Roadmapping Broadband

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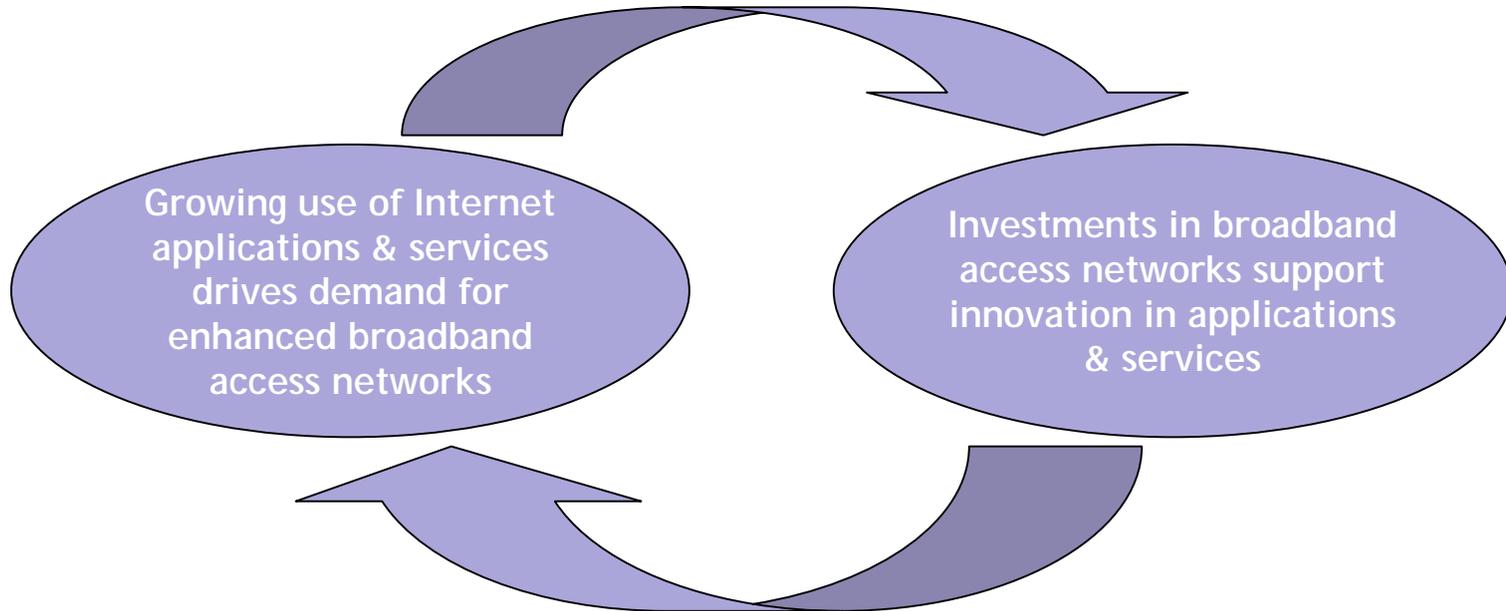January 27, 2005

Broadband Roadmap Matters Across Value Chain

Networked User Experience

User Devices, Appliances
Cell phones, PDAs, PCs, TVs, …

Applications & Services
Software, Telework, Gaming, Telephony, VoD, …

Network Equipment & Systems Integration
Base stations, routers, OSS, …

Network Connectivity
Mass market local, metro, wide area + interconnection

Components
Chips, amplifiers, batteries, …

Materials & Process Equipment
Optical fiber, fabrication equipment, …

Goal: Roadmap Evolution of Broadband Ecosystem

- **The "virtuous cycle" ideal**

Growing use of Internet applications & services drives demand for enhanced broadband access networks

Investments in broadband access networks support innovation in applications & services

- **Identify barriers; Work to remove**
  - White papers, cross-value-chain discussion, technical + interdisciplinary research

- **Identify opportunities**

Accomplishments to Date: 2-3 Areas of Focus

- **Group began meeting in November**
  - Bi-weekly meetings/conference calls since; robust discussion

- **"Broadband Usage Cost Recovery"**
  - **Problem**: Mismatch between current broadband pricing models and virtuous cycle
  - **Status**: Problem identified; small group meeting; white paper drafted (edits ongoing)
  - **Contact**: John Watlington (FT)

