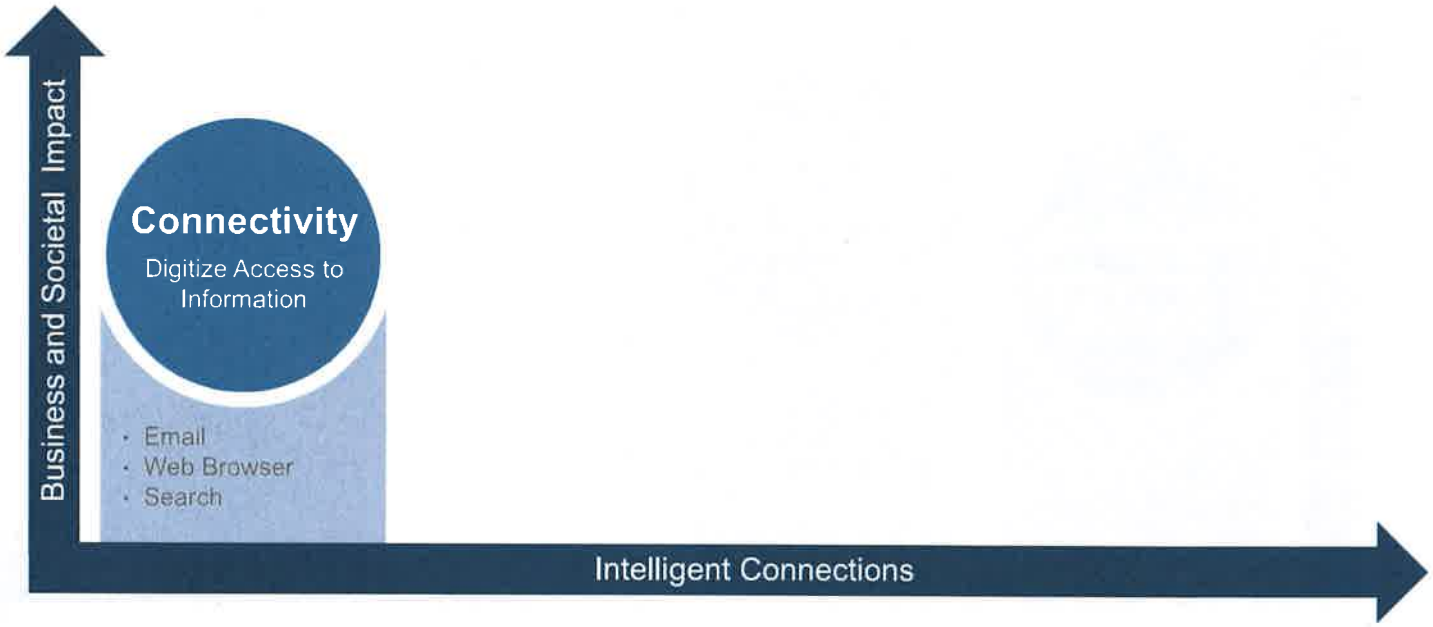
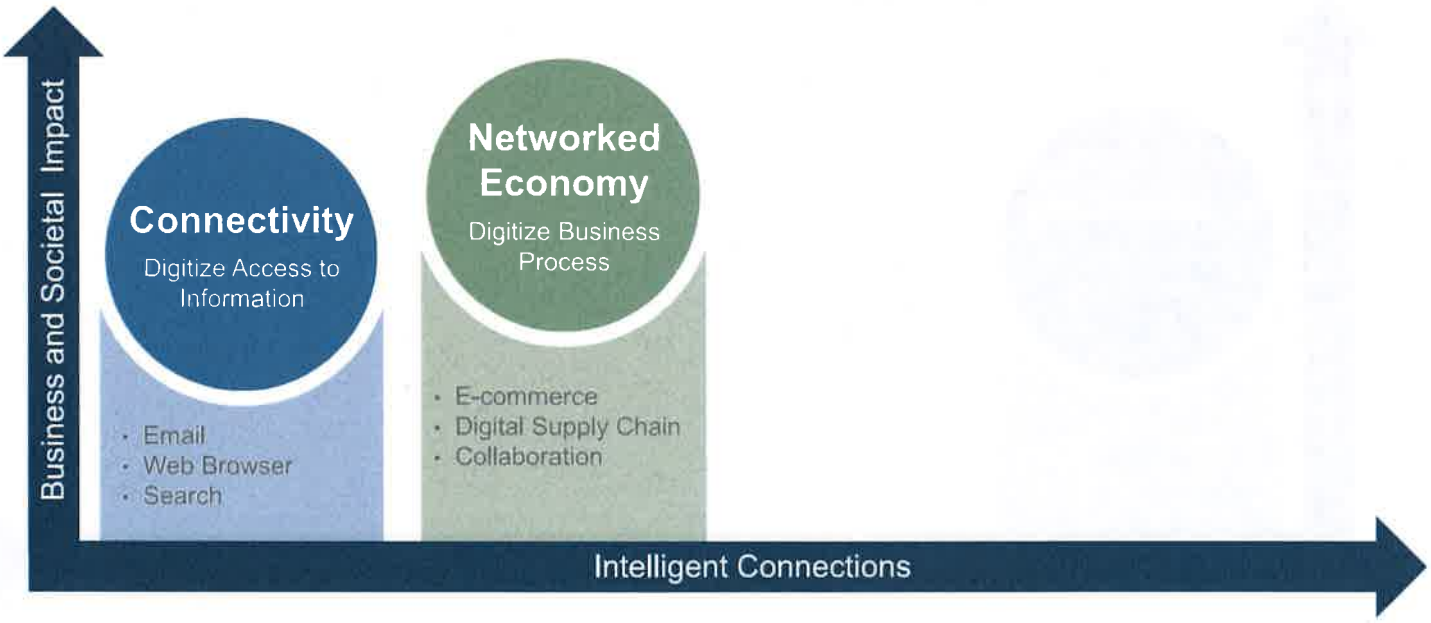
