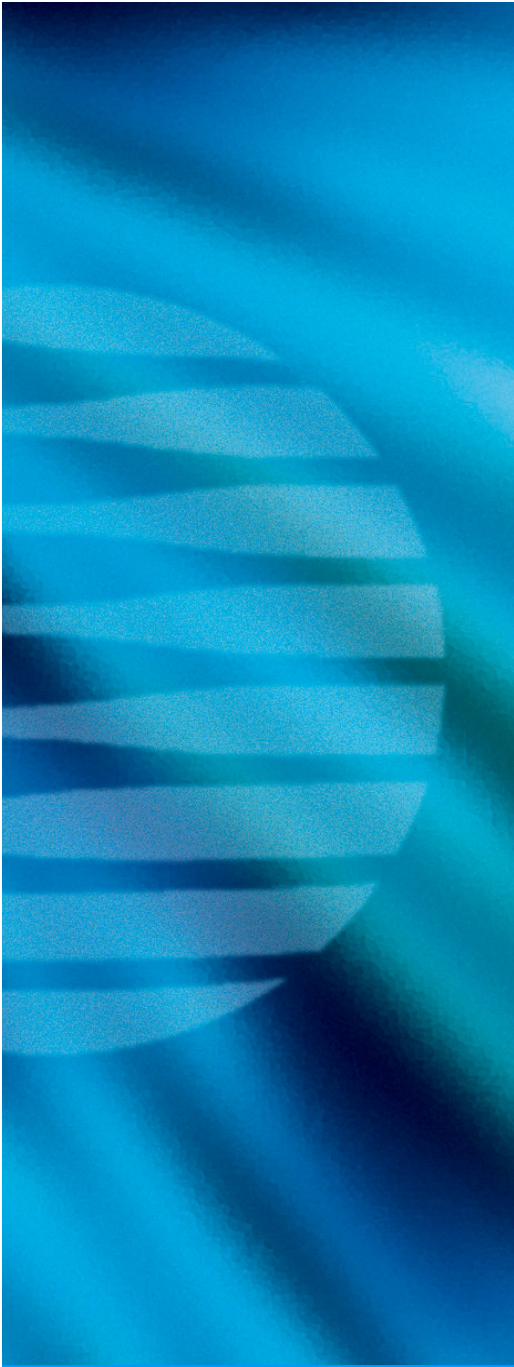




**InfoCom**  
**March 15, 2005**

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## **The Power of Technology to Transform the Future**

**Hossein Eslambolchi, PhD.**

*President -- Global Networking Technology Services & AT&T Labs*

*AT&T CTO & CIO*

*AT&T Fellow*



**The world's networking company <sup>SM</sup>**

# Technology Trends

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- 1. IP Will Eat Everything!**
- 2. Convergence of Communications & Applications Will Be A Reality**
- 3. Ethernet Will Be Universally Deployed**
- 4. Wireless Internet Will Be Big – Driving Mobility**
- 5. Sensor Networks Will Be Everywhere**
- 6. Death of Locality**
- 7. Broadband Will Be Common**
- 8. Wireless & Wired Lines Will Converge – Accelerating Virtualization**
- 9. Information Mining Will Transform the Way We Do Business**
- 10. Home LANs Will Proliferate**