- **Personal Broadband**
  - **Problem**: Today's broadband experience far from seamless or easily customized to user's choices / preferences
  - **Status:** Topic being refined; Small group in formation; Proposal for white paper
  - **Contact:** Hossein Moiin (T-Mobile), Dirk Trossen (Nokia)

- **Roadmapping Broadband**
  - **Problem:** How to think about rate of broadband evolution?
  - **Status:** Topic being refined; Gauge group interest
  - **Contact:** Sharon Gillett (MIT)

What We Learned: Usage Issue (1)

- **Yes there is a problem**
  - Try #2 on succinct explanation of its essence

- **Traffic volumes expected to increase for mass-market bb users**
  - Rate of increase uncertain, but early indications & plausible scenarios for rapid growth (video)

- **Short-term $\Rightarrow$ changes to access pricing models and/or network topology**
  - Issue is **recouping and/or reducing** usage-sensitive operational costs without throttling application innovation
  - Backhaul opex is primary short-term concern, but dimensioning of rest of network may also be affected in short- or medium-term
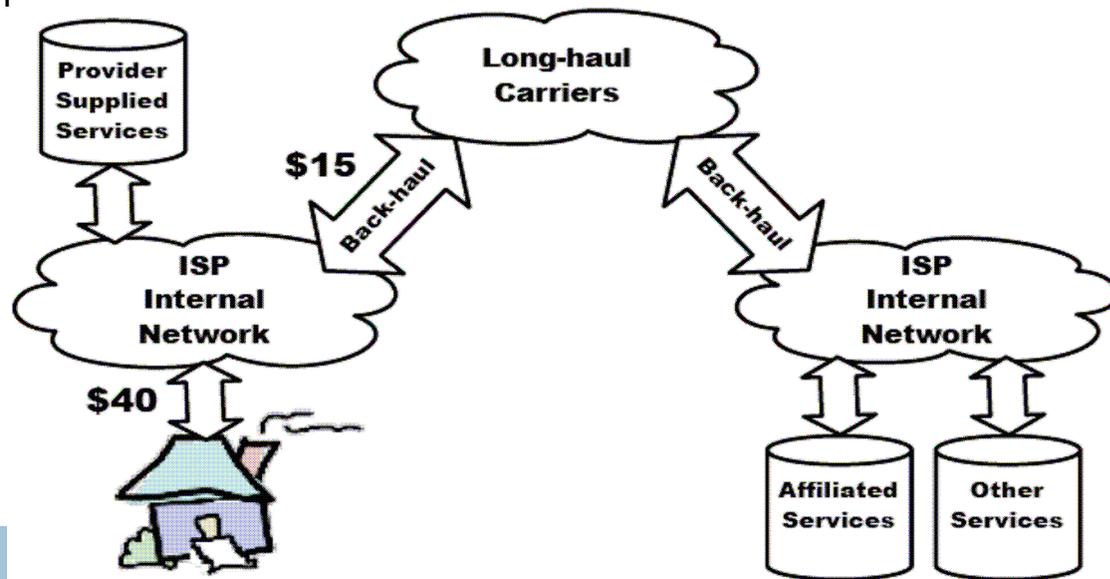
What We Learned: Usage Issue (2)

- **Long-term $\Rightarrow$ new architectures can wring major costs out of the network**
  - Payne & Davey proposing passive optical architecture: "Death of the Central Office"

- **Point of intersection with routing WG (inter-domain traffic)**

- **Analysis of real data related to this issue would have "virtuous cycle" benefits across value chain**
  - Data can be from multiple operators, anonymized, and aggregated
  - Benefits to operators from the analysis
    - Help limit exposure to traffic-sensitive costs
    - Help craft more user-acceptable flexibility into pricing schemes

What We Learned: Personal Broadband

- **Broadband Vision**
  - Place $\Rightarrow$ Person (Lippman)
  - A series of capabilities (value chain?), not a product
  - An opportunity to be taken advantage of, not an "issue"

- **Historically, personalization of technologies boosts growth**
  - Desktop $\Rightarrow$ laptop PCs, household (fixed) $\Rightarrow$ mobile (personal) phones, TV $\Rightarrow$ TiVo, etc.

- **First steps taking place**
  - IRAP, etc.