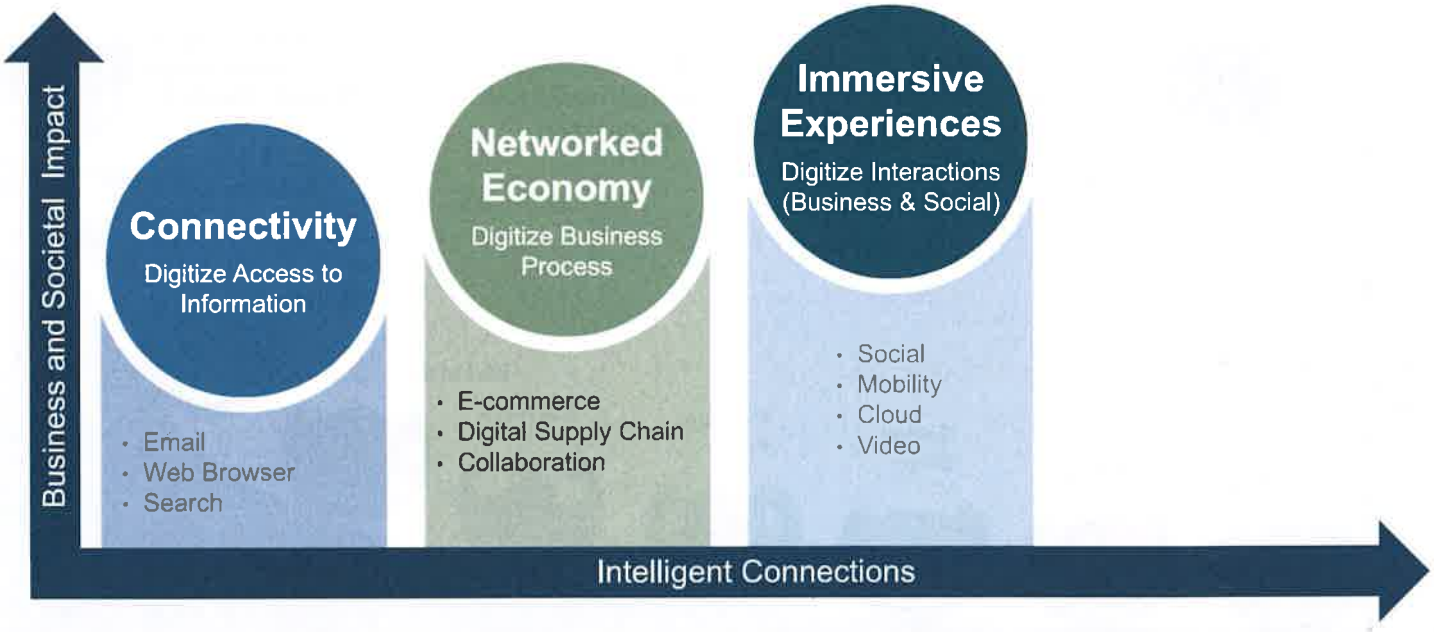
# Evolution of the Internet



