Municipal Broadband in the U.S.

Sharon E. Gillett,

Principal Research Associate

MIT Center for Technology, Policy & Industrial Development

Broadband Working Group Co-Chair

MIT Communications Futures Program,

Based on joint work with William Lehr & Carlos Osorio (MIT) and Marvin Sirbu (CMU)

April 2006

Public Policy and Municipal Broadband

- **State restrictions on municipal broadband upheld by Supreme Court**
  - 13 states had enacted limits on municipal communications
    - Varying restrictions on services, business model, approval process, imputed costs, cross-subsidy etc.
  - *Nixon vs. Missouri Municipal League,* March 2004
    - Telecom Act of 1996 does not pre-empt state restrictions on municipal entry, despite "any entity" language of section 253(a)
  - 5 new additions since: Pennsylvania, Colorado, Florida, Louisiana, Tennessee
  - But also some significant legislative defeats recently e.g. Texas, Indiana; is tide turning?

- **Federal proposals: Congressional ping-pong, 2005**
  - May, H.R. 2726 (Sessions): ban municipal communications if private offers in same area
  - June, S. 1294 (Lautenberg-McCain): ban state bans; anti-discrimination clause
  - July, S. 1504 (Ensign): broadly deregulatory (Titles I, II, VI); munis defer to private
  - Sept/Nov, H.R. xxxx (Barton-Dingell): network neutrality (sort of); ban state and federal bans on public BITS, VoIP, video (sec. 409)

  Sources: American Public Power Association (www.appanet.org);
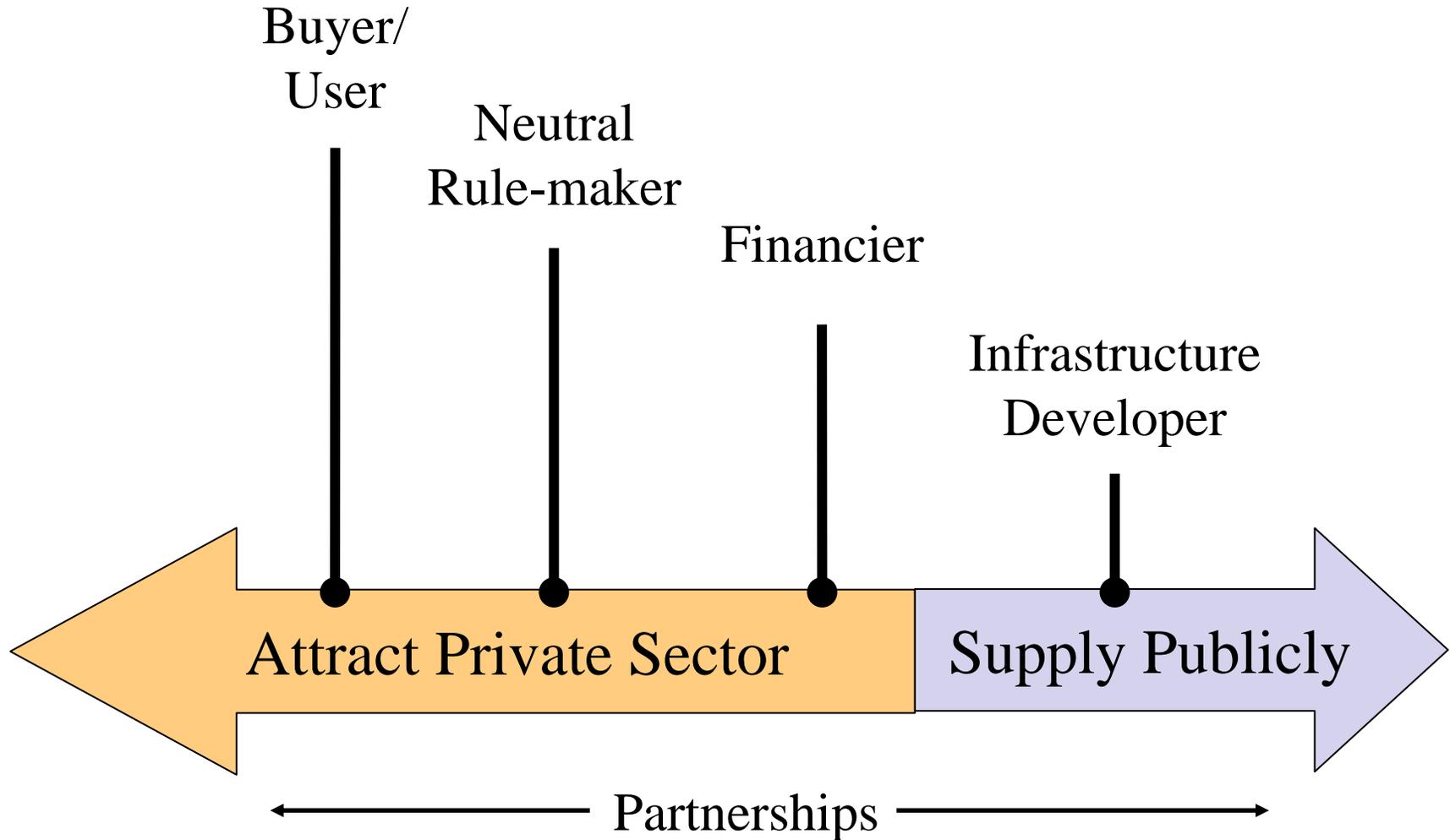 Baller Herbst Law Group (www.baller.com)

Key Takeaways

- **Local governments have range of options for stimulating broadband**
  - Not all require local government to fund network construction!