- **Open questions / challenges**
  - User choice, trust-mediation, branding
  - Role of current operators, open WiFi, 3rd parties…
  - Context-awareness
  - Scalability
  - Diversity of challenges and potential solutions (technical, contractual …)

- **High level of interest from carriers, vendors and content providers**

Proposal: A Programme of Research by June 2005
As Agreed In Small Group

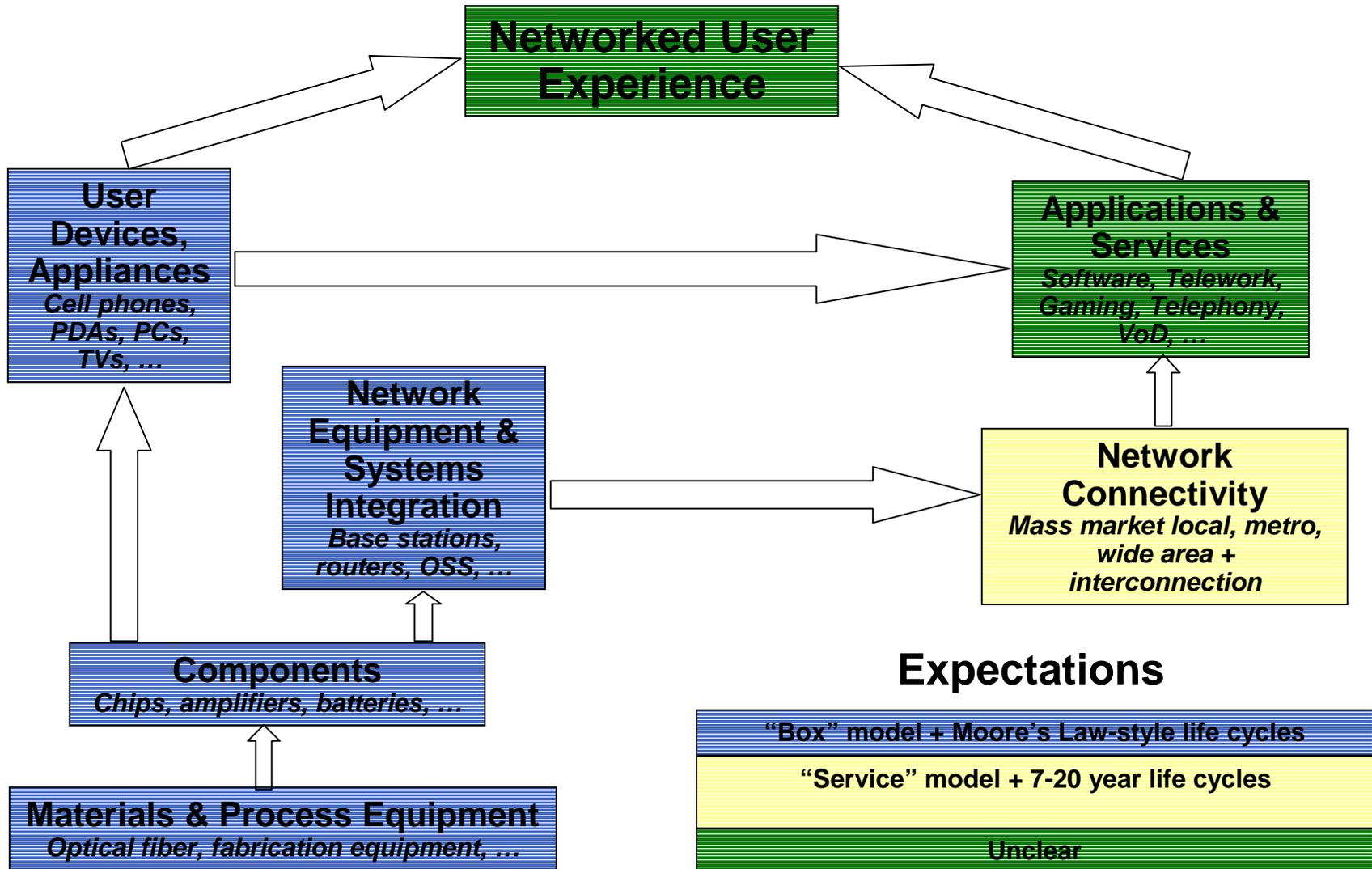|	**Description**
1. Vision (4/05)	• What would personal broadband look like & is it a good idea? • What services would it offer? What characteristics would it possess? • How would it benefit general public?
2A.Technology (6/05)	• What are the key technological barriers to the vision? • What are the potential approaches to removing these barriers? • Which of these holds most promise and should be pursued in CFP?
2B. Business (6/05)	• What are the key barriers to the vision (considering tussle and existing investments) on both the supply and demand sides (business or otherwise, e.g., micro-barriers)? • What are the potential approaches to remove those barriers? • Which of these holds most promise and should be pursued? • Incorporate regulatory, lesson from near industries, and consumption trends
Approach	• Small team to propose the vision, frame the questions and come up with initial answers (mix of academia and industry covering both technology and business issues) • Update the larger team (Broadband and Core-Edge working groups) and solicit input • Incorporate inputs and gain approval • Present Whitepapers in June to a broad audience outlining the programme of research
Process	• Use MIT/CFP BBWG & Core Edge (industry neutral, but heavily subscribed by various industries) to define and agree a vision and identify a programme of research to take to various standard bodies, corporations, institutions, etc