# Evolution of the Internet



# Evolution of the Internet

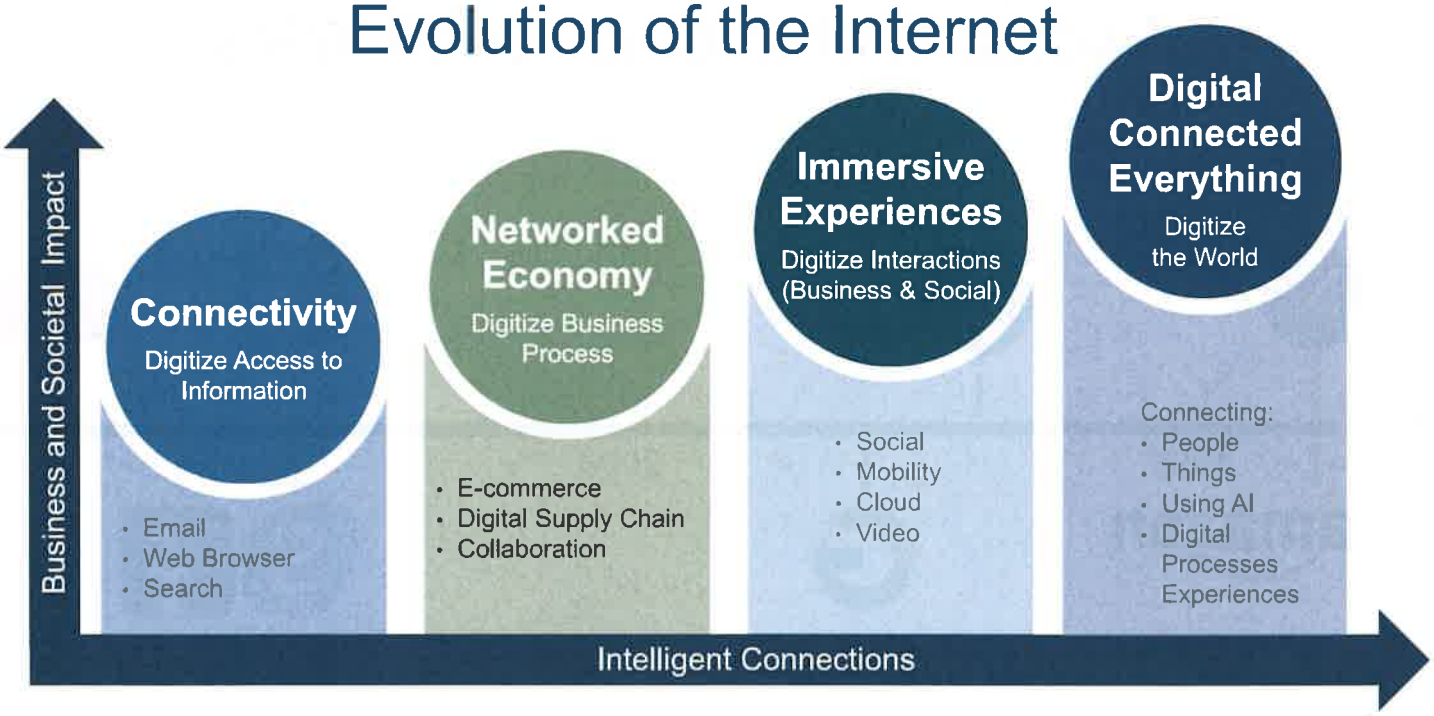


# Compute & the Internet: General Purpose Technologies

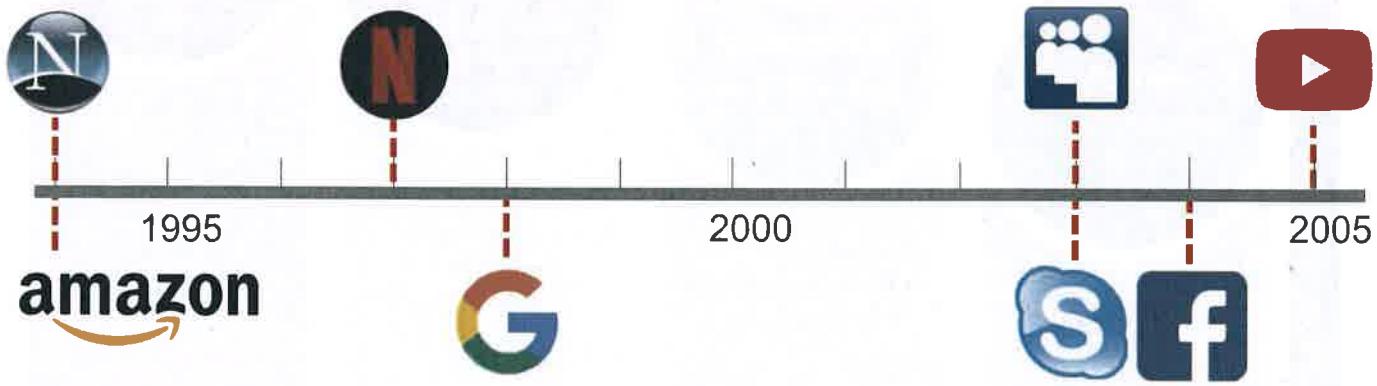
**Long term economic growth is driven by pervasive General Purpose Technologies (GPT's)… and the Internet meets the criteria**

Lipsey, Carlaw, Becker

# Evolution of the Internet



# Evolution of Internet Companies



# Largest Publicly Traded Companies

| Rank | 1997 | 2017 |
|---|---|---|
| 1 | General Electric Company | Apple, Inc. |
| 2 | Ford Motor Company | Alphabet, Inc. |
| 3 | Nippon Telegraph and Telephone | Microsoft Corporation |
| 4 | The Coca-Cola Company | Amazon |
| 5 | Exxon Mobil Corporation | Berkshire Hathaway |
| 6 | Microsoft Corporation | Facebook |
| 7 | Merck & Co., Inc. | Exxon Mobil Corporation |
| 8 | Altria Group, Inc. | Johnson & Johnson |
| 9 | Toyota Motor Corporation | JP Morgan Chase |
| 10 | Deutsche Telekom AG | Wells Fargo |
| 11 | International Business Machines Corporation | Tencent Holdings Ltd |
| 12 | The Procter & Gamble Company | Alibaba Group |
| 13 | Intel Corporation | General Electric |
| 14 | American International Group, Inc. | Samsung Electronics |
| 15 | Wal-Mart Stores, Inc. | AT&T |

# Largest Publicly Traded Companies

| Rank | 1997 | 2017 |
|---|---|---|
| 1 | General Electric Company | Apple, Inc. |
| 2 | Ford Motor Company | Alphabet, Inc. |
| 3 | Nippon Telegraph and Telephone | Microsoft Corporation |