- **Number of U.S. cities and counties sponsoring broadband networks is small, but growing**
  - Wired networks mostly limited to communities with public electric utilities
  - Wireless networks growing much more quickly

- **Municipal wireless follows three basic models**
  - (1) Self-provision communications to meet city's own needs
  - (2) Serve the public directly
  - (3) Public-Private Partnerships (hybrid) – typical in major cities

- **Partnerships typically leverage existing city resources**
  - Implies need for inventory
  - City resources include city facilities, infrastructure, and buying power (city's comms demand)
  - Strategic decision whether to exploit city resources for direct or indirect benefit

- **Real public policy issue is exclusivity, not competition per se**
  - How to manage multi-party access to city facilities? Treat like rights-of-way?
  - "Open access" (wholesale/retail split) model popular but fuzzy

Taxonomy:
Role of Government *vis a vis* Broadband

Buyer/ User

Neutral Rule-maker

Financier

Infrastructure Developer

Attract Private Sector

Supply Publicly

Partnerships

Government as Buyer/User

Type of Government Intervention	Examples
Measure Demand	• Demand Assessment (Surveys or online registration)
Stimulate Demand	• "Extension" programs (Training businesses in effective ICT use) • Community technology centers (Training citizens, primarily disadvantaged, in ICT use, e.g. Atlanta); • Sectoral pilots (E-government, distance education, telemedicine etc.) • Community information services (Web pages for local businesses and community groups, e.g. Blacksburg [Virginia] Electronic Village)
Aggregate Demand	• Buying Cooperative (Group pricing) • Anchor Tenant (Government's telecom contract in exchange for broader infrastructure availability, e.g. Chicago CivicNet)

Aggregation usually requires a regional approach

Government as Rule-Maker

Type of Policy	Examples
Access to Local Facilities	• Franchising/Licensing and Rights of Way (Use of streets and other public property) • Utility pole attachment (Rules for adding wires and equipment) • Zoning (Rules for facilities placement, esp. wireless antennas)
Coordinated Planning	• Conduit installation during road construction (e.g. Chicago CivicNet) • Antenna siting (e.g. Dubuque, IA)
Industry-specific Regulation	• Negotiation of cable franchise agreement (Cable system upgrades, deployment of networks for municipal use, schools and libraries, etc.)

More classic "policy" - at the local level

Government as Financier

Target of Subsidy	Examples
Providers	• Grants • Loans (typically at lower-than-market interest rates) • Tax Incentives
Users	• Equipment • Service (typically for a limited time)
Community Groups	• Planning Grants • Training • Non-profit deployments

Bigger pots at higher layers of government

Government as Infrastructure Developer

| Decision Factor	Options
Targeted Users	• **Government** (including schools, municipal facilities) • **Businesses** • **Residents**
Type of Infrastructure	• **Ducts or conduit** (possibly with dark fiber) • **"First mile" network** (connections to customer premises) • **Interconnection point(s)** (e.g. neutrally administered "carrier hotel") • **"Middle mile" connection** (backhaul links to other locations)
Technology (when applicable)	• **Wireless** (unlicensed or licensed) • **Wired** (copper, hybrid fiber-coax, fiber)
Services	• **Broadband** (Internet access, other data communications) • **Video** (cable TV) • **Voice** (telephony)
Government Responsibility	• **Finance** (bonds: special issue or general obligation) • **Build** (may contract to private sector) • **Operate** (may contract to private sector)
Business Model	• **Wholesale** (local government sells capacity to carriers, or leases dark fiber to anyone but with no associated service, or provides "open access" platform to multiple ISPs) • **Retail** (local government sells higher-level services to end users)

Almost entirely local

Wired Municipal Broadband:
Dominated by Public Electric Utilities

U.S. Muni Electric Utilities Doing Communications

Of about 2,000 MEUs in U.S.
Source: American Public Power Association (APPA)
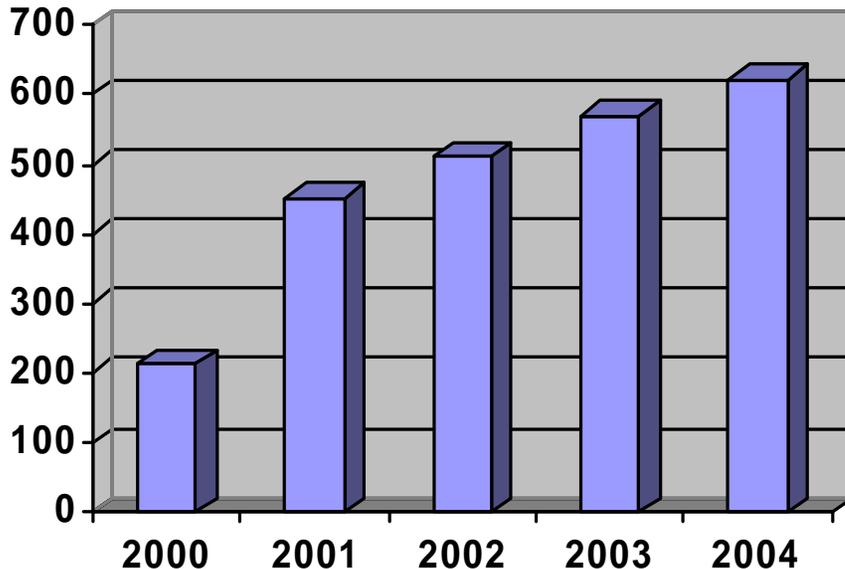
Technologies
Fiber backbone / ring
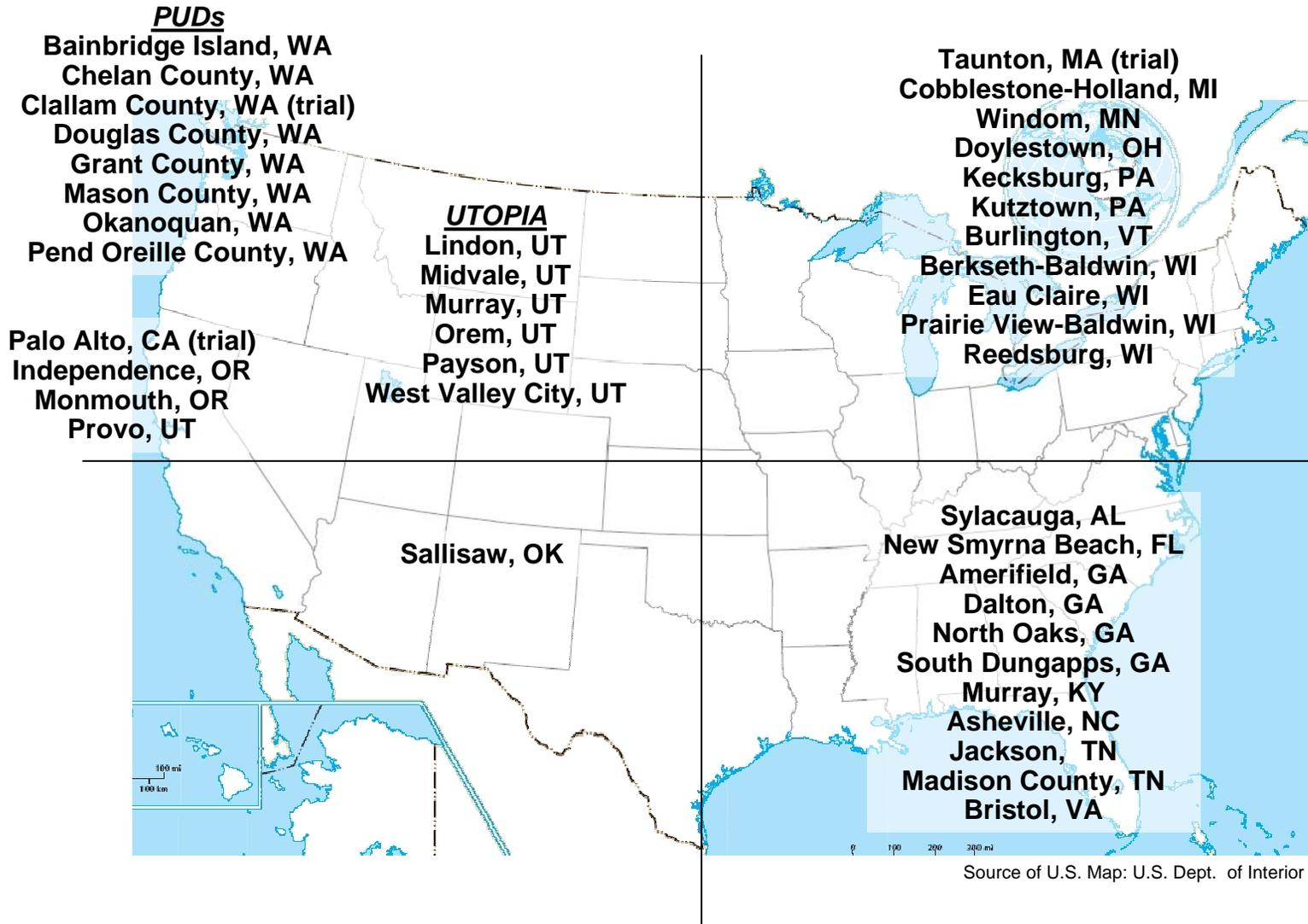Fiber to user's premises (FTTP / H / X)
Hybrid fiber coax (HFC, aka "cable")
Broadband over power lines (BPL)