Current Team: MIT, Nokia, BT, FT, (Telus), (DT) Potential Contributors: ?
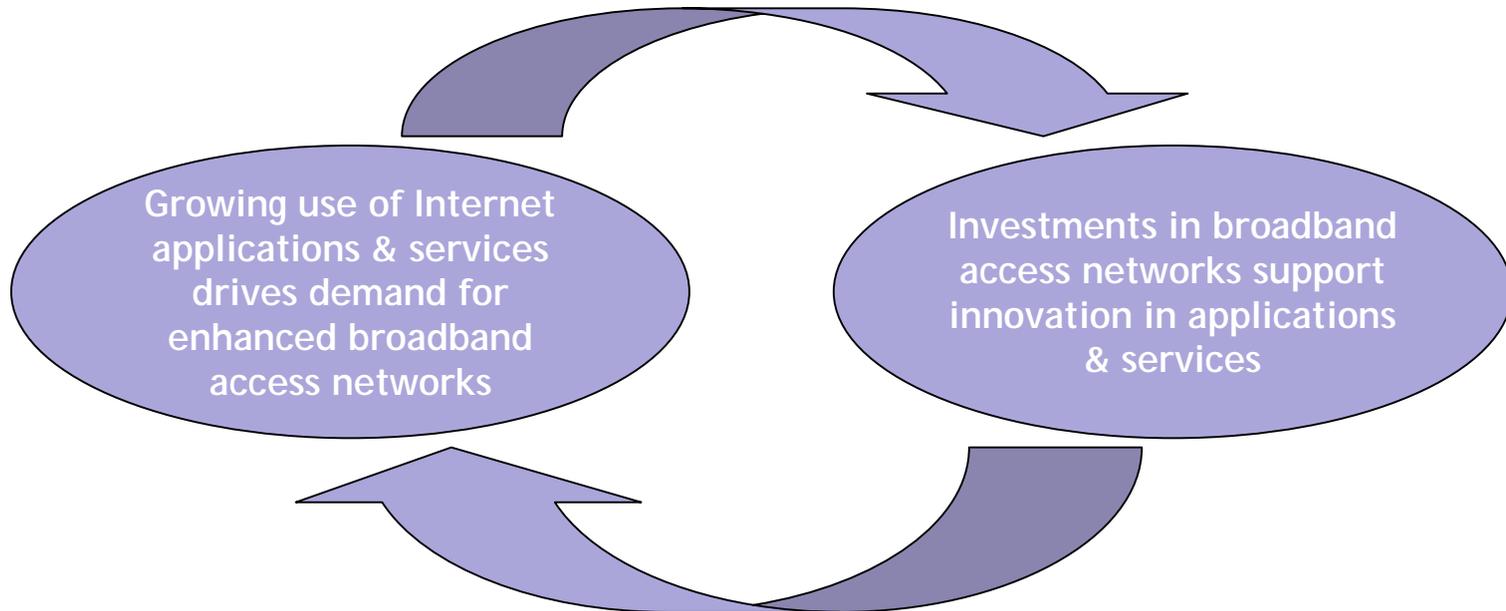
In-feed from BBWG Participants

- **Who else needs to be part of these discussions?**

- **I want to get notified of BBWG meetings/conference calls…**
  - Ask Rita Adom, <u>radom "at" mit.edu</u>, to add you to "broadband" email list
  - Agenda for Spring 2005
    - Refine "usage" white paper
    - Draft "personal" white paper
    - Develop "roadmapping demand" proposal

- **I want to participate in small group focused on ….**
  - Contact Sharon Gillett or John Watlington

- **What other questions are important?**
  - To your company
  - To health of overall value chain
  - Not adequately addressed elsewhere

What Clockspeed to Expect?