| 4 | The Coca-Cola Company | Amazon |
| 5 | Exxon Mobil Corporation | Berkshire Hathaway |
| 6 | Microsoft Corporation | Facebook |
| 7 | Merck & Co., Inc. | Exxon Mobil Corporation |
| 8 | Altria Group, Inc. | Johnson & Johnson |
| 9 | Toyota Motor Corporation | JP Morgan Chase |
| 10 | Deutsche Telekom AG | Wells Fargo |
| 11 | International Business Machines Corporation | Tencent Holdings Ltd |
| 12 | The Procter & Gamble Company | Alibaba Group |
| 13 | Intel Corporation | General Electric |
| 14 | American International Group, Inc. | Samsung Electronics |
| 15 | Wal-Mart Stores, Inc. | AT&T |

# Largest Publicly Traded Companies

| Rank | 1997 | 2017 |
|---|---|---|
| 1 | General Electric Company | Apple, Inc. |
| 2 | Ford Motor Company | Alphabet, Inc. |
| 3 | Nippon Telegraph and Telephone | Microsoft Corporation |
| 4 | The Coca-Cola Company | Amazon |
| 5 | Exxon Mobil Corporation | Berkshire Hathaway |
| 6 | Microsoft Corporation | Facebook |
| 7 | Merck & Co., Inc. | Exxon Mobil Corporation |
| 8 | Altria Group, Inc. | Johnson & Johnson |
| 9 | Toyota Motor Corporation | JP Morgan Chase |
| 10 | Deutsche Telekom AG | Wells Fargo |
| 11 | International Business Machines Corporation | Tencent Holdings Ltd |
| 12 | The Procter & Gamble Company | Alibaba Group |
| 13 | Intel Corporation | General Electric |
| 14 | American International Group, Inc. | Samsung Electronics |
| 15 | Wal-Mart Stores, Inc. | AT&T |