Services in APPA Survey

Internal Utility Services	•**Internal telephone service** •**Automated meter reading** •**System control & data acquisition**
Government Services	•**Data services for municipal gov't**
External Services, primarily residential / consumer	•**Cable television** •**Local, l-d telephone** •**Video on demand** •**Wireless services*** •**ISP (incl. Dialup)*** •**Broadband modem*** •**FTTH***
External Services, primarily business / commercial	•**Leased (private) lines*** •**(Dark) Fiber leasing***

*In 2004, 253 of the 621 utilities shown offered at least one of these external bb-related services

Municipal Fiber to the Home, 2005

PUDs
Bainbridge Island, WA
Chelan County, WA
Clallam County, WA (trial)
Douglas County, WA
Grant County, WA
Mason County, WA
Okanoquan, WA
Pend Oreille County, WA

Palo Alto, CA (trial)
Independence, OR
Monmouth, OR
Provo, UT

UTOPIA
Lindon, UT
Midvale, UT
Murray, UT
Orem, UT
Payson, UT
West Valley City, UT

Sallisaw, OK

Taunton, MA (trial)
Cobblestone-Holland, MI
Windom, MN
Doylestown, OH
Kecksburg, PA
Kutztown, PA
Burlington, VT
Berkseth-Baldwin, WI
Eau Claire, WI
Prairie View-Baldwin, WI
Reedsburg, WI

Sylacauga, AL
New Smyrna Beach, FL
Amerifield, GA
Dalton, GA
North Oaks, GA
South Dungapps, GA
Murray, KY
Asheville, NC
Jackson, TN
Madison County, TN
Bristol, VA

Source of U.S. Map: U.S. Dept. of Interior

The Non-Utility Exception:

UTOPIA

From www.utopianet.org:
UTOPIA is a consortium of 14 Utah cities engaged in deploying and operating a 100% fiber optic network to every business and household (about 140,000) within its footprint. Operating at the wholesale level, it supports open access and promotes competition in all telecommunications services.

- **Wholesale-retail split**
  - Required by law in WA and UT
  - Rarely appears voluntarily