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Expectations

"Box" model + Moore's Law-style life cycles
"Service" model + 7-20 year life cycles
Unclear

Can Broadband Ecosystem Follow Moore's Law?

- **Implicit in "virtuous cycle" ideal of BBWG charter**

Growing use of Internet applications & services drives demand for enhanced broadband access networks

Investments in broadband access networks support innovation in applications & services

- **Previous talks identified specific barriers to virtuous cycle**

- **More general way to think about the problem?**
  - Make sure we have identified all the important barriers.

Methodology

- **Observe Moore's Law embodies implicit *dynamic* of ongoing ROI**

- **Characterize this dynamic explicitly**
  - Ex. System dynamics (causal loop) modeling
  - Quantitative calibration of underlying relationships where data available
  - Validate model by replicating reality

- **Map the dynamic to broadband ecosystem**
  - Deal with resulting questions

- **Assess where dynamic applies qualitatively**
  - Determine quantitative calibrations
  - Model can then suggest likely rate of evolution

- **Determine where it doesn't**
  - Consider potential for disruption that might change this – technical, regulatory, social…
 - E.g. viral nets convert "service provider" business to "box selling" business?

Moore's Original Observations

- **Transistor density doubling annually**

- **Cost per component declining exponentially**
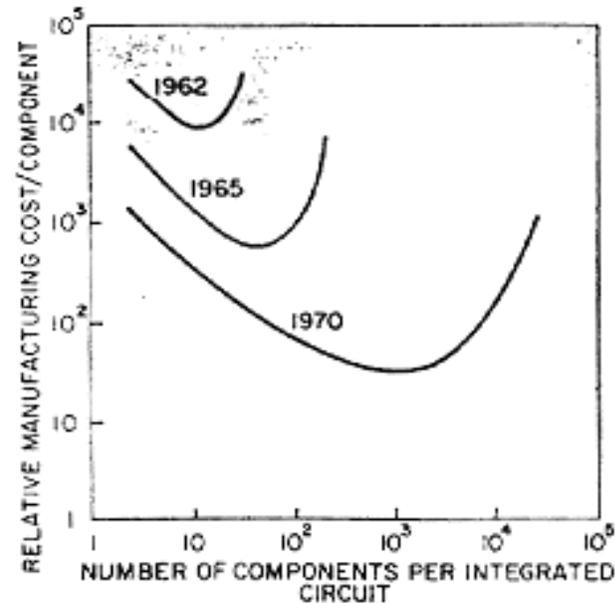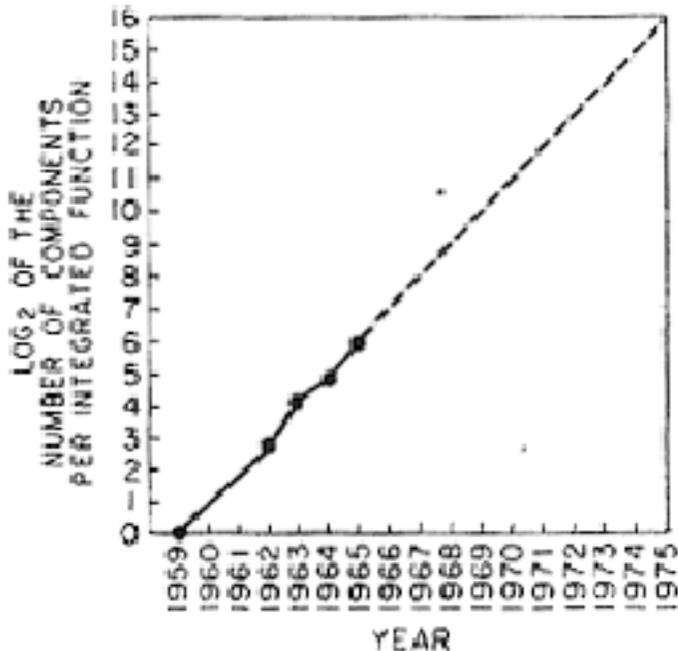
"Cramming more components onto integrated circuits." Gordon E. Moore, Director, Research and Development Laboratories, Fairchild Semiconductor. Published in *Electronics*, Volume 38, Number 8, April 19, 1965.