# 1997

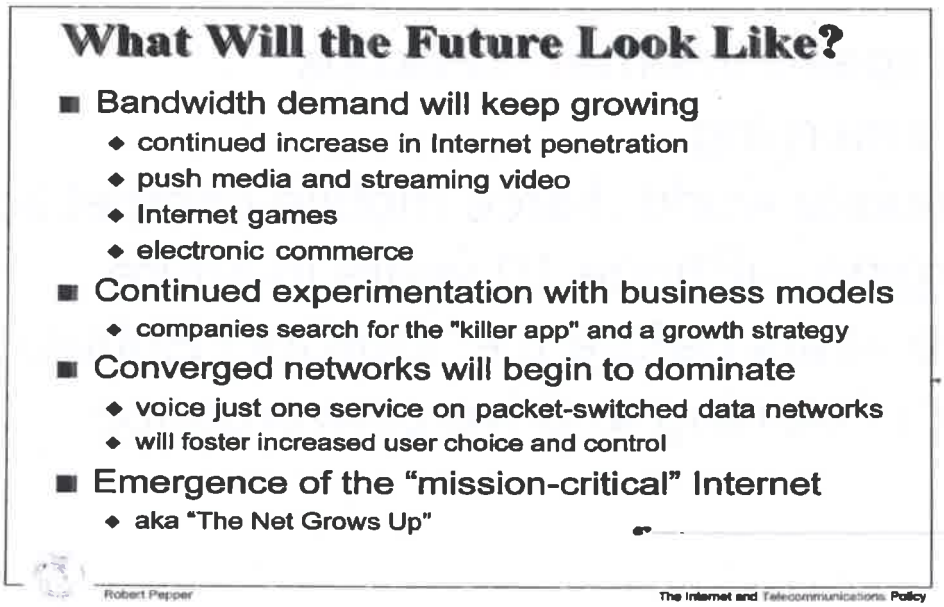
## Internet Trends

- Increasing numbers of ISPs
  - » Over 4,000 in North America, and 31 national backbones *(Boardwatch July/August 1997 ISP Directory)*
- High rate of growth
  - » 1.2 million domain names as of 4/97, up from 30,000 in 1/94
- Innovation in both software and hardware
  - » Internet telephony
  - » Web TVs
  - » Push media
  - » Streaming audio/video
  - » Wireless services
  - » Networked interactive games
- Internet/online games
  - » Ultima Online sales: 40,000 units in 4 weeks
  - » Average number of players/game: 5,000
  - » Average time on-line: 6 hours/day

## 1997—Where We Were

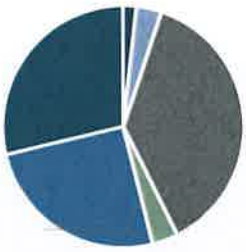
- High speed Internet: 128kbps
- DSL emerging
- 2G mobile world, fierce mobile competition emerging—iPhone 10 years in future
- Three years before the “DotCom Bubble” Burst
- Internet starting to drive convergence

# 1997


What Will the Future Look Like?
Bandwidth demand will keep growing
continued increase in Internet penetration
push media and streaming video
Internet games
electronic commerce
Continued experimentation with business models
companies search for the "killer app" and a growth strategy
Converged networks will begin to dominate
voice just one service on packet-switched data networks
will foster increased user choice and control
Emergence of the "mission-critical" Internet
aka "The Net Grows Up"
Robert Pepper
The Internet and Telecommunications Policy

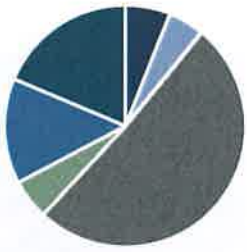
# From North America/Europe to Global Internet Users