- **Utopia retail service providers**
  - MStar - Voice, Video, Internet
  - Xmission - Internet
  - AT&T - Internet
  - Veracity - Internet
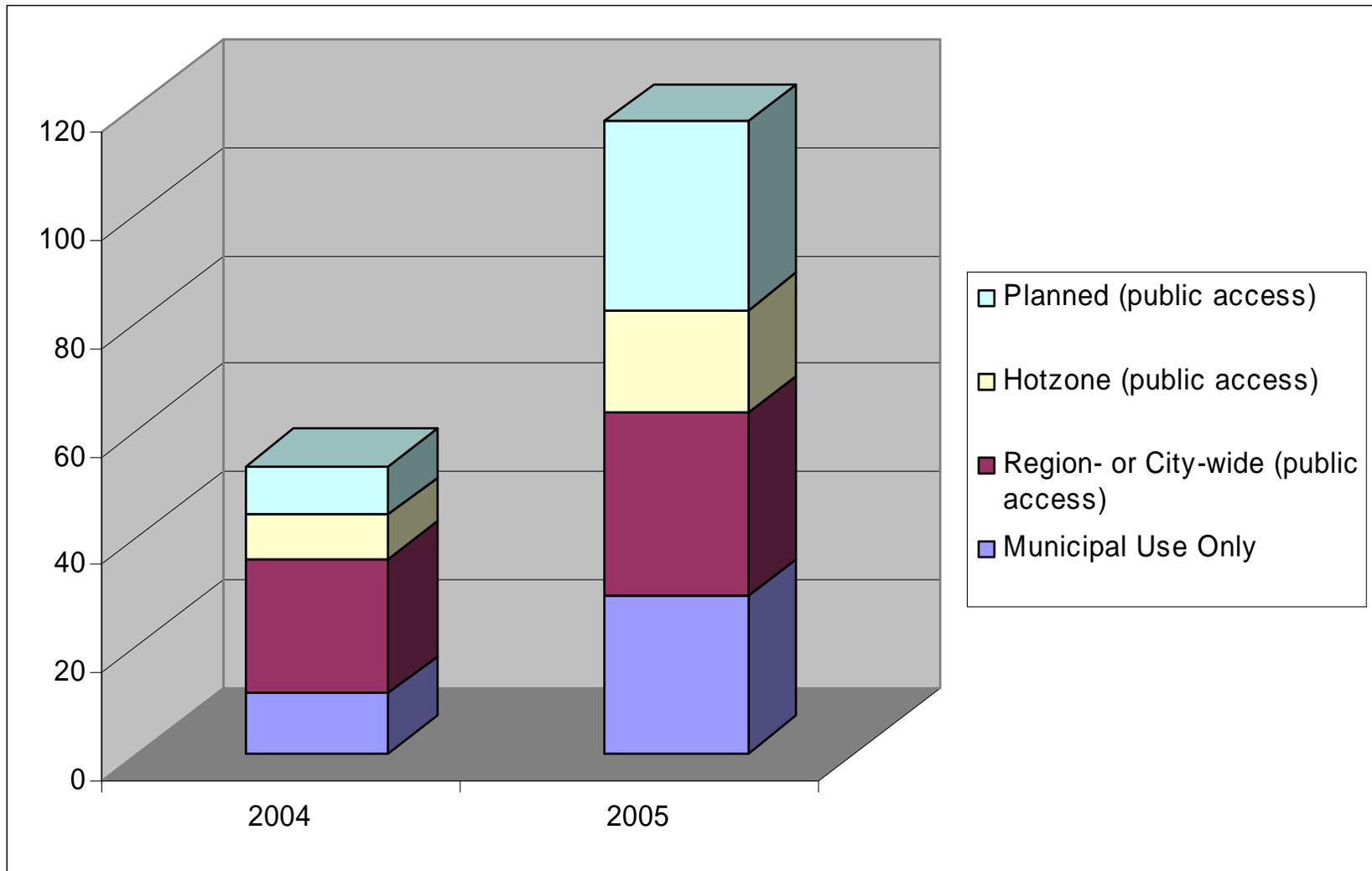
Courtesy of UTOPIA. Used with permission.