Typical Representation Today:
Doubling Every 18-24 Months

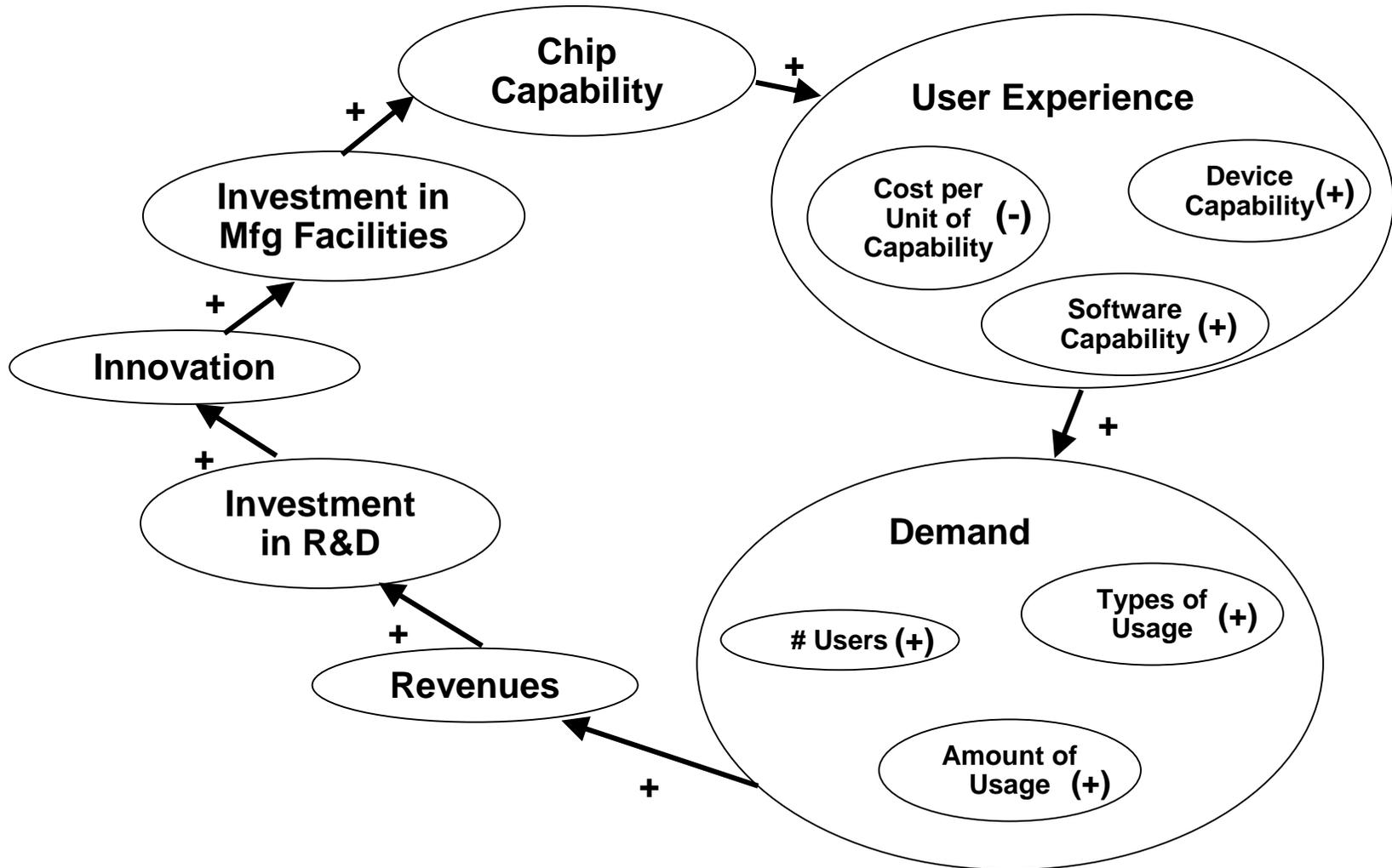http://www