## **1. Network Architecture**

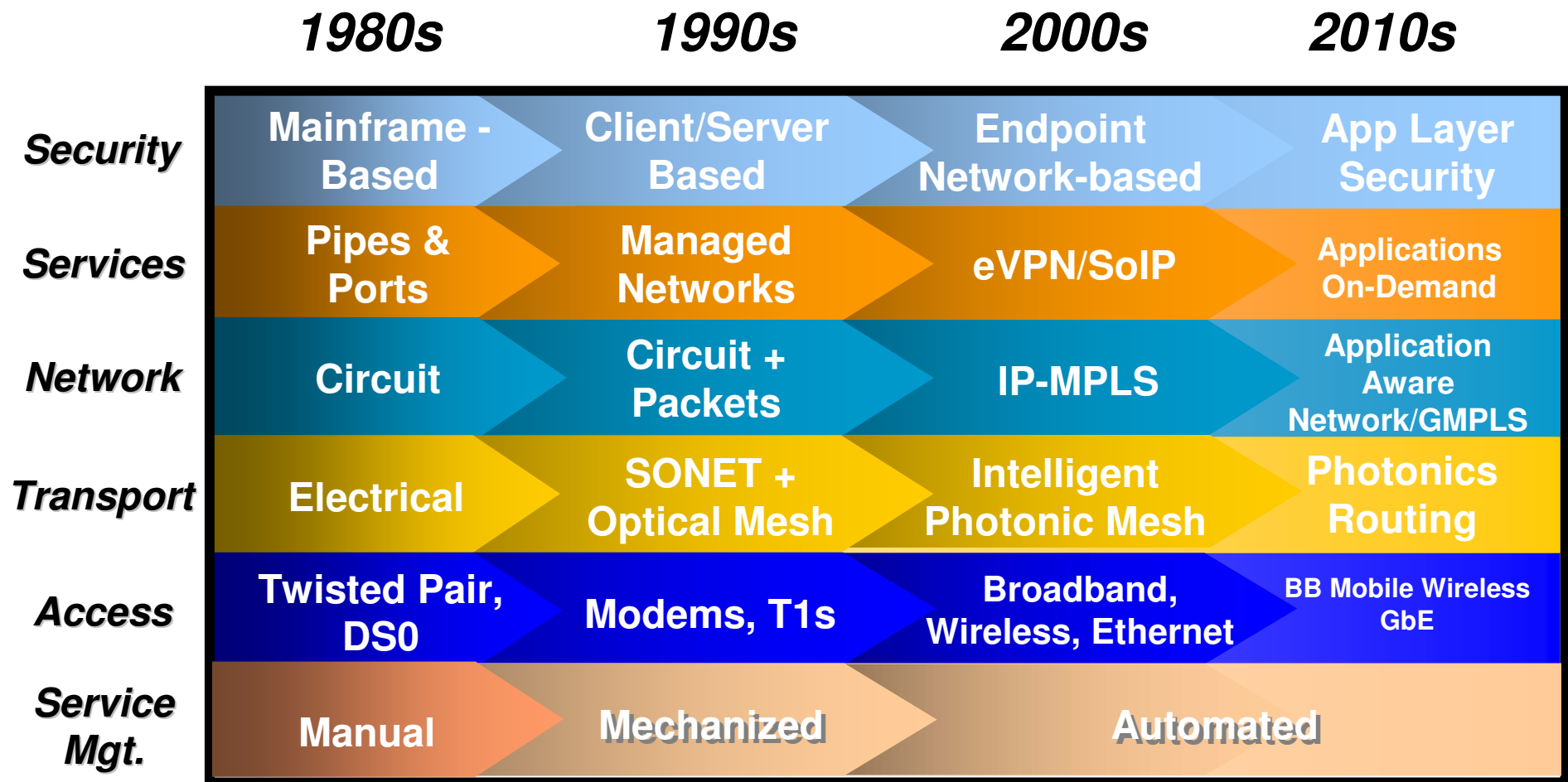
## **2. Network Management**

## **3. Security**

## **4. Wireless**

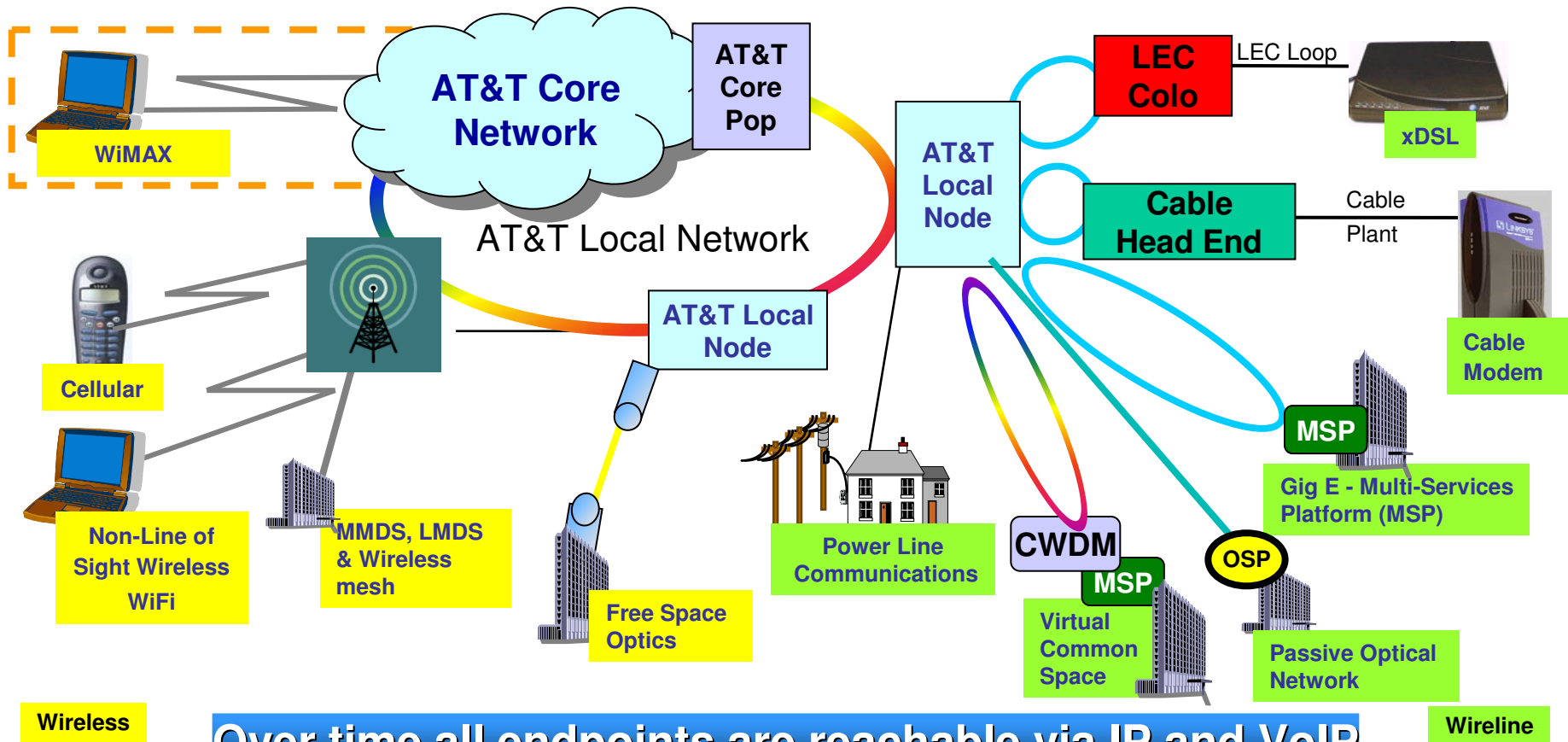
## **5. Knowledge-based Services**

# Evolution & Future of Network Architecture

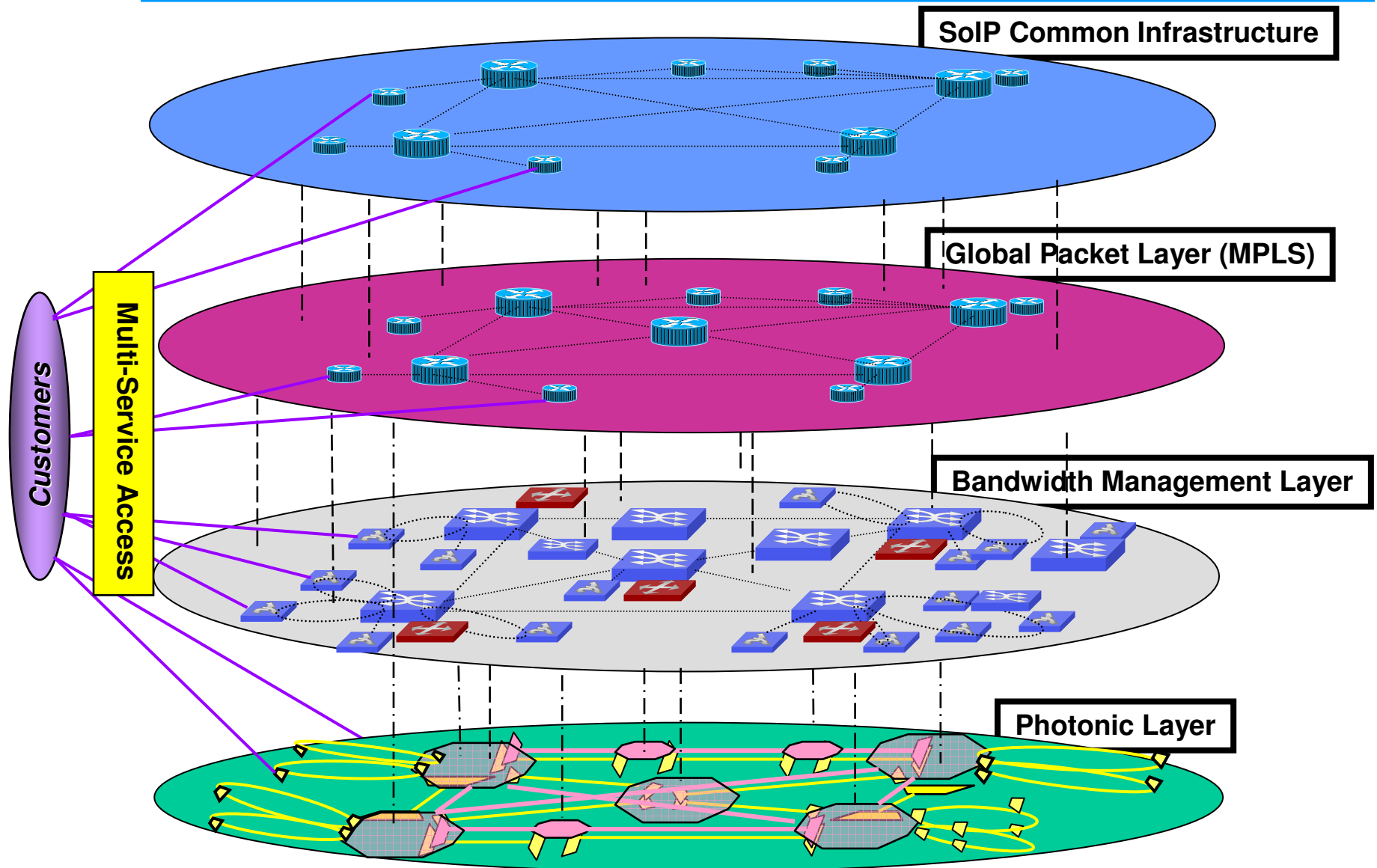


**Telecommunications Is Undergoing A Massive Transformation**

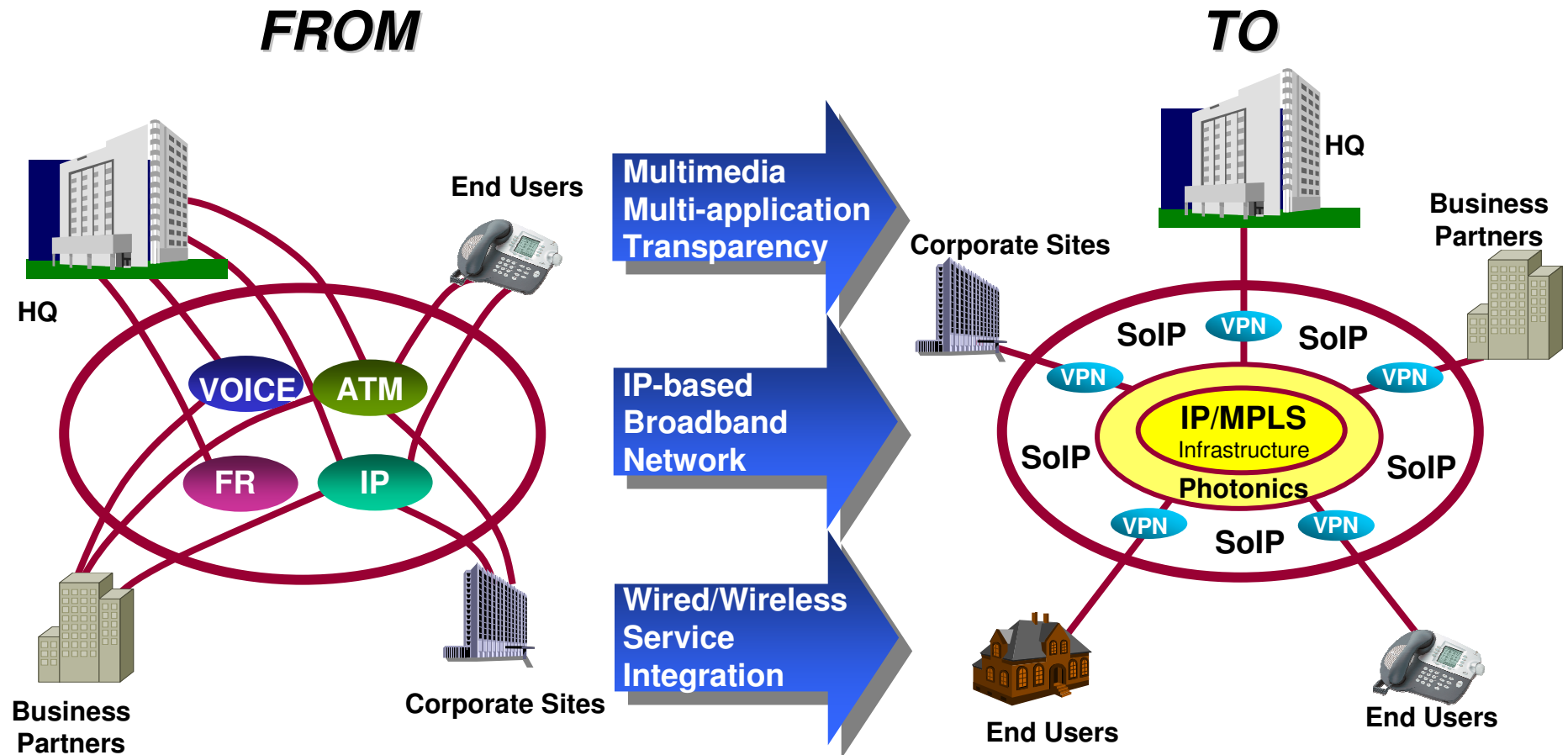
# Transformation: Last Mile Access



# Network Convergence Target Architecture



# Power of Convergence

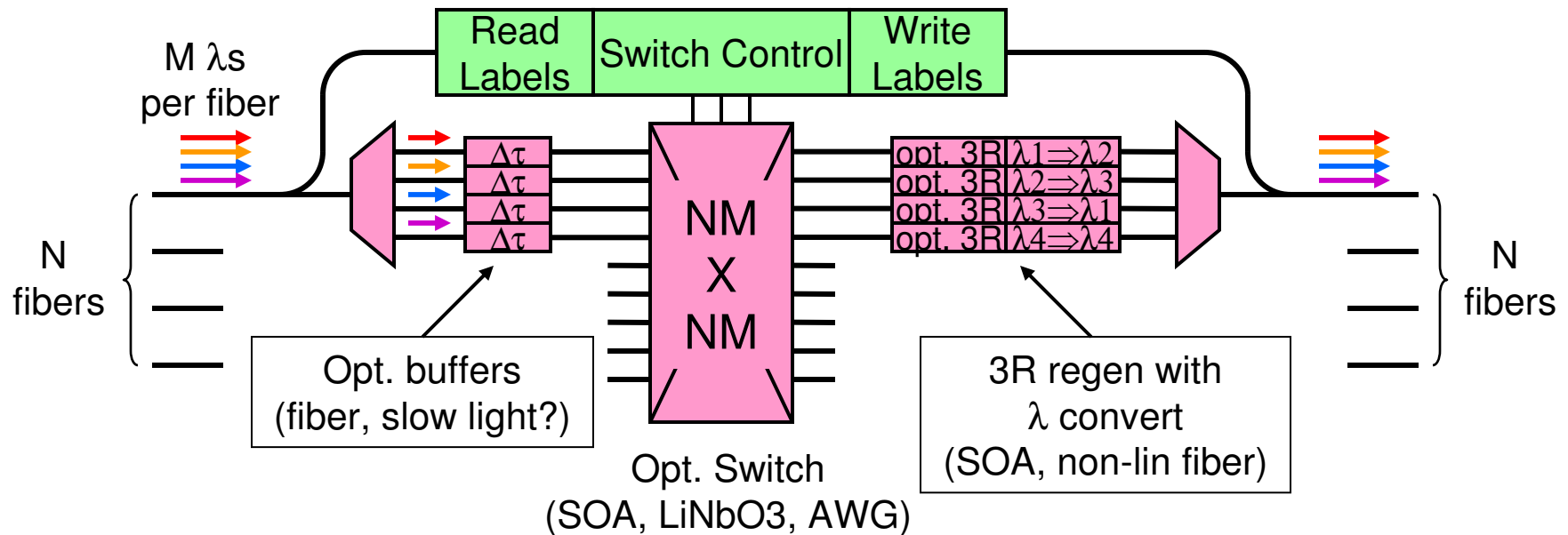


***IP Network Convergence: Delivers The Flexibility & Integration To Serve Users Better***

# Photonic Packet Networks

**Data Remains Optical From Source To Destination**

## Photonic Packet Routers



- Photonic Packet Networks pose a 'Grand Challenge' for the industry
- Optics challenges include fast switches, fast-tuning Tx & Rx, and optical buffers
- Network challenges include management, reliability, QoS, and basic architecture
- Cost, efficiency & functional capability will set the pace of photonic packetization