The Unlicensed Wireless Wildcard

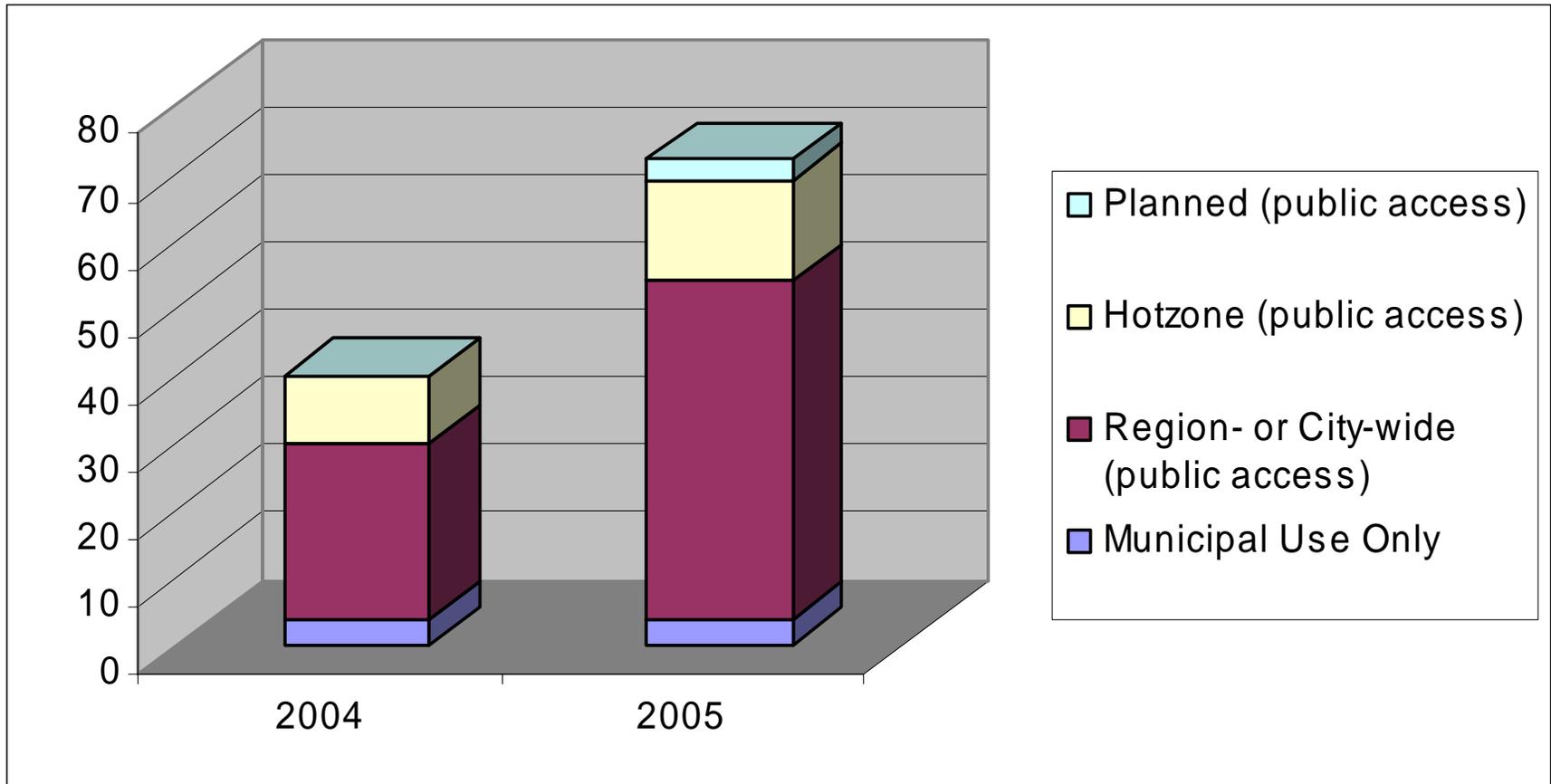*Complements Traditional Carrier Models*
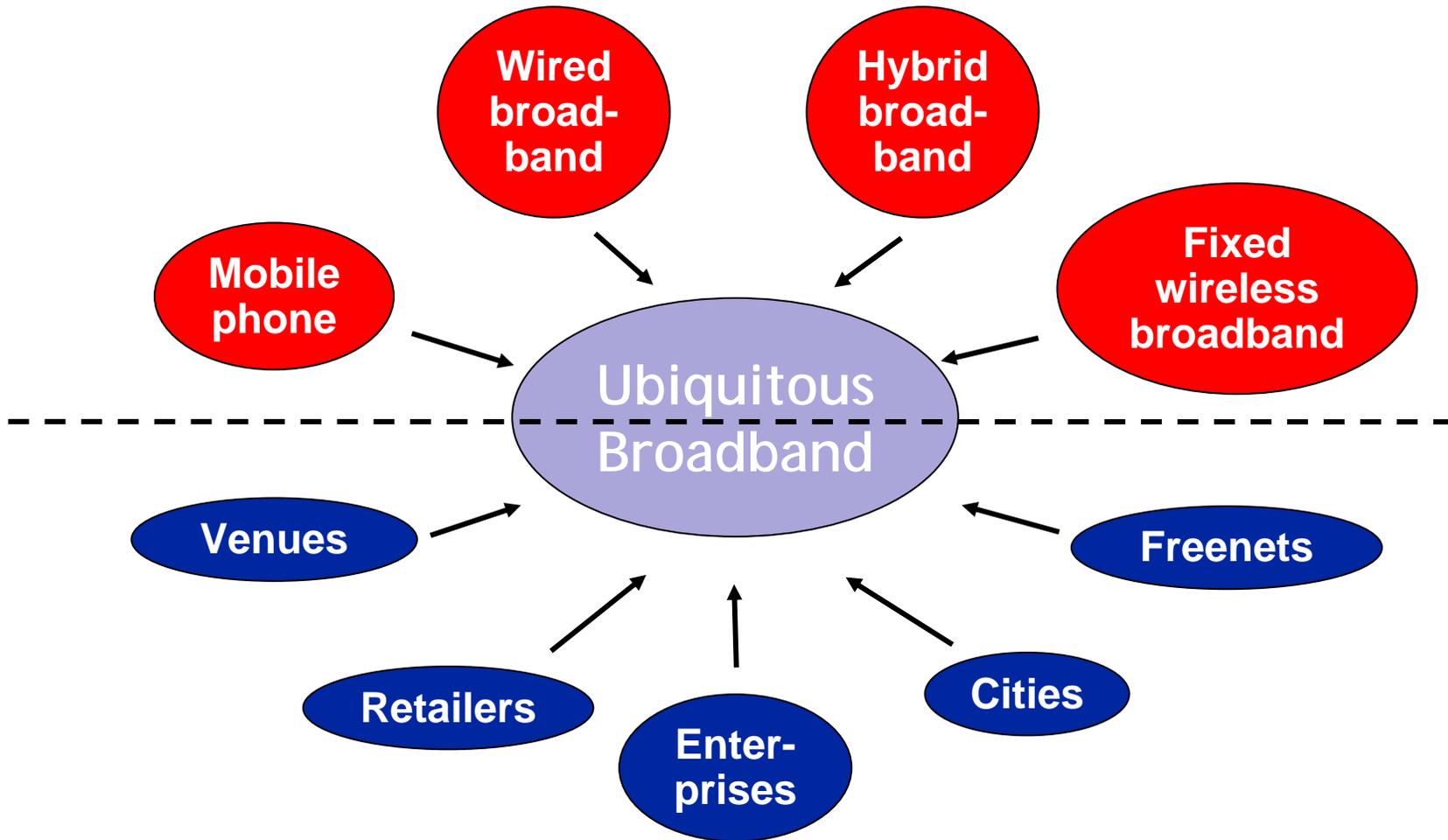
Enables Unconventional Infrastructure Models

U.S. Muni Wireless Deployments

Source: MuniWireless.com Anniversary Reports (Esme Vos)

Non-U.S. Muni Wireless Deployments

Source: MuniWireless.com Anniversary Reports (Esme Vos)

Model 1:
Self-provision Wireless to Meet City's Own Needs

- **Part of broader "Customer-owned Network" trend (fiber and wireless)**

- **Enabled by unlicensed wireless spectrum**

- **Motivation: More bandwidth and/or more ubiquitous coverage → more efficient city services for less money**

- **Dominated by public safety today, but future possibilities limited only by imagination**
  - Homeland security and emergency preparedness in addition to day-to-day policing
  - Other mobile city workforce (inspectors, meter readers, …)
  - Sensor (RFID)-based applications (parking meters, traffic lights, rubbish bins…)
  - Urban traffic and parking management (e.g. Denver, CO)
  - Road maintenance (potholes)

City's Own Use:
Customer-Owned Network in San Mateo, CA

- **Public Safety Network**
  - Wi-Fi mesh network, on city-owned light poles
  - All HQ broadband applications now mobile
    - Mug shots, fingerprints , Amber alerts, GIS data, HazMat data
  - New applications easily enabled
    - Real-time video surveillance, VoIP
    - Mobile, tactical broadband networks

- **Low cost**
  - $50k grant funding
  - Lower cost than the 19.2Kbps data radio system it replaced
  - "Edge" investments replace recurring costs
  - Same user equipment works in car and at HQ

Several figures removed for copyright reasons

Significant Productivity and Efficiency Improvement

Sources: Ron Sege, Tropos; Muniwireless.com

AllCoNet: Intranet for Allegany County, Maryland

Figures removed for copyright reasons.
See http://www.allconet.org/

Model 2:
Serve the Public Directly

- **Hotspots, businesses, or homes**

- **Motivation: digital divide, economic development**

- **City-wide deployments dominated by communities with publicly owned electric utilities**
  - E.g. Chaska, MN and Scottsburg, IN
  - Already have all the customer-service staff and infrastructure in place
  - Can often build on a municipally owned fiber ring already in place
  - These communities are "special" and not particularly good templates for larger, non-MEU communities

- **Hotspots**
  - Churn evident (half of 2004 list gone by 2005)
  - Many other actors also provide
  - But, cities can fill unique niche *vis a vis* digital divide

Serving the Public Directly:
Ellaville, Georgia Municipal Electric Utility

Map removed for copyright
reasons.