.intel.com/research/silicon/mooreslaw.htm
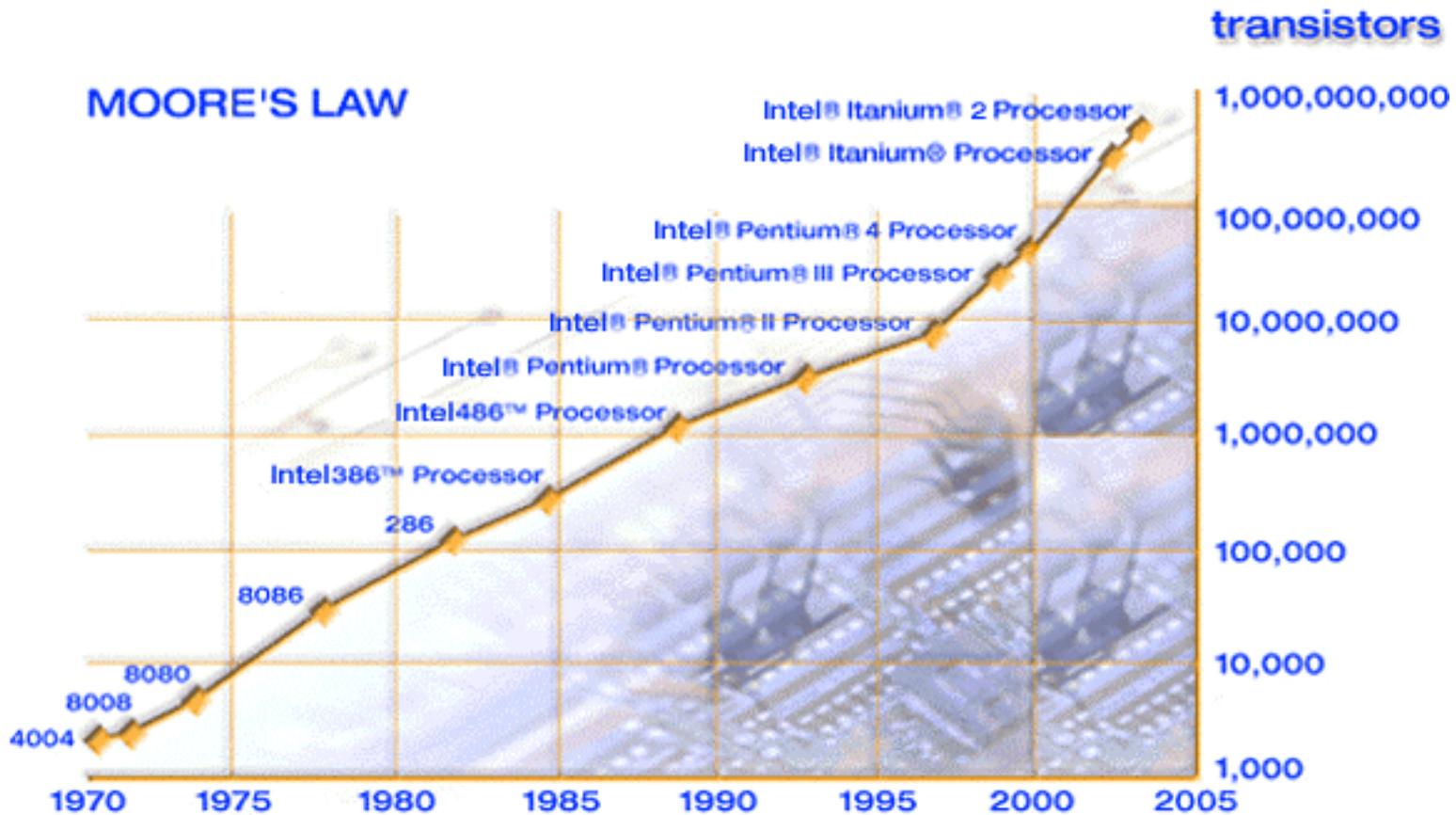
Why Moore's Law Matters