**1. Network Architecture**

**2. Network Management**

**3. Security**

**4. Wireless**

**5. Knowledge-based Services**

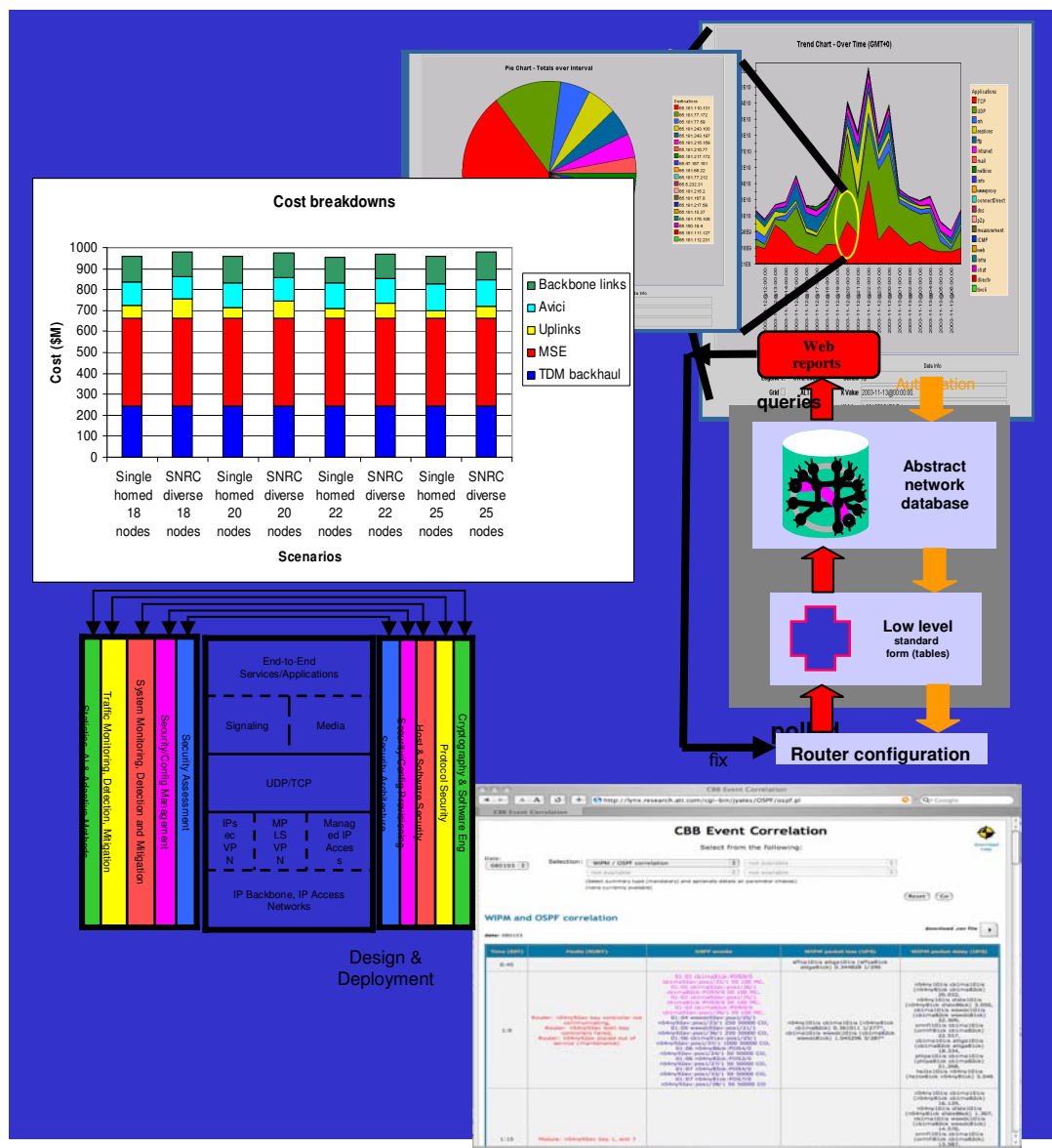
# Network Management

## Network Management

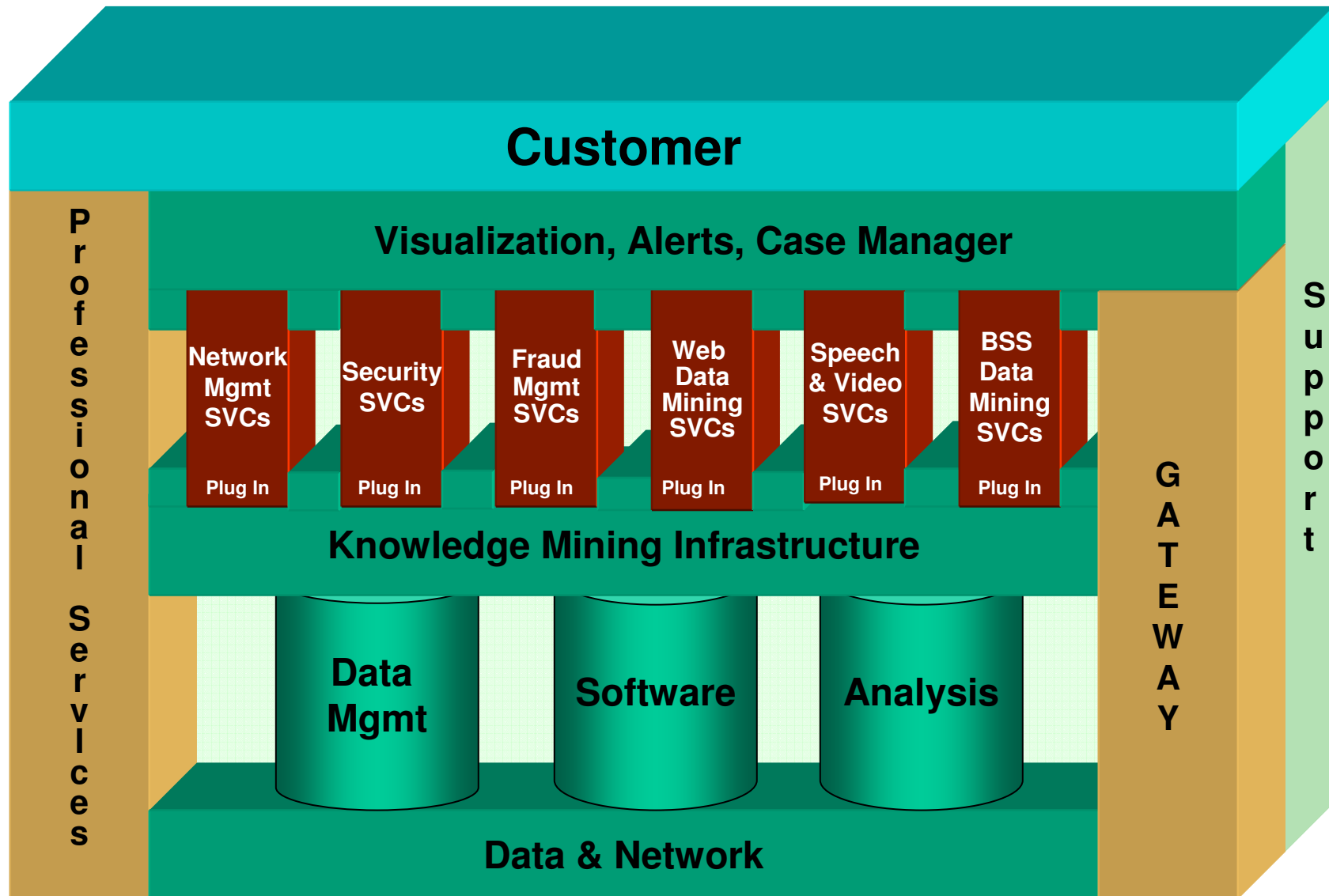
- Traffic,
- Configuration,
- Route Management,
- Performance Management,
- Planning and Design Optimization
- Managing Scale