- **Population <2,000**

- **3 antennas on City's main water tank**
  - 2.4 GHz LOS (Alvarion) + 900 MHz N-LOS (WaveRider) – trees!

- **$200,000 upfront cost**

- **Users pay for service (~1 Mbps @ $30-45/mo), modem ($200) + antenna ($100-150)**

- **1.5 Mbps backhaul (ouch)**

Small Cities Serve Their Own
http://www.isp-planet.com/fixed_wireless/business/2002/municipal.html
June 25, 2002   **www.epride.net**

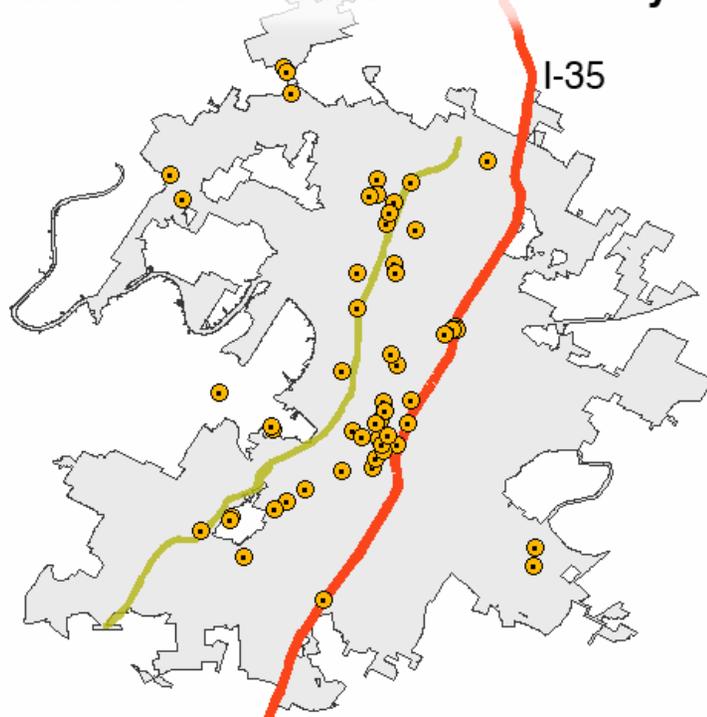Wi-Fi Hotspots by Location (Worldwide 2001-2004)
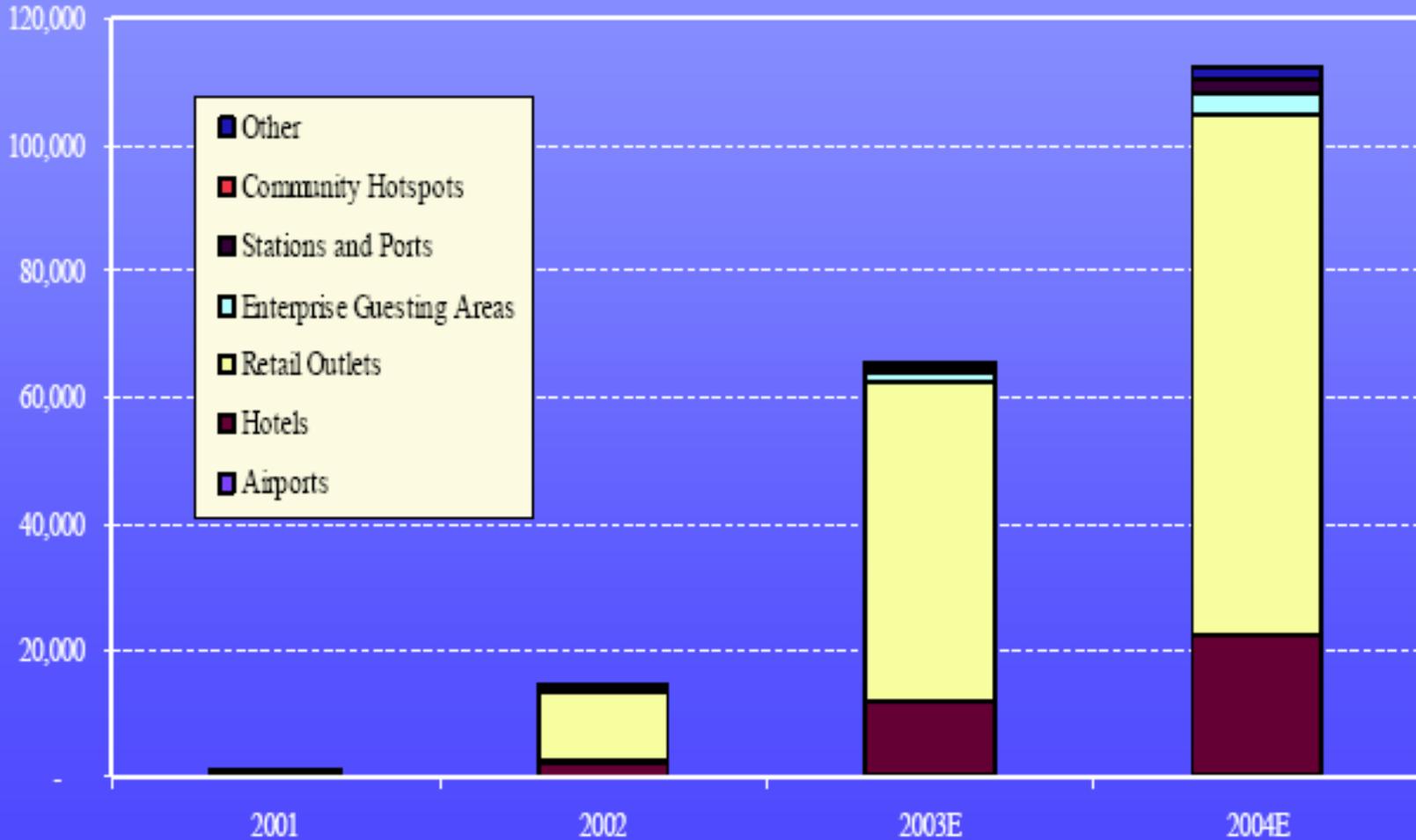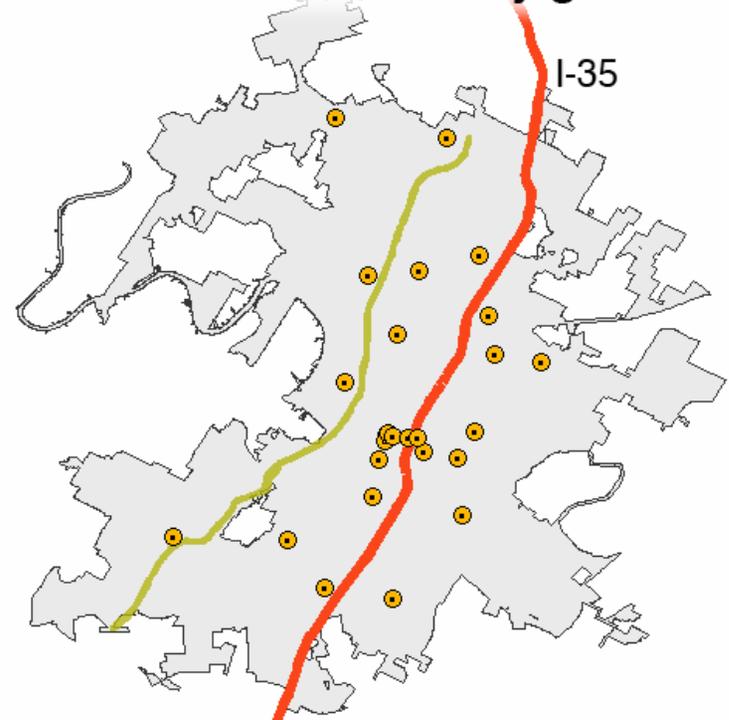
Source: Gartner Dataquest, June 2003