1997



- Africa
- Arab States
- Asia Pacific
- CIS
- Europe
- Americas

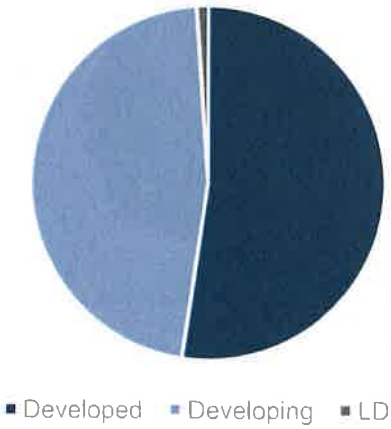
2017



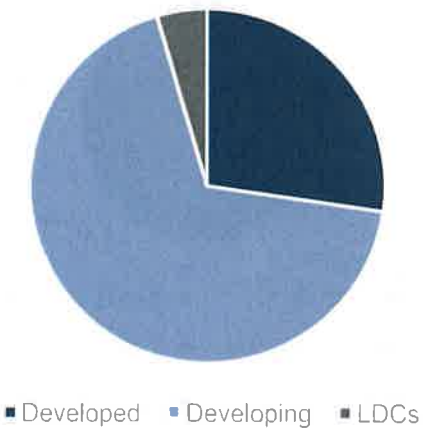
- Africa
- Arab States
- Asia Pacific
- CIS
- Europe
- Americas

# From Developed to Global
## Internet Users

1997




2017

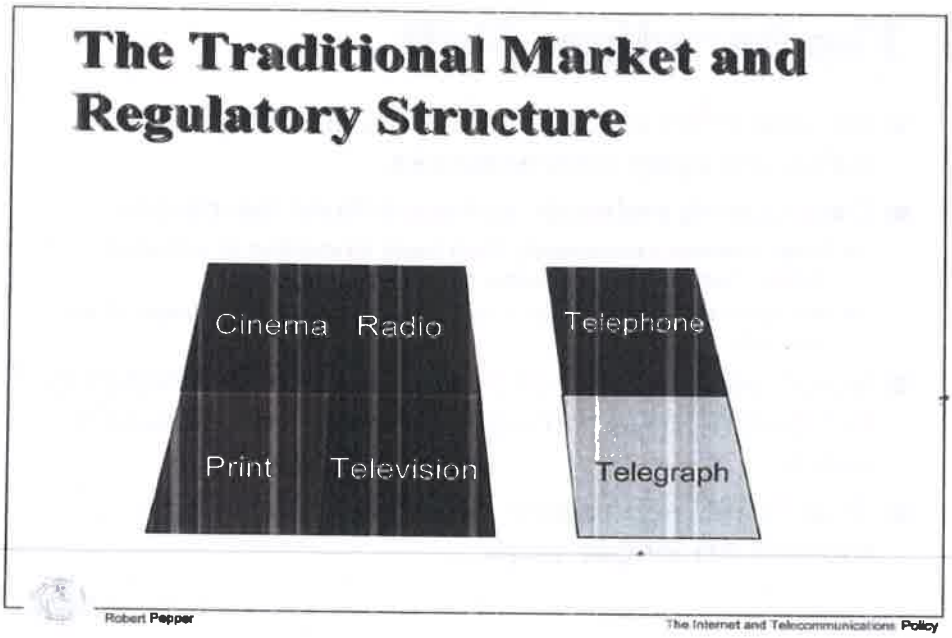


# 1997

## The Paradigm Shift

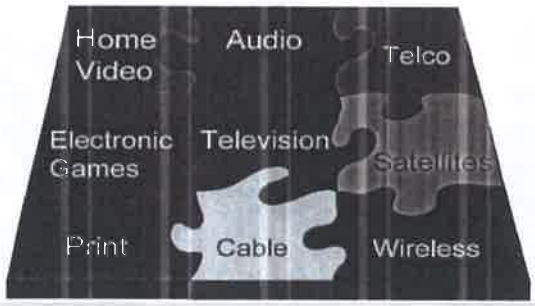
- Moving from circuit-switched voice to packet-switched open internetworks
- Decoupling network software from hardware
  - Users benefit immediately from rapid innovation in software, rather than waiting for extensive switch upgrades
  - Ability to take advantage of scale economies at the edge of the network
- Voice as one form of data, rather than struggling to transmit data through networks optimized for voice
- Traditional regulatory, policy, and business models no longer work