## Security

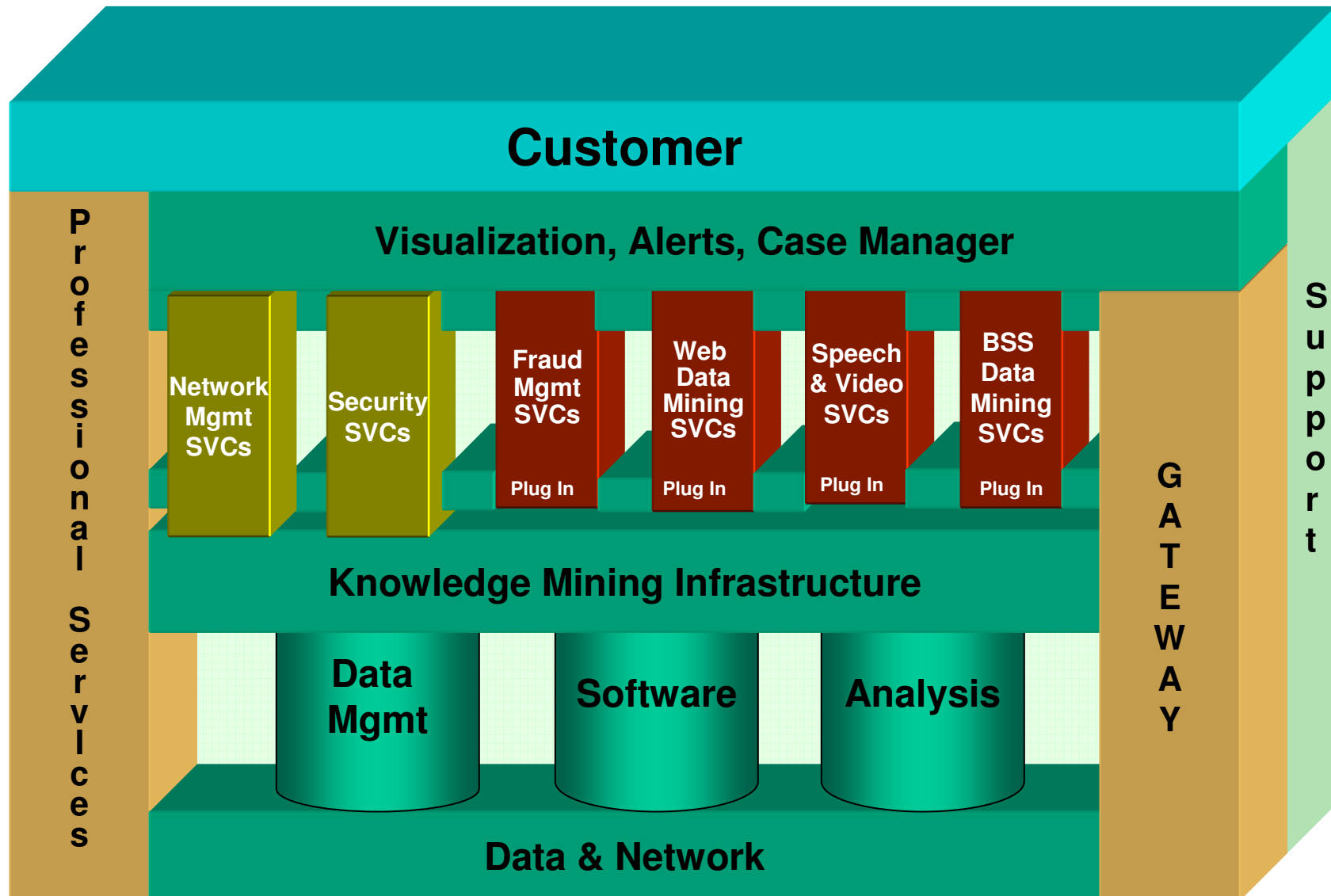
- BGP Security
- Route Security
- S/W Vulnerability
- Configuration Vulnerability
- VoIP Security
- Worms and Viruses
- Cloaking



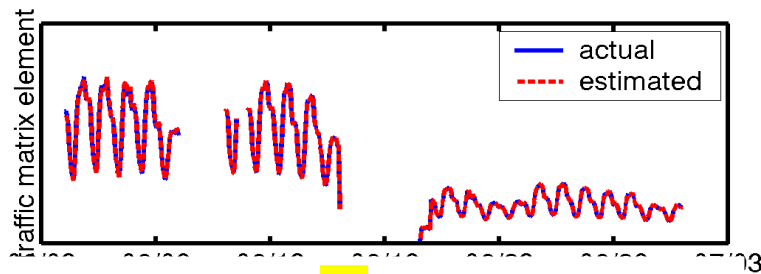
# Service Oriented Framework



# Service Oriented Framework



## Tomo-gravity



## IP Decision Support

| Date                                             | Status        | Number of Circuits | Type                    | Reason                           | Comment                                                                                 |
|--------------------------------------------------|---------------|--------------------|-------------------------|----------------------------------|-----------------------------------------------------------------------------------------|
| Sun Jan 04 08:00:00 EST 2004                     | Green         | 2                  | Planned Cable Intrusion | Railroad Generated Rearrangement | EMERGENCY RXR REROUTE BETWEEN WHITAKER AND BROOKLYN                                     |
| Sun Jan 18 09:00:00 EST 2004                     | Not evaluated | 1                  | Planned Cable Intrusion | Permanent Repair                 | Permanent Repair between Loveland - Mondamin                                            |
| Wed Jan 21 11:00:00 EST 2004 (no service impact) | Not evaluated | 3                  | Planned Cable Intrusion | Single Fiber Repair              | Splicing spares 29 - 34 to LNS cable between San Diego & Rancho Bernardo at 2 locations |
| Thu Jan 22 11:00:00 EST 2004 (no service impact) | Not evaluated | 3                  | Planned Cable Intrusion | Single Fiber Repair              | Splicing LNS cable to spare fibers 29 - 34 between Rancho Bernardo & Vista              |
| Thu Jan 22 21:00:00 EST 2004                     | Not evaluated | 1                  | Planned Cable Intrusion | Permanent Repair                 | Repair damage done between the Lancaster Jct splice and East Hempfield                  |
| Sat Jan 24 10:00:00                              | Not           | 7                  | Planned Cable           | Railroad Generated               | Railroad rearrangement between Van                                                      |

### ■ Challenge: Network Survivability

- Requires detailed network-wide views of layer 1-3 topology, routing, risk and failure modes, traffic matrix
- Knowledge of traffic matrices (where traffic comes from and goes to) had been totally missing in IP networks
  - A showstopper for sound, economical network engineering

### ■ Breakthrough: Tomo-gravity

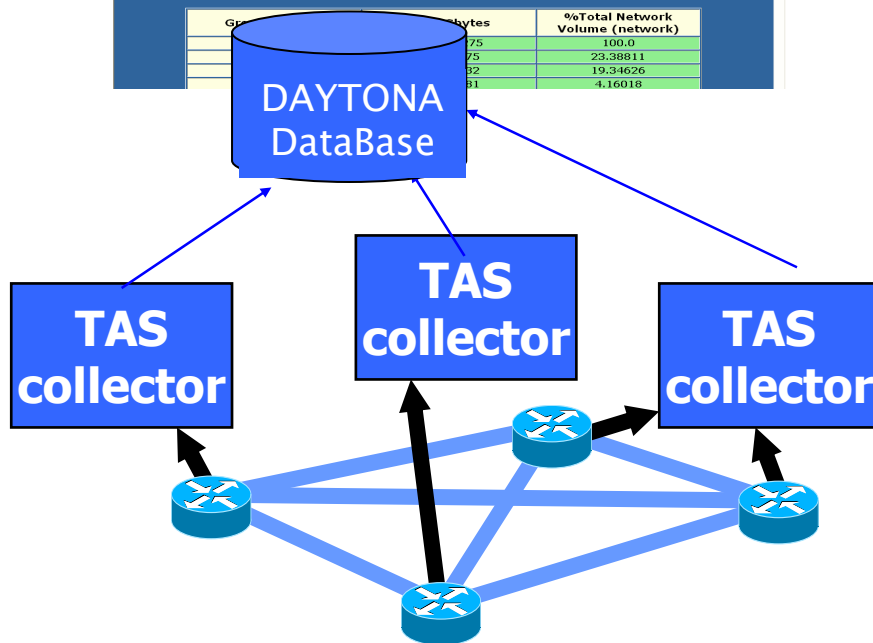
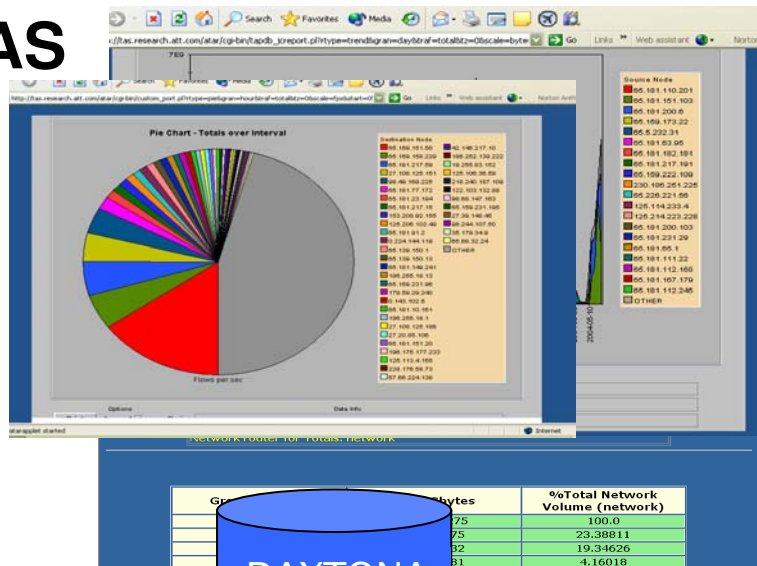
- Accurate inference of IP traffic matrices in seconds from link loads

### ■ Result

- Automated systems and tools to assure network survivability
- Dramatic improvement in network engineering and operations

# Application and Traffic Analysis

TAS



## ■ Challenge: IP Traffic Analysis

- Flow data volumes are HUGE
- Aggregation?
  - Answers to a small set of fixed queries
  - No answers to a myriad of other queries that inevitably arise and demand answers – no drill down capability

## ■ Research Breakthroughs

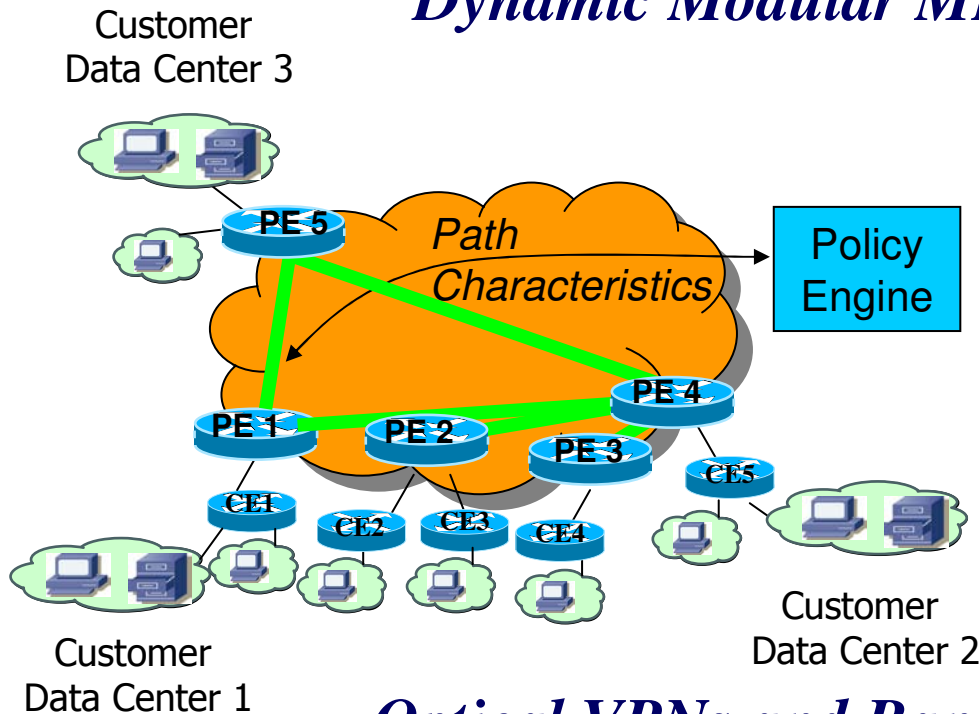
- *Smart sampling<sup>TM</sup>* of flow data
- *Daytona<sup>TM</sup>* data management system