Kenneth R. Carter

Source: Kenneth Carter, FCC, April 16, 2004 presentation

City's Role in Narrowing Digital Divide: Public-Private Hotzones in Austin, Texas

Courtesy of Martha Fuentes-Bautista and Nobuya Inagaki. Used with permission.

AWCP=Austin Wireless City Project

Source: Martha Fuentes-Bautista and Nobuya Inagaki, "Wi-Fi's Promise and Broadband Divides: Reconfiguring Public Internet Access in Austin, Texas," Telecommunications Policy Research Conference, September 2005, www.tprc.org

Model 3:
Public Private Partnerships (PPP)

- **Hybrid approaches typically addressing needs of both city and community**

- **Motivation: Economies of scope**
  - Leverage city resources to reduce cost, improve quality of city services *and* facilitate entry by non-muni actors (private sector and non-profits)

- **Dominant model among planned initiatives in major cities**

Public-Private Partnership:
Cerritos, CA Dual-Use WiFi Mesh Network

- *Fast and simple*
  - Commodity 802.11b clients
  - Less than 1 month to install

- *True metro-scale*
  - 9 sq. miles
  - 17,000 homes passed
  - 50,000 residents

Figures removed for copyright reasons.

- *Low cost to own and to operate:*
  - <$600k *total* CAPEX
  - *One* wired backhaul link for the network
    - POP to Internet
  - No special CPE; no truck rolls
  - $15 opex/sub @15% penetration

- **Bands used: 2.4 GHz**

Source: Ron Sege, Tropos

Glendale School District, Flinton, Pennsylvania

Map removed for copyright reasons.

- **$457,000 "digital divide" grant - GAIN**

- **Extend wireless bb Internet access from school to nearby communities, schools**

- **Mobilize community support for "100 laptops" – tech and job skills training**

Diverse PPP approaches

- **Philadelphia, PA**
  - City leases to Earthlink access to city fixtures for wireless antenna placement
  - City requires "open access" i.e. wholesale access for other ISPs on resulting Earthlink network
  - Earthlink agrees to invest $10-15m and charge "low" wholesale rates
  - Wholesale profits feed into digital divide funds (taxation by another name)
  - Analogous to cable franchise, but many details still not clear / public

- **Anaheim, CA**
  - Exclusive deal with Earthlink, but "open access"

- **Tempe and Chandler, AZ**
  - Non-exclusive deal with NeoReach

- **San Francisco, CA**
  - Six proposals; Earthlink+Google selected
  - Google/Earthlink and SF Metro Connect both proposed free-to-end-user access + advertising support + options for paid service tiers

Will Broadband be "Free"? (TANSTAAFL)

- **Normative: *Should* be free, as a matter of equity**

  – Externality benefit from those who wouldn't otherwise be on net

  – Analogous to public libraries
    - Info access key to democracy
    - Compete with bookstores, but limited

  – Expect some users will pay for more: support, bandwidth, etc.