1997

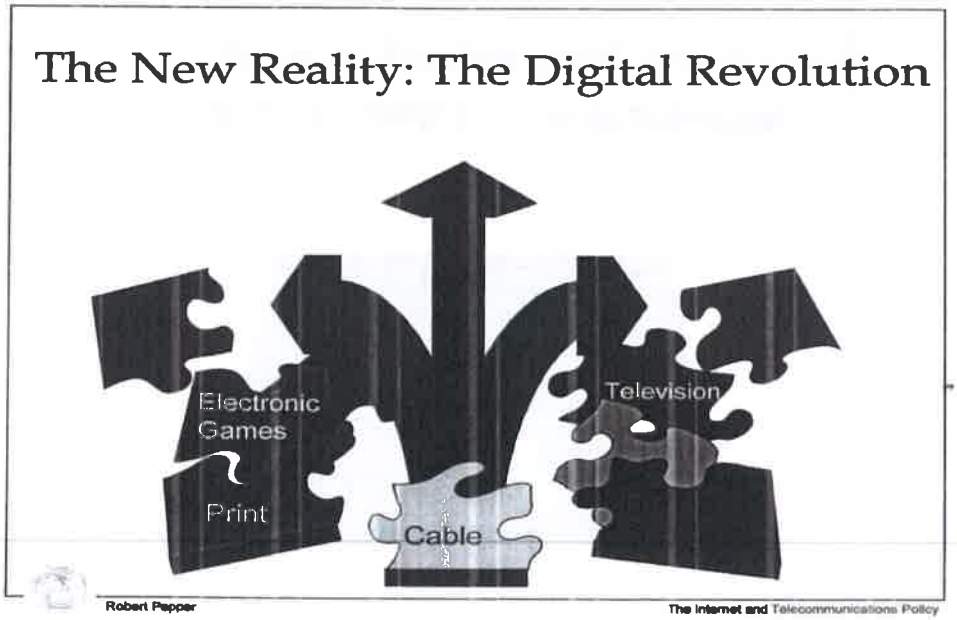

The Traditional Market and Regulatory Structure
Cinema
Radio
Print
Television
Telephone
Telegraph
Robert Pepper
The Internet and Telecommunications Policy

1997

## Blurring Boundaries and Competition -- 1995-1998



# 1997


The New Reality: The Digital Revolution
Electronic Games
Print
Cable
Television
Robert Pepper
The Internet and Telecommunications Policy

# 2017—Convergence is Here

- Digital transformation of everything—not just the Internet
- 80% Internet traffic is video
- Mobile Internet
- Social media creating new communitites
- Wireless connections for devices
- Apps not applications
- User choice and control
- Pull not push

# 1997—Where We Were—Policy Debates

- EC Green Paper on Convergence
- FCC working paper, "Digital Tornado," concludes: the USGs "efforts to avoid burdening the Internet with regulation should be looked upon as a major success, and should be continued"
- Most of industry and regulation still in silos
- Telcos complaining the Internet will crash their networks and destroy their business models

# Past is Prologue—The Policy Debate 2017

- Incumbents complaining about disruption from the Internet—not just telcos and broadcasters
  - Travel companies, publishers, movie theatres, taxis, retail, banks…
- Protecting the "Mission Critical" Internet
- Desperately seeking new business models
- The "level playing field"
- Regulate up or down?