## ■ Result

- Detailed views of network traffic are critical for large ISPs and enterprise networks
  - Drill-down/drill across applications, sites, traffic sources, services ...
  - Billing/accounting/chargeback by network address application, volume ...
  - Security: investigation of DoS attacks, port scans
- 365x24x7 network-wide traffic views

# Emerging Capabilities

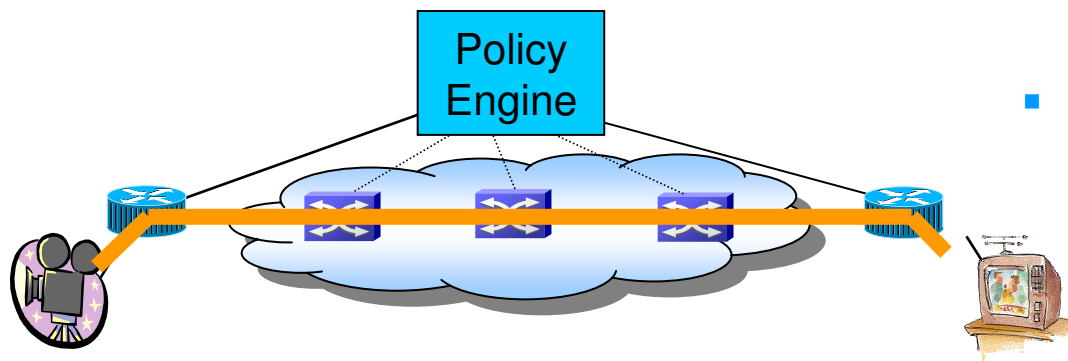
## Dynamic Modular MPLS VPNs



- Customer leverages detailed views of traffic, and APIs to express their own routing policies

- Customer specifies own routing service policies and requirements
  - sites communicate only with data centers, with preferred data center varying by site and by currently available resources
- Network policy engine dynamically adapts routing integrating customer's policies with end to end performance and availability measurements

## Optical VPNs and Bandwidth on Demand



- Enable customer to build a dynamic layer 1 network
  - Customer determines dynamic bandwidth needs and signals these to the network to establish dynamic end to end circuits

# Power of the Cybernated Network

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## *Continuous Monitoring, Flexible Command & Dynamic Response*

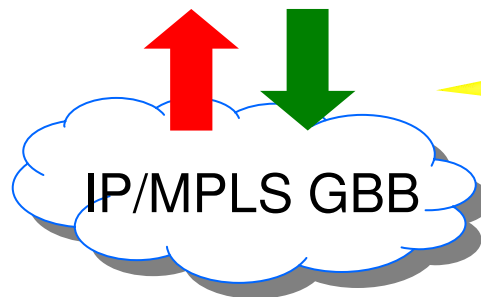
### Non-Real Time

- Monitor – traffic, topology
- Decide – capacity, configuration
- Control – capacity, topology & update

### Real Time

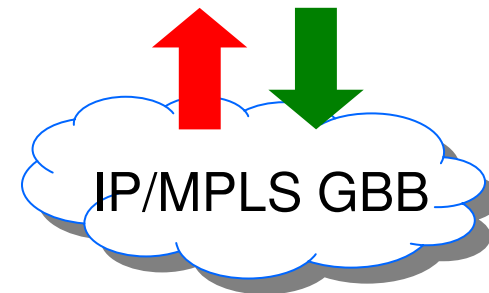
- Monitor – fault, performance
- Decide – problem mitigation
- Control – network update

### Hitless Maintenance



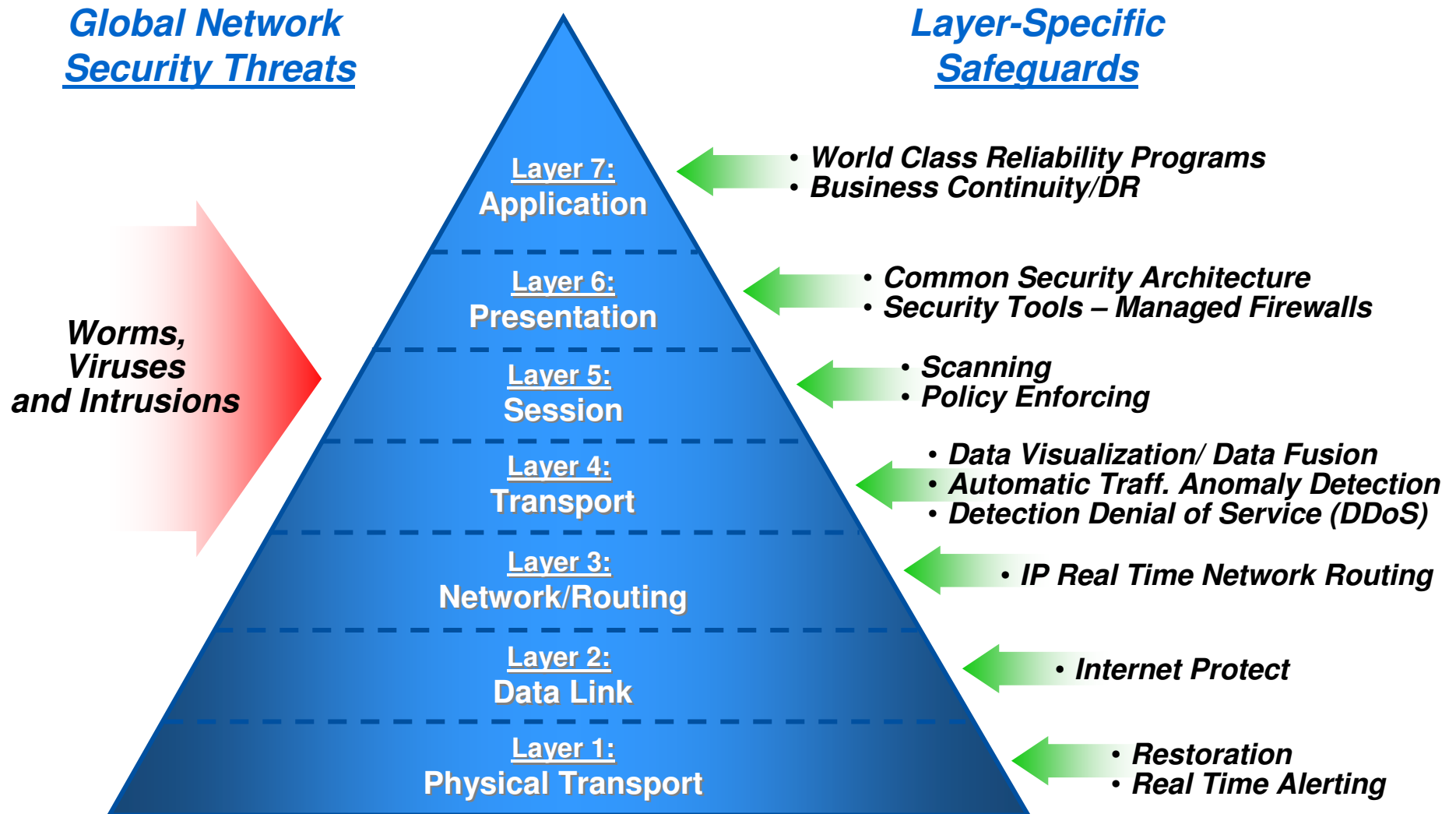
**Innovation**

### Automated Restoration

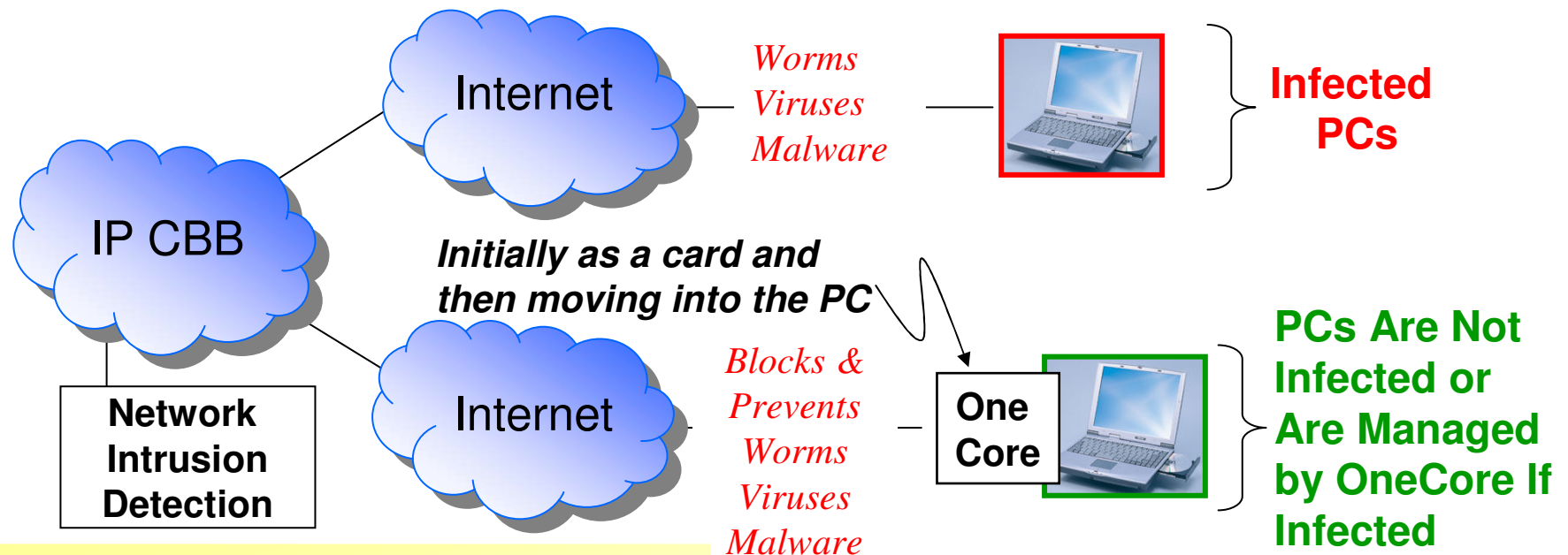


- 1. Network Architecture**
- 2. Network Management**
- 3. Security**
- 4. Wireless**
- 5. Knowledge-based Services**