- **Positive: Cost structure makes "free" more efficient**

  – Low capital costs of wireless

  – Effectiveness of targeted (Google) ads as revenue source

  – But: Operational costs?
    - Billing (no)
    - Support
    - Bandwidth (middle-mile)
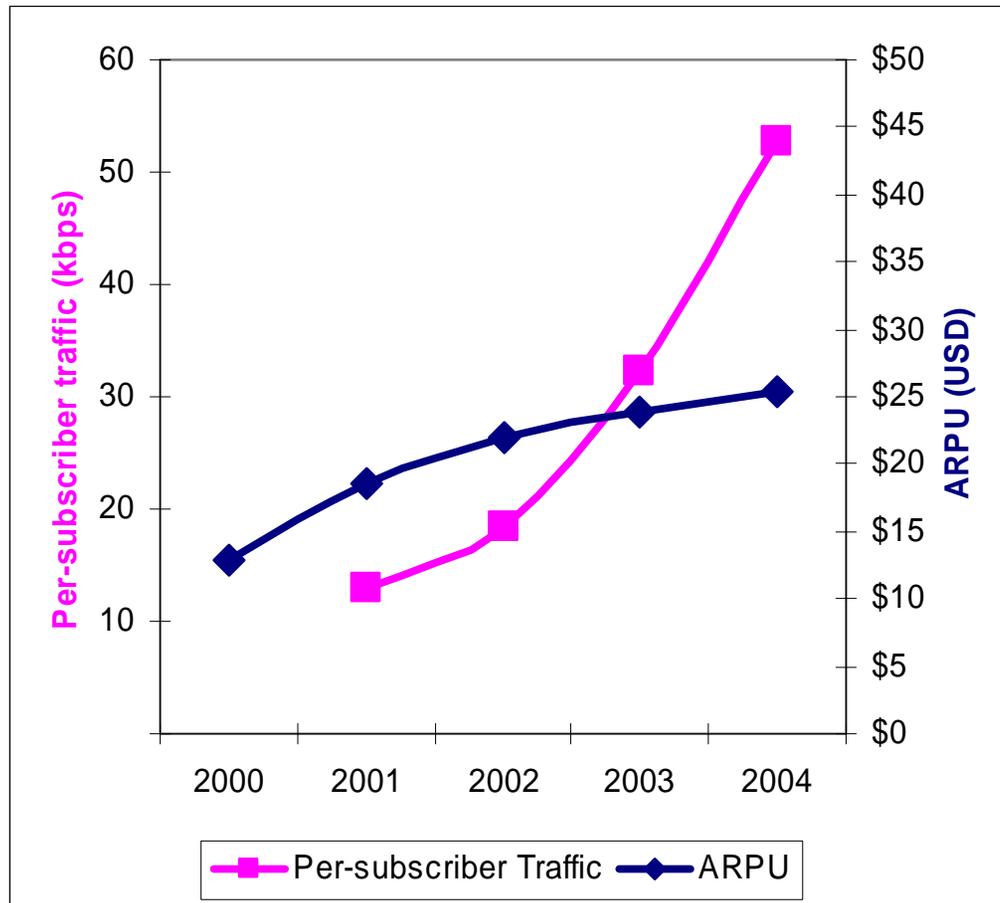
Korea Telecom Traffic vs. Revenue Growth

Sources: Korean Times, KT Seeks Usage-Based Internet Pricing, 3/29/05; KT Corporation 2004 Annual Report.

Partnerships: Leveraging City Resources

- **Infrastructure-based resources**
  - Traffic and street light poles
  - Underground conduits
  - Rooftops of municipal buildings (antenna placement / real-estate model)
  - Towers (water, fire, etc.)
  - Fiber rings/backhaul connections
  - Essentially, any right-of-way or city property that facilitates wireless networking

- **Impact of building and zoning codes**
  - Requirements for conduit, antenna placement, etc.
  - E.g. Loma Linda, CA required builder to install fiber for any new subdivision

- **City's buying power is also an important resource**
  - Demand aggregation / anchor tenant strategies

Best Practice Partnerships Avoid Exclusivity

- **Consider exclusivity at three "layers"**
  - Access to physical facilities (e.g. light poles)
  - Access to connected network
  - Access to city as customer (buying power)

- **In the process of facilitating the first wireless entrant, don't accidentally hinder the next one**
  - There can and will be many wireless networks, services, business models, etc.
  - Not all will look like traditional service providers (e.g. organic mesh networks)

- **How to manage multi-party access to city facilities?**
  - Consider treating like rights-of-way

- **"Open Access" Model Proving Popular**
  - Generally, means multiple competitors use a common shared network infrastructure, and customers can elect services from alternative suppliers
  - But requires clarification along many dimensions

Open Access Decision Points (1)

- **To which services?**
  - Voice telephony
  - Data (ISP): Internet access
  - Data (transport): broadband "circuits"
  - Video: broadcast TV, VoD

- **At what (technical) layer?**
  - Physical
  - Data link
  - Network/IP

Open Access Decision Points (2)

- **With what partnership model?**
  - Legal structure of network operator, partnership?
  - Network operator also competes at retail?
  - What control over identity and number of service providers?
  - Who bills customer? Who pays whom on what basis?
  - Wholesale prices negotiated or regulated?

- **What shared facilities beyond "last-mile" distribution?**
  - Shared middle-mile backhaul to tier 1 ISPs
  - Shared ISP peering point (NAP or IXP)
  - Shared telephony gateway
  - Shared video head end

Amsterdam, Netherlands

Architecture diagram removed for
copyright reasons.

Source: Figure 1 in http://www.citynet.nl/upload/Wholesale-bandwidth-Amsterdam-Citynet.pdf

Publications on Municipal Broadband: MIT Communications Futures Program

William H. Lehr, Marvin A. Sirbu, and Sharon E. Gillett, "Wireless is Changing the Policy Calculus for Municipal Broadband" Government Information Quarterly, forthcoming.

Marvin A. Sirbu, William H. Lehr, and Sharon E. Gillett, "Evolving Wireless Access Technologies for Municipal Broadband" Government Information Quarterly, forthcoming.

Sharon E. Gillett, William H. Lehr, and Carlos Osorio, "Municipal Electric Utilities' Role in Telecommunications Services," Telecommunications Policy, forthcoming.

Sharon E. Gillett, William H. Lehr & Carlos A. Osorio. "Municipal Trends," Broadband Properties Magazine, September 2004. Excerpted from "The Municipal Role in U.S. FTTH Market Growth," FTTH Council's 3rd Annual FTTH Conference & Expo, October 3-6, 2004, Orlando, FL.

Marvin Sirbu, William Lehr, and Sharon E. Gillett. "Broadband Open Access: Lessons from Municipal Network Case Studies," 32nd Annual Telecommunications Policy Research Conference, October 1-3, 2004, Arlington, VA. Also see Case Study Appendix.

Sharon E. Gillett, William H. Lehr, and Carlos Osorio, "Local Government Broadband Initiatives," Telecommunications Policy 28, August/September 2004, pp. 537-558.

Carlos A. Osorio, "Bits of Power: The Involvement of Municipal Electric Utilities in Broadband Services," MIT MS Thesis, June 2004.