Portability
- High Capacity
- Broadband (not Wideband) Performance
- 90% + Coverage Footprint

Changing the Business Dynamics

Capacity – Coverage – Cost – QoS

- Supercell → Macrocell → Microcell
- Efficient Media Access Control
- High Spectral Efficiency
- LoS → OLoS → NLoS
- QoS Management
  - Multi-Tiered Services
  - Business Grade Performance

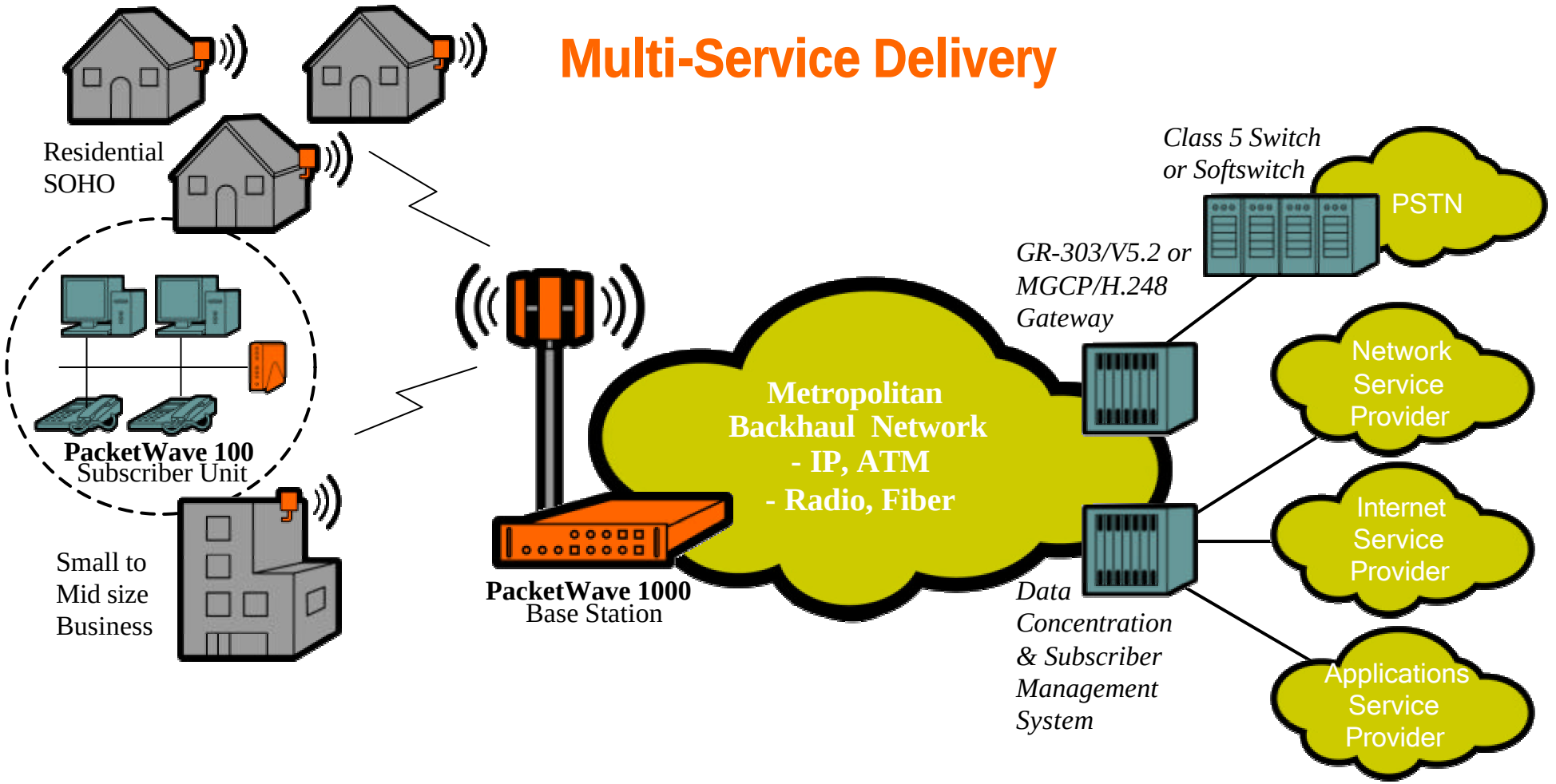
1G -> 2G Business Dynamics

Comparison between First and Second Generation Fixed Broadband Wireless Access Solutions