# Security Services



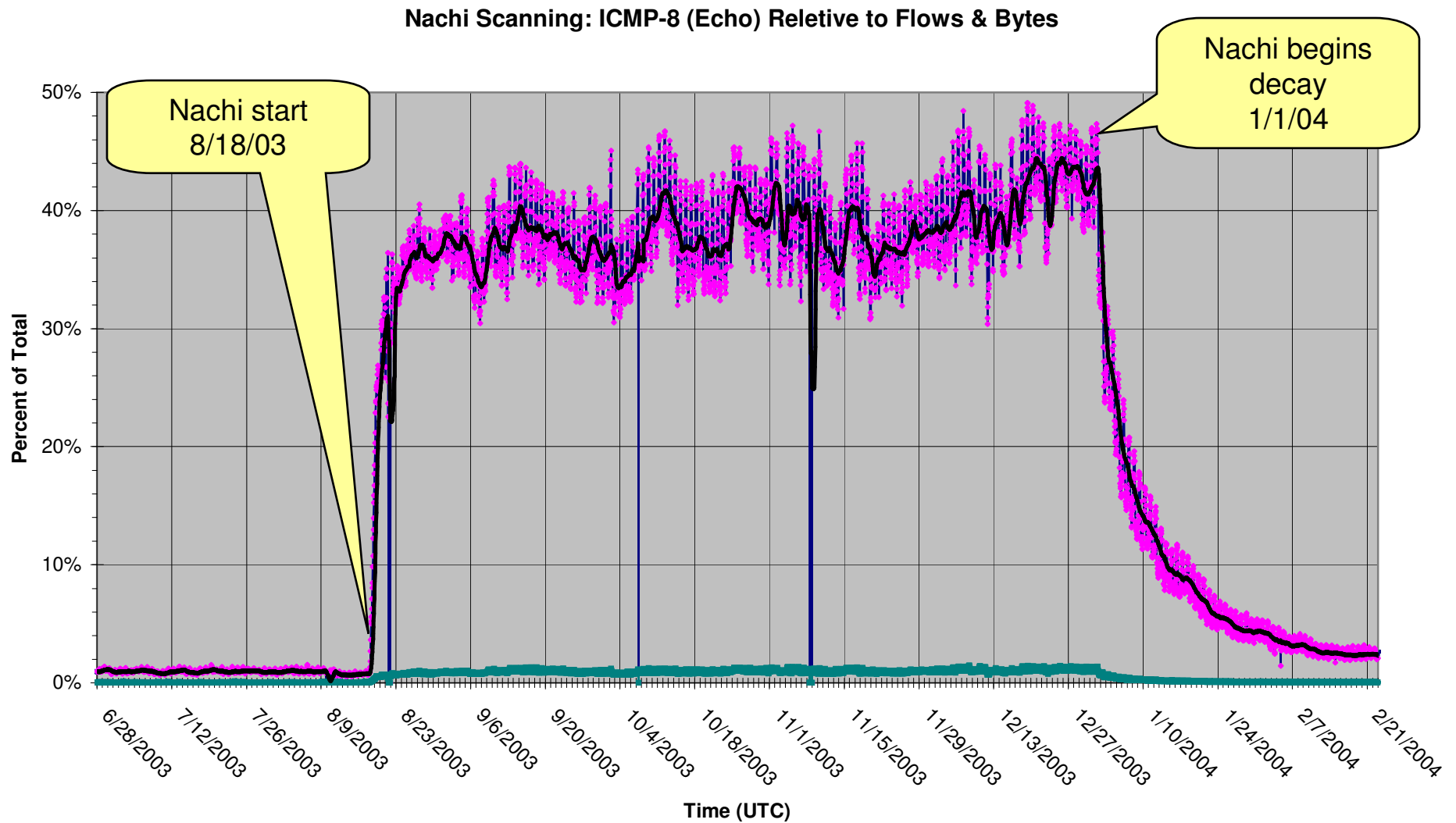
## Turning the Network into the First Line of Defense



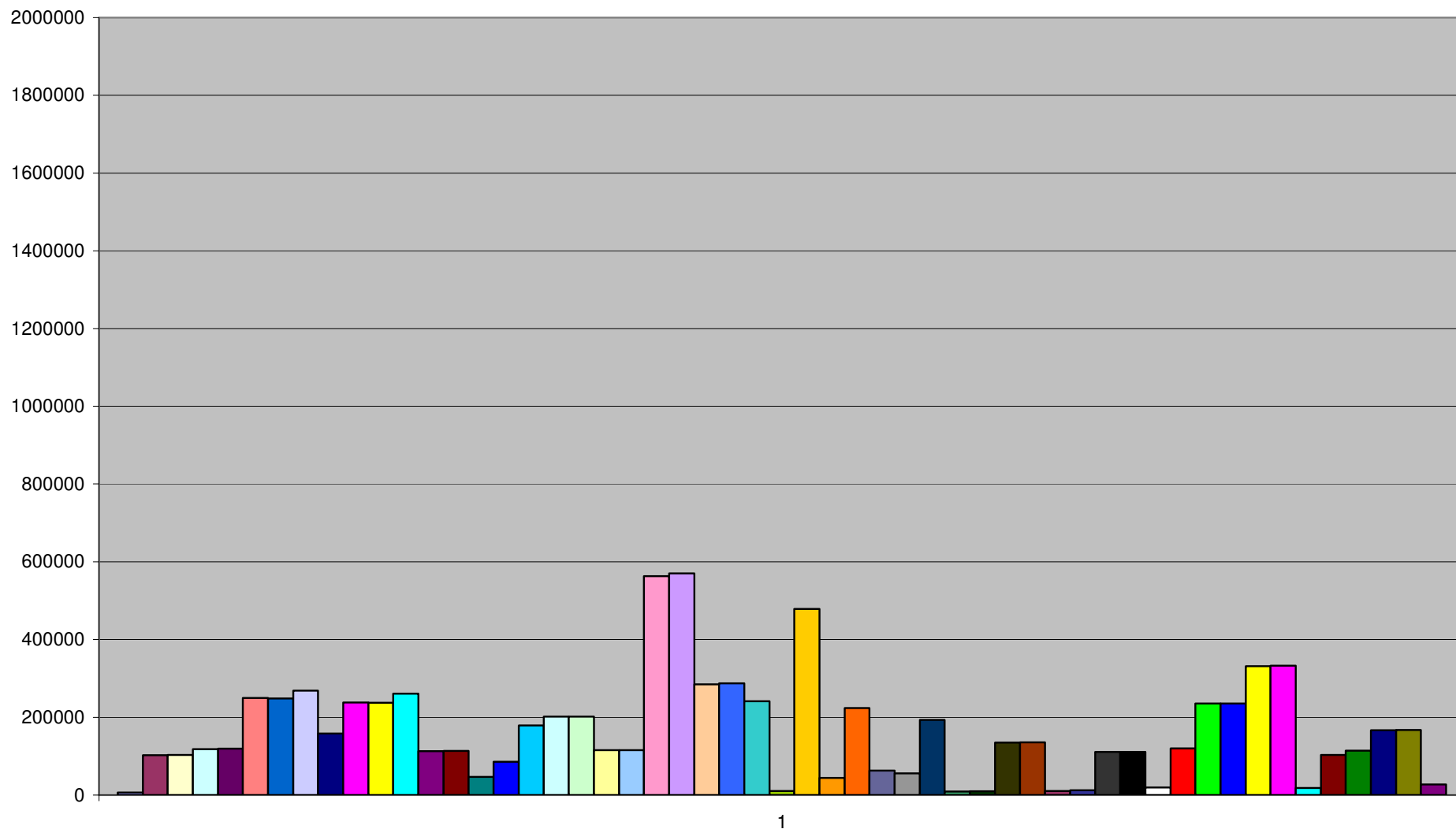
**Network knows about attacks and blocks them before user, or even the software virus protection companies know. (e.g. AT&T Internet Protect)**