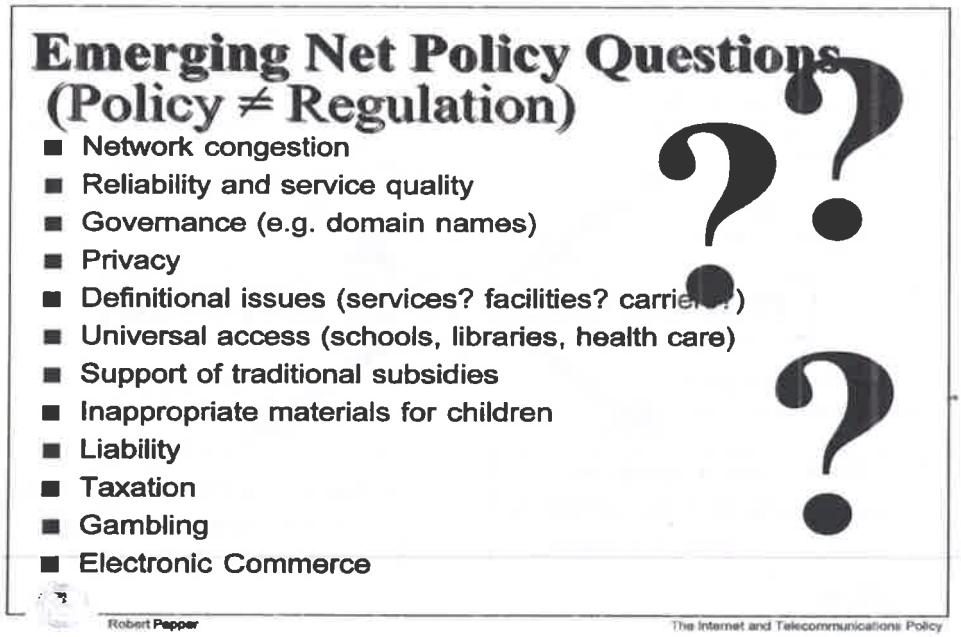
1997

# The Internet:
## How to Regulate it, Tax it, and Prevent it from Growing

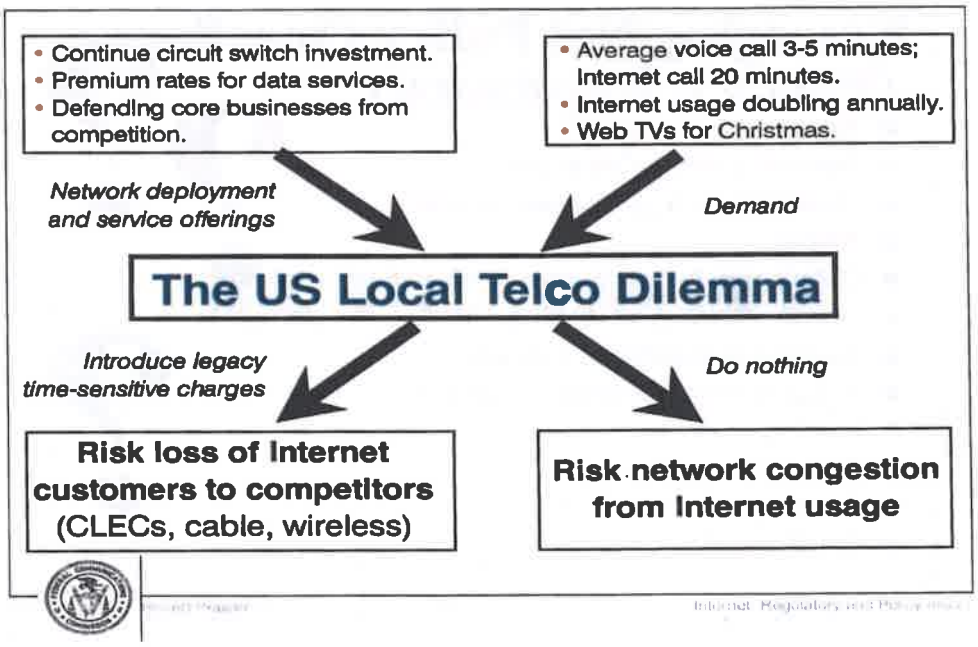
**Dr. Robert M. Pepper**
**Chief, Office of Plans and Policy**
**Federal Communications Commission**
**<rpepper@fcc.gov>**

December 1996

1997


Emerging Net Policy Questions
(Policy ≠ Regulation)
Network congestion
Reliability and service quality
Governance (e.g. domain names)
Privacy
Definitional issues (services? facilities? carriers?)
Universal access (schools, libraries, health care)
Support of traditional subsidies
Inappropriate materials for children
Liability
Taxation
Gambling
Electronic Commerce
Robert Pepper
The Internet and Telecommunications Policy

# 1997


• Continue circuit switch investment.
• Premium rates for data services.
• Defending core businesses from competition.
• Average voice call 3-5 minutes; Internet call 20 minutes.
• Internet usage doubling annually.
• Web TVs for Christmas.
Network deployment and service offerings
Demand
The US Local Telco Dilemma
Introduce legacy time-sensitive charges
Do nothing
Risk loss of Internet customers to competitors (CLECs, cable, wireless)
Risk network congestion from Internet usage

# Digital Transformation of Telecom
# Need New Business Models

## Old Assumptions

- The product is voice
- The metric is minutes
- Distance matters
- Duration matters
- Location matters

≠

## New Realities

- The product is connectivity
- The metric is bandwidth/throughput
- Distance insensitive
- Time insensitive
- Location insensitive

# 1997

## Lessons:

- Competition will happen, but needs constant attention
- The Internet is looming
- Regulators need humility as they can't predict competitors or entry strategies
- Be flexible

# Lessons—An Update

- Competition is here and evolving in new ways and needs to continue
- The Internet is everywhere
- Need humility as we can't predict technology nor how consumers and business will use it nor how markets will evolve
- Policy and regulation needs to be flexible and adaptive
- Need policies for innovation
- Once size does not fit all