Characteristics	First-Generation F-BWA	Second-Generation F-BWA	Capacity	Coverage	Cost	Speed of Deployment	Quality
Cell Configuration	Supercell/ macrocell technology - limited capacity	Multicell/ technology Cellular frequency reuse	X	X	X		
QoS	Limited or no QoS	QoS enabled with multiple flows & CoS			X		X
Duplexing Scheme	FDD	TDD or FDD	X		X		X
Multi Service Capability	Data only	Multi-service (data, voice, video)	X	X	X		
Media Access Control	DOCSIS MAC or primitive wireless MAC	MAC designed for F-BWA	X	X			X
Subscriber Link Optimization	Single set of performance parameters for all subscribers	Customizable parameters by user (Aperto's OptimaLink provides dynamic per-subscriber link optimization)		X	X	X	X
Reach	Line-of-sight only	Line-of-sight, obstructed and non-line-of-sight depending on distance from base station		X	X		
Installation	Carrier tech only, multiple truck rolls Roof mount only	Simplified technology→some end-user install, eliminating multiple truck rolls Roof mount, eves mount, window mount			X	X	

IP-based Service-Intelligent Architecture

Multi-Service Delivery

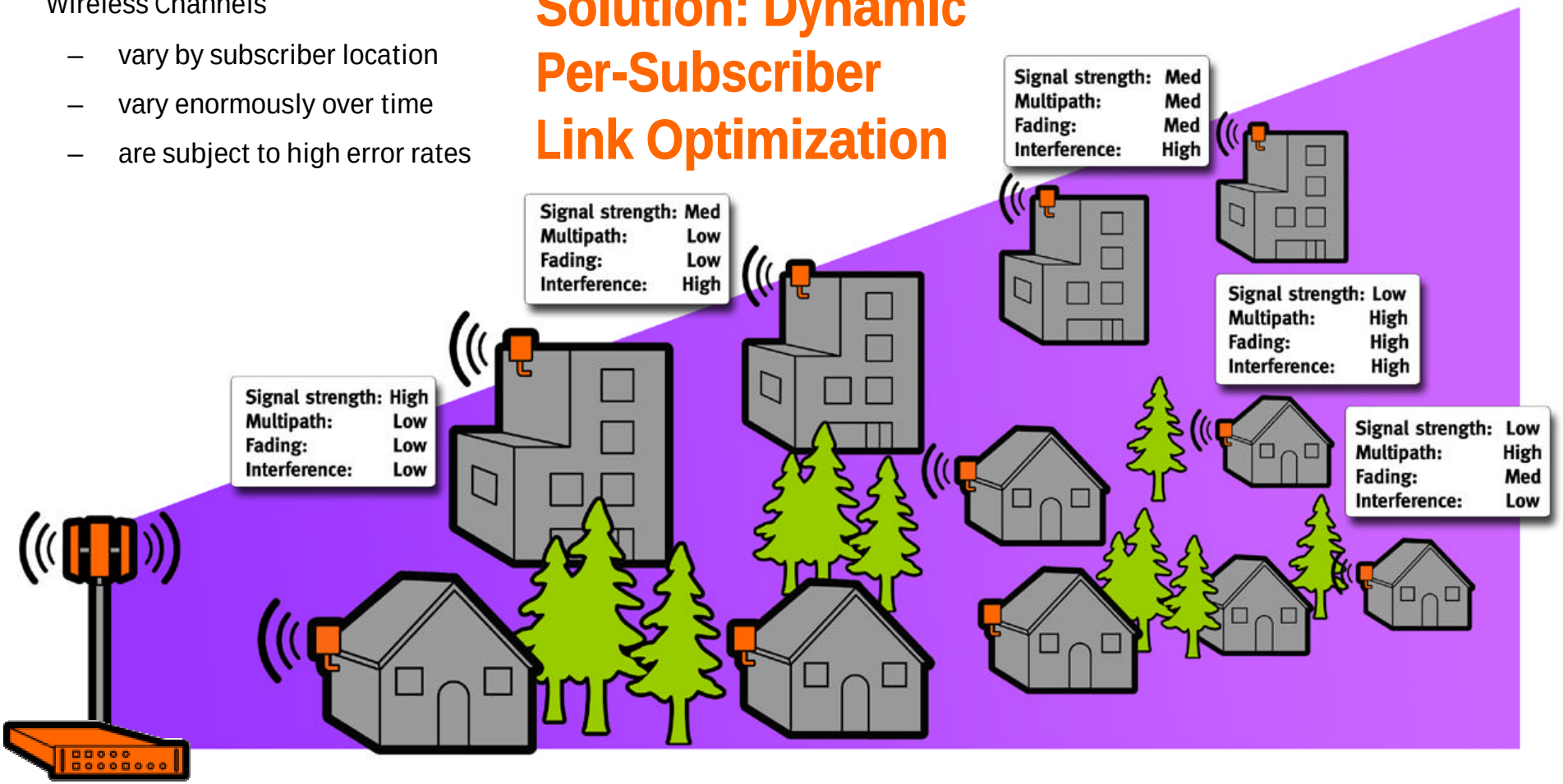


Real World Deployment

Wireless Channels

- vary by subscriber location
- vary enormously over time
- are subject to high error rates

Solution: Dynamic Per-Subscriber Link Optimization



Personalized Service Delivery

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Differentiated Services

- **Carrier-Class Multi-Service QoS**
  - Constant Bit Rate (CBR) Service
    - Voice, video, low latency, low jitter
  - Committed Information Rate (CIR) Service
    - Min rate guarantee; peak rate regulation
  - Best Effort (BE) Service
    - Peak rate regulation
- **Intelligent Classification of Traffic**
  - Multiple Flows per Subscriber

Infrastructure Cost

- Cost per Subscriber
  - Dependent on several factors
  - Cell size (base station capacity & coverage)
  - Number of cells to cover a particular market
- Capital Equipment (~$95K)
  - Base Station equipment: $60K - $80K
  - Back-haul equipment: ~ $20K
- Recurring Costs (~$9K /month)
  - Backhaul cost: ~ $3K /month
  - Facilities Cost (tower,power, etc) ~ $1.2K to 3K /month
  - Operations & Support Costs: ~ $3K /month