## Breakthroughs in Speed & Scale Enable Power of Detection

# Life-Cycle of Nachi

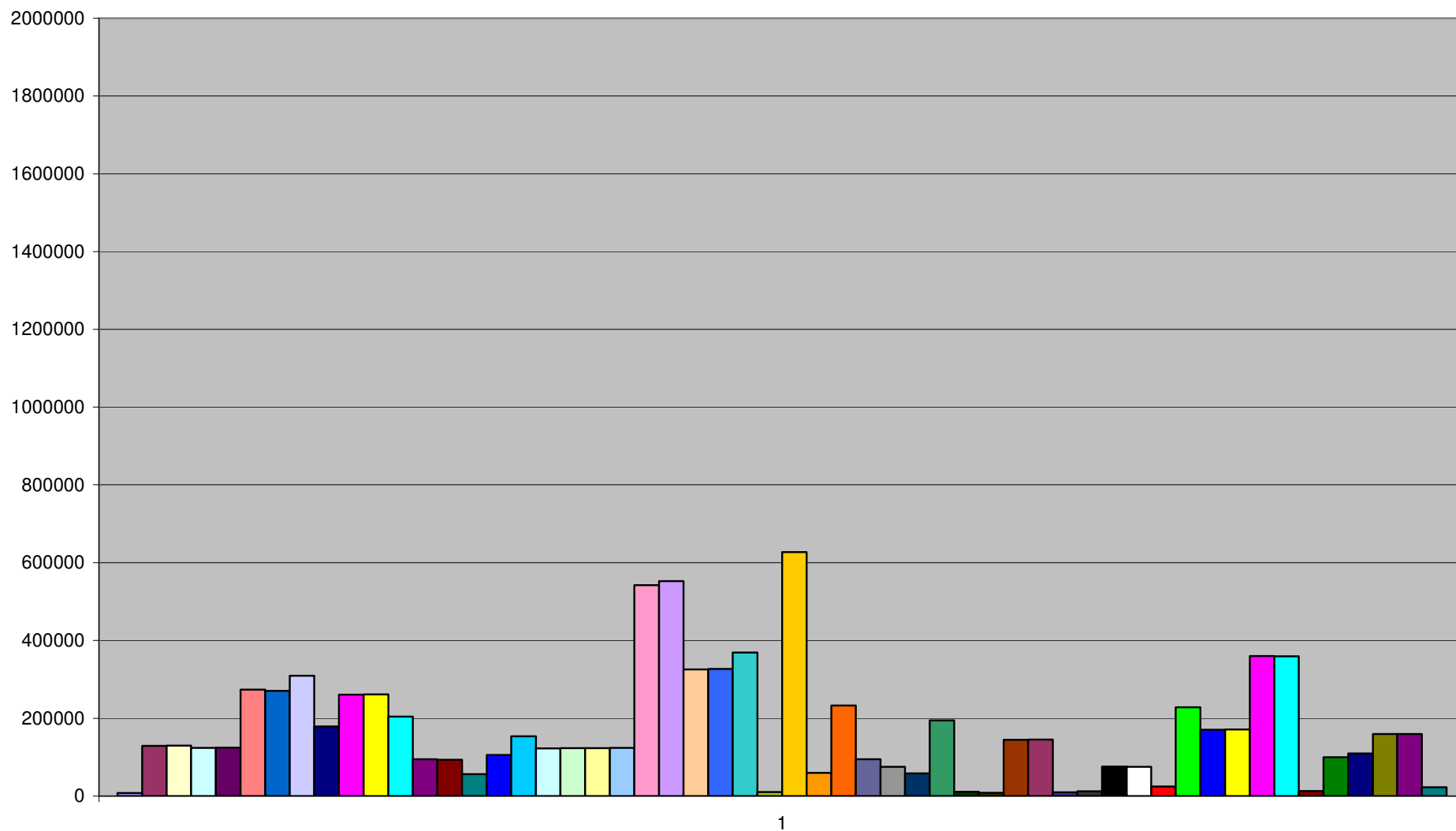


## ***Pre-Nachi – ICMP/8 (Echo) - 8/17 2200GMT***

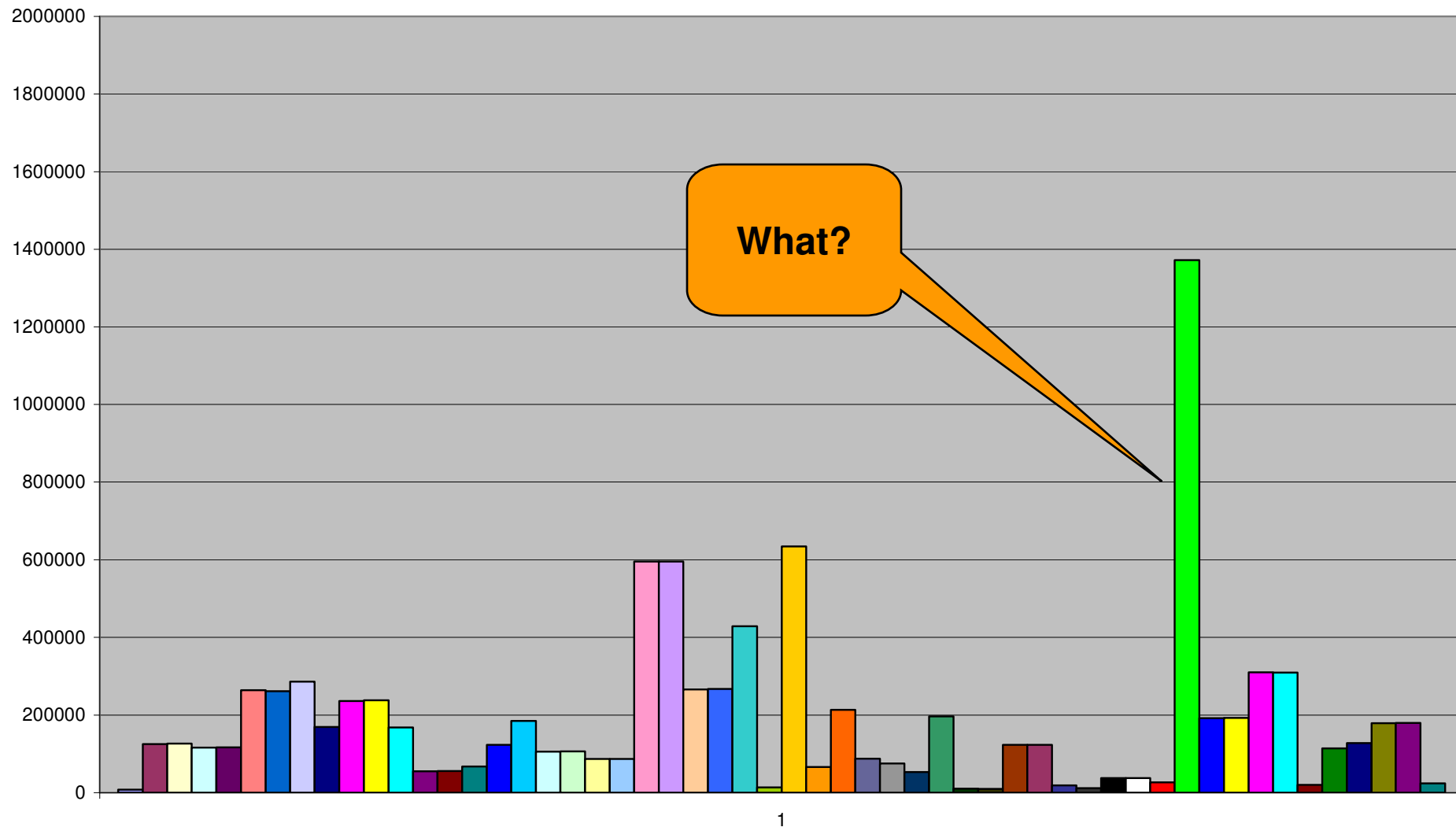


## ***Pre-Nachi – ICMP/8 (Echo) - 8/18 0000GMT***

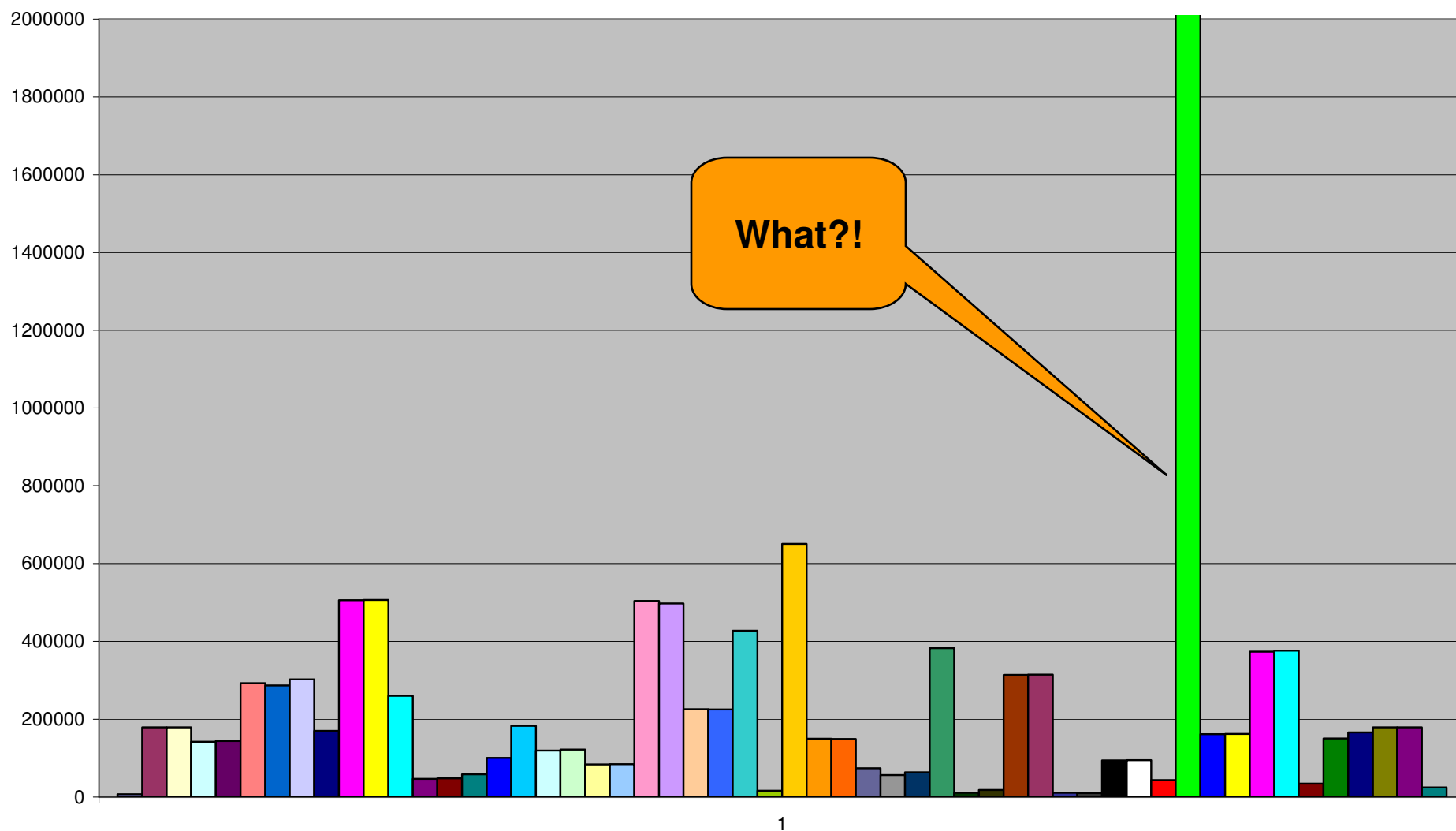
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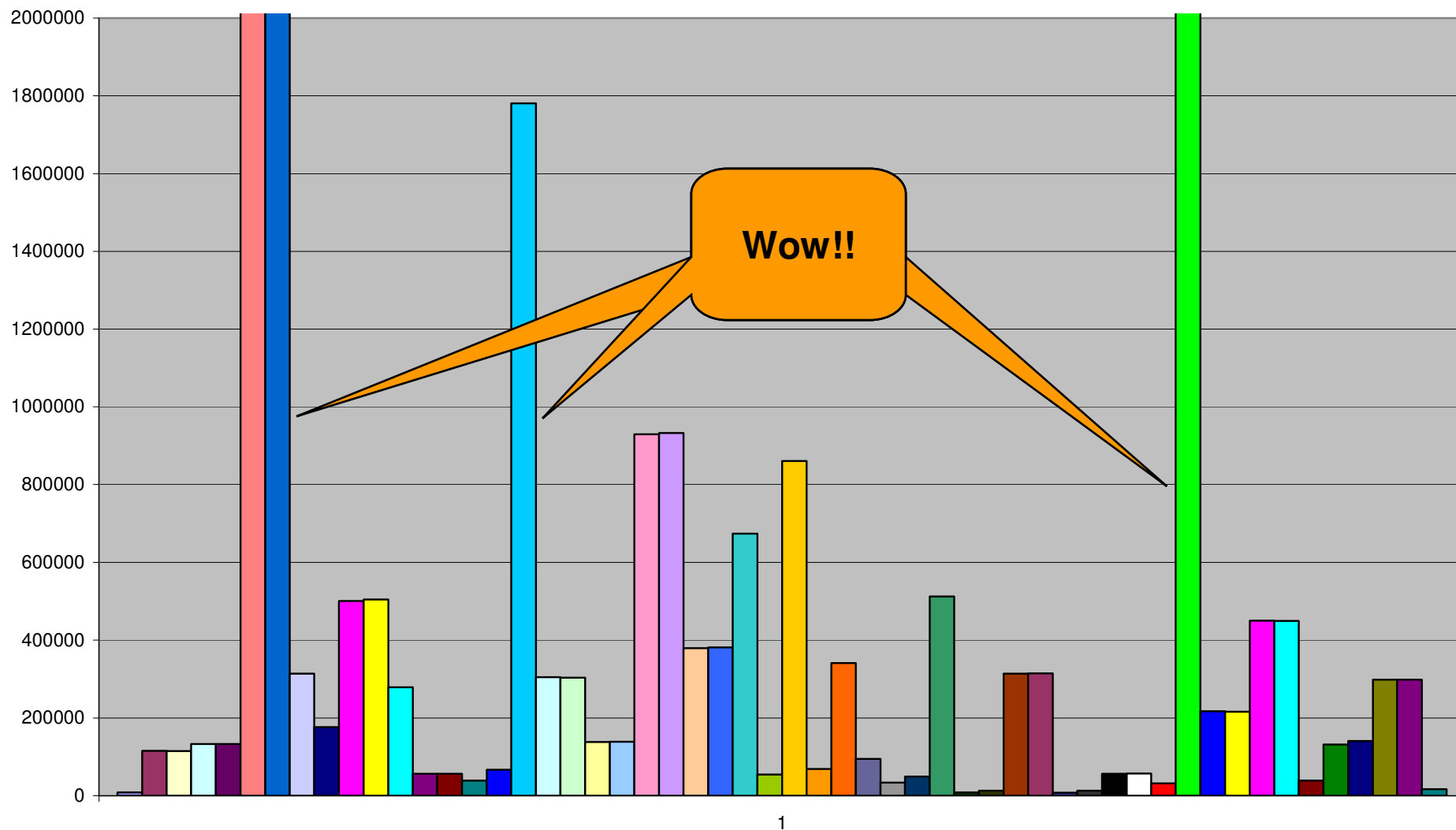
# *Pre-Nachi – ICMP/8 (Echo) - 8/18 0200GMT*