"Cramming more components onto integrated circuits." Gordon E. Moore, Director, Research and Development Laboratories, Fairchild Semiconductor. Published in *Electronics*, Volume 38, Number 8, April 19, 1965.

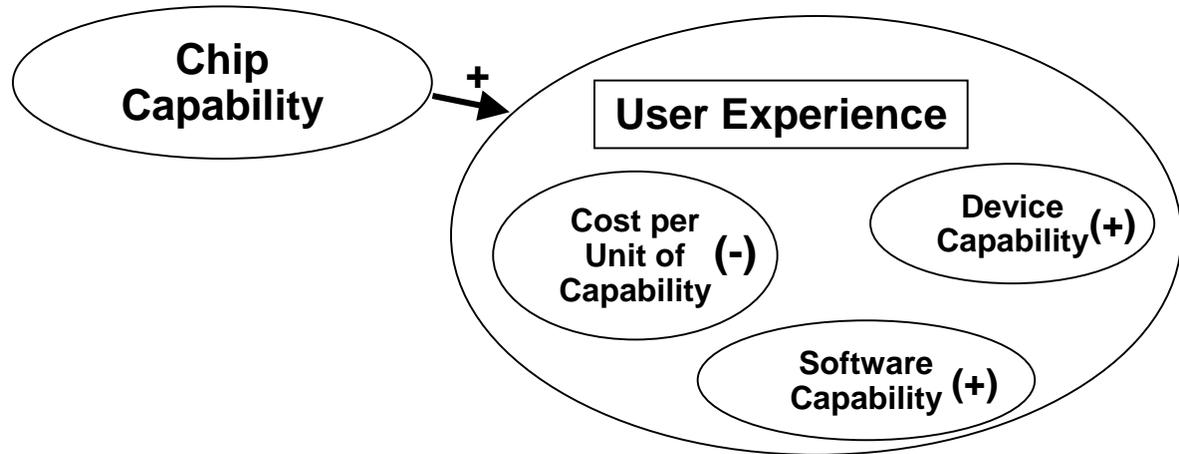# Moore's Law as Dynamic Model (Semiconductors)

Application to Broadband: Revenue Flows

- **Issue addressed by "Broadband Usage Cost Recovery" White Paper**

- **Relating demand growth to revenue growth**
  - Links must be there for positive feedback loop to work
  - For all forms of demand growth?
  - Revenues to *whom?*
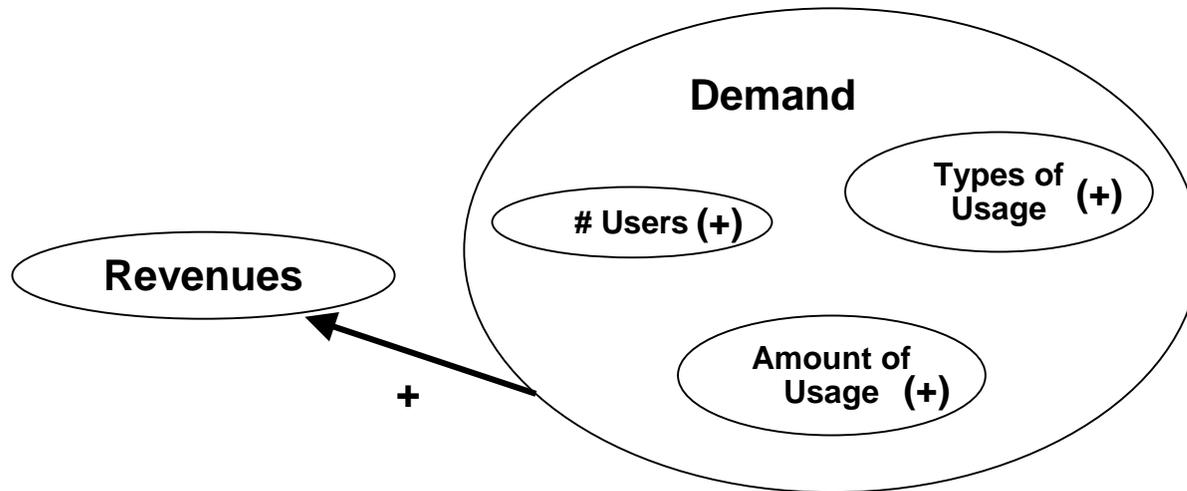
Application to Broadband: User Experience

- **Issue addressed by proposed "Personal Broadband" White Paper**

- **"Classic" technical performance metrics and monetary cost are not the only important aspects of user experience**
    - User choice, convenience, ease of use, trustworthiness etc. are also important dimensions
    - Can the "box"-oriented chip model capture such dimensions adequately?

Proposed Application to Broadband: Demand Growth

- **Objective: Map improvements in chip/broadband capability to demand growth rates**
  - Calibrate with data for chips
  - Compare with broadband (data avail?)
    - Key variables for determining clockspeed
  - Qualitative understanding of demand growth dynamics may also be enlightening
    - Ex. Case study of how increased capability drove adoption in a new economic sector

- **Issues**
  - Defining system boundaries
  - What "capability" metric(s) for broadband?
  - Are some metrics more important to target for coordination across value chain?
    - Ex. Chips focused on transistor density, but power consumption also important to portability

Chip Capability

User Experience

Cost per Unit of Capability **(-)**

Device Capability **(+)**

Software Capability **(+)**

+

Demand

Users (+)

Types of Usage **(+)**

Amount of Usage **(+)**