Installed Subscriber Cost

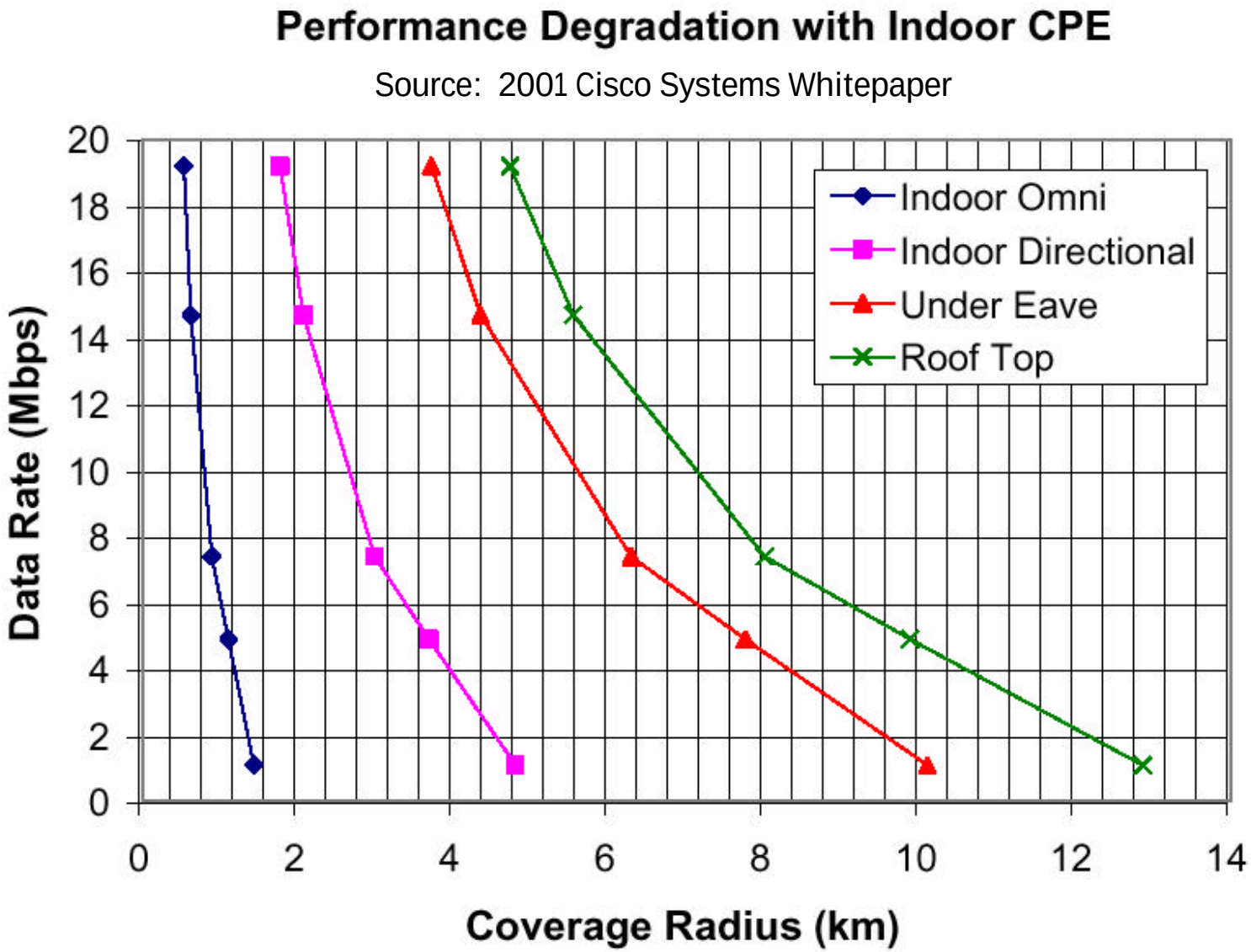
Installation Costs

Roof Top Mount	Under Eave or Window Mount	Indoor Self Install
$250 - $300	$100 - $150	$0
Trained Installer	Install similar to DSS	No Expertise