## *Pre-Nachi – ICMP/8 (Echo) - 8/18 0400GMT*



# *Pre-Nachi – ICMP/8 (Echo) - 8/18 0600GMT*



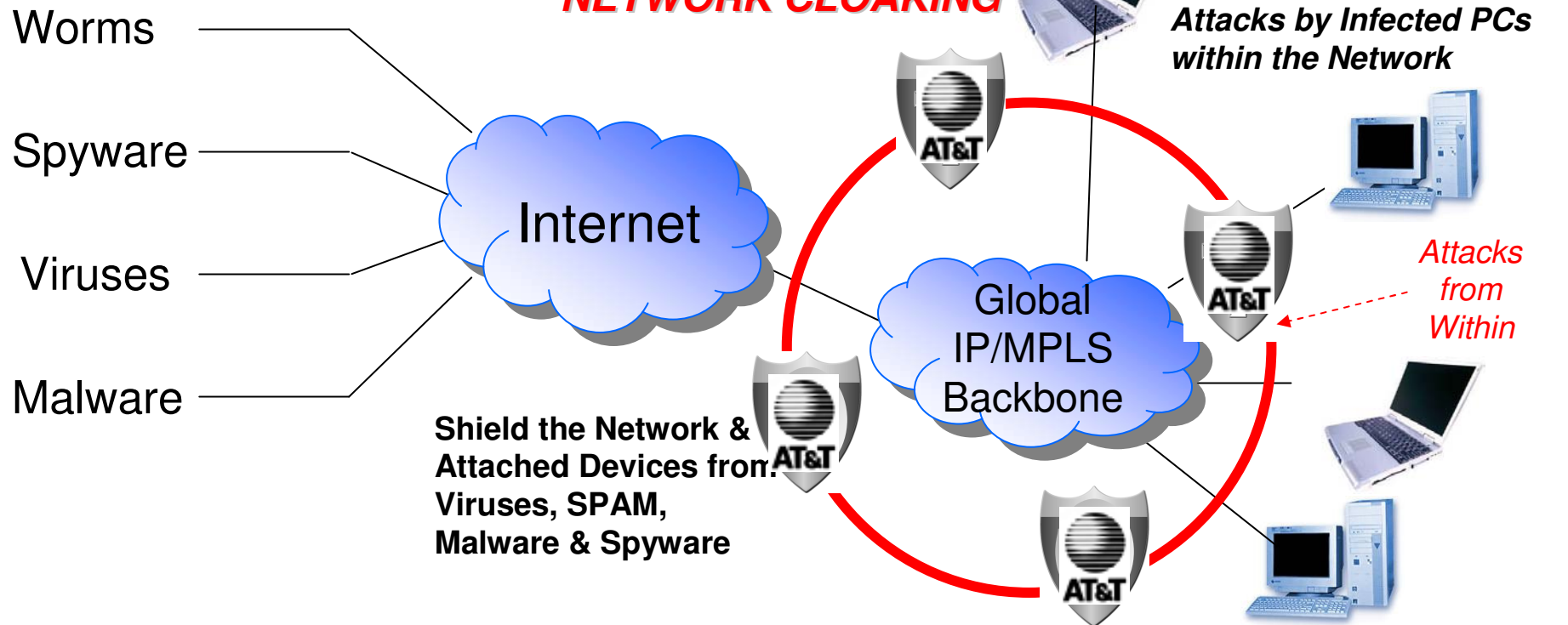
# Power of Protection



**Breakthrough  
Technology**

A cloaking device is a form of stealth technology, used to render an object invisible to the eye and to most sensor systems. *StarTrek*

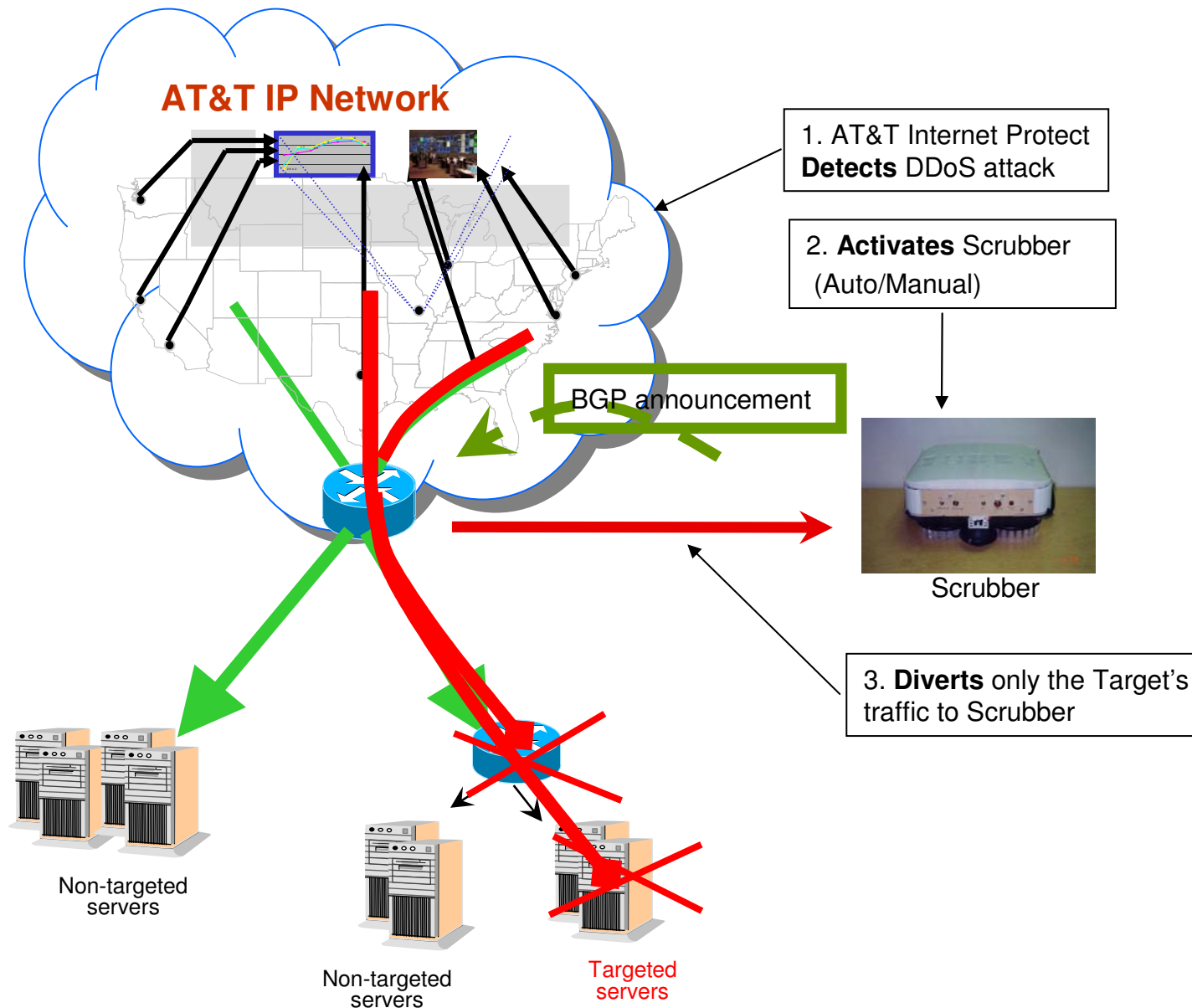
## NETWORK CLOAKING