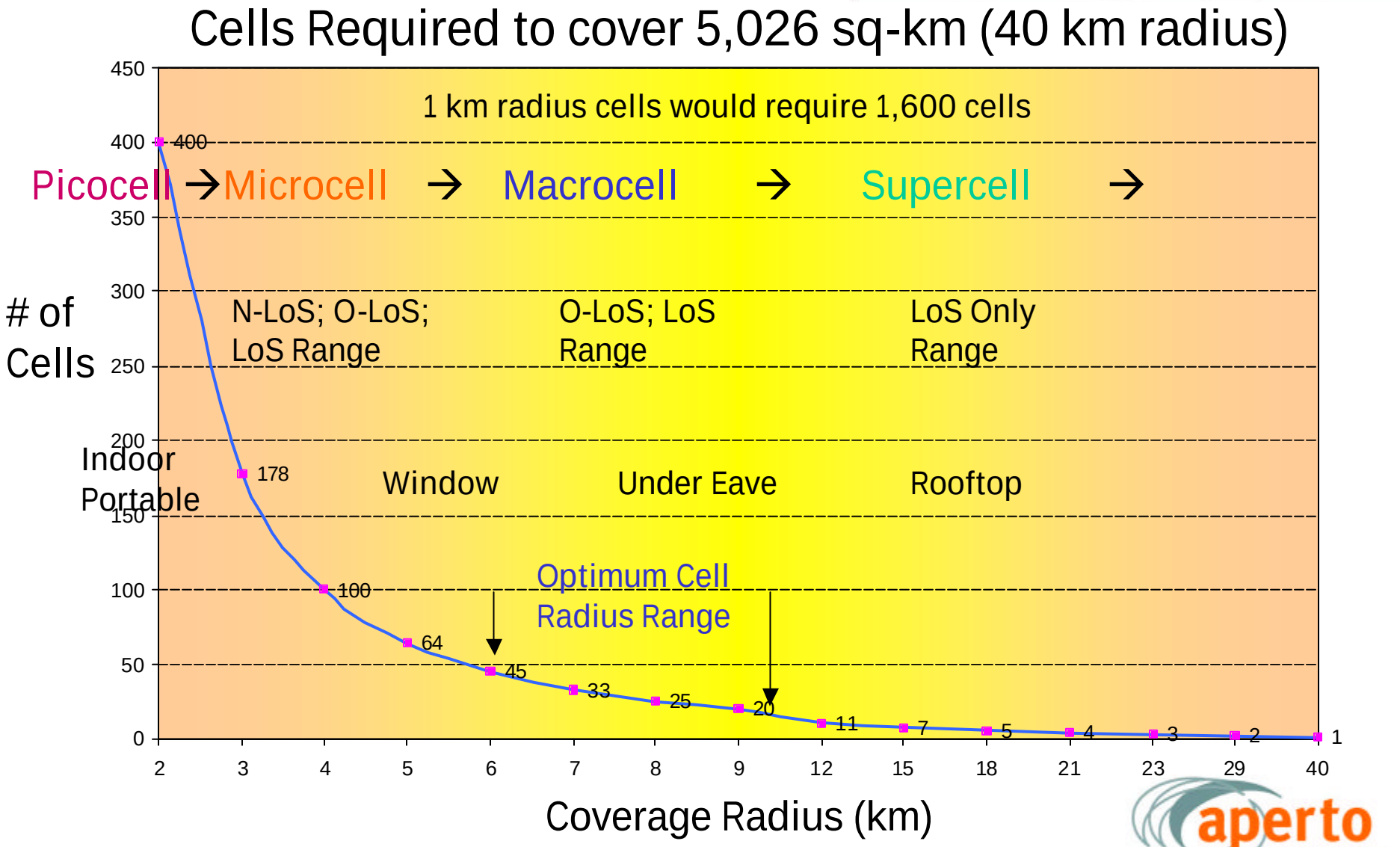
Equipment Costs

- Depending on functionality & volume
- → $1,500 → $1,000 → $500 →

The True Cost of Indoor CPE



Cell Radius & Infrastructure Cost



Impact of Indoor CPE on Cell Size

- Coverage limited to ~ 2 km radius
- 100 times higher infrastructure cost than under-the-eave antenna mount
- 1/10 the performance and capacity of under-the-eave antenna mount
- Limited to only residential services

Portability

- 802.11b now a multi-billion $ market
- Public 802.11 networks proliferating as well as in the office and home
- 802.11 adapters are inexpensive (<$80) and integrated into laptops
- 802.11 is the dominant standard for portability

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Revenue Models

- Six-Sector Base Station with net TCP throughput over 80 Mbps using only two 6 MHz channels

	SOHO	Small Business	Medium Business
Throughput	512 kbps down & 256 kbps up	768 kbps down & 384 kbps up	1 Mbps down & 512 Kbps up
Statistical Multiplexing	10:1	5:1	3:1
Subscribers	1,080	360	165
Monthly Fee per Subscriber	$90	$250	$500
Annual Revenue	$1,166,400	$1,080,000	$990,000

Revenue Model – Subscriber Mix

- Single Cell serves 485 subscribers (Mix of Medium/ Small Business & SOHO) using 1 Base Station and generates annual revenue over $1M

6 sectors - Single channel/sector						
	Downstream	Upstream	Stat. Mux	Total	Monthy	Monthly
	BW (Mbps)	BW (Mbps)	N:1	Sub's	Price	Revenue
Medium Business	1.00	0.512	3	45	$500.00	$22,500
Small Business	0.768	0.384	5	180	$250.00	$45,000
SOHO	0.512	0.256	10	260	$90.00	$23,400
				485		**$90,900**
Single Base Station (with 6 channels)				Annual	Revenue:	$1,090,800

Business Model: Single Cell

Assumptions

- Initial capital investment for infrastructure $95K
- Operating cost $9K/ month
- Installs of 60% under-eaves & 40% rooftop
- Mix of SOHO, medium & small business subscribers rolled out over 12 months

Results

– Subscriber pays CPE & Installation Costs

- Operating Capital – $180K
- Payback by Month 8

– Service Provider pays 50% CPE & Installation Costs

- Operating Capital – $500K
- Payback by Month 12

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Conclusion: 2G Business Model

- Typical payback in less than 18 months
- Cellular deployment and QoS are critical for scaling capacity, coverage and cost
- Every cell must be a profit center
- Cell coverage radius and throughput have a huge impact on the economics
- Business services are a faster path to profitability; consumer services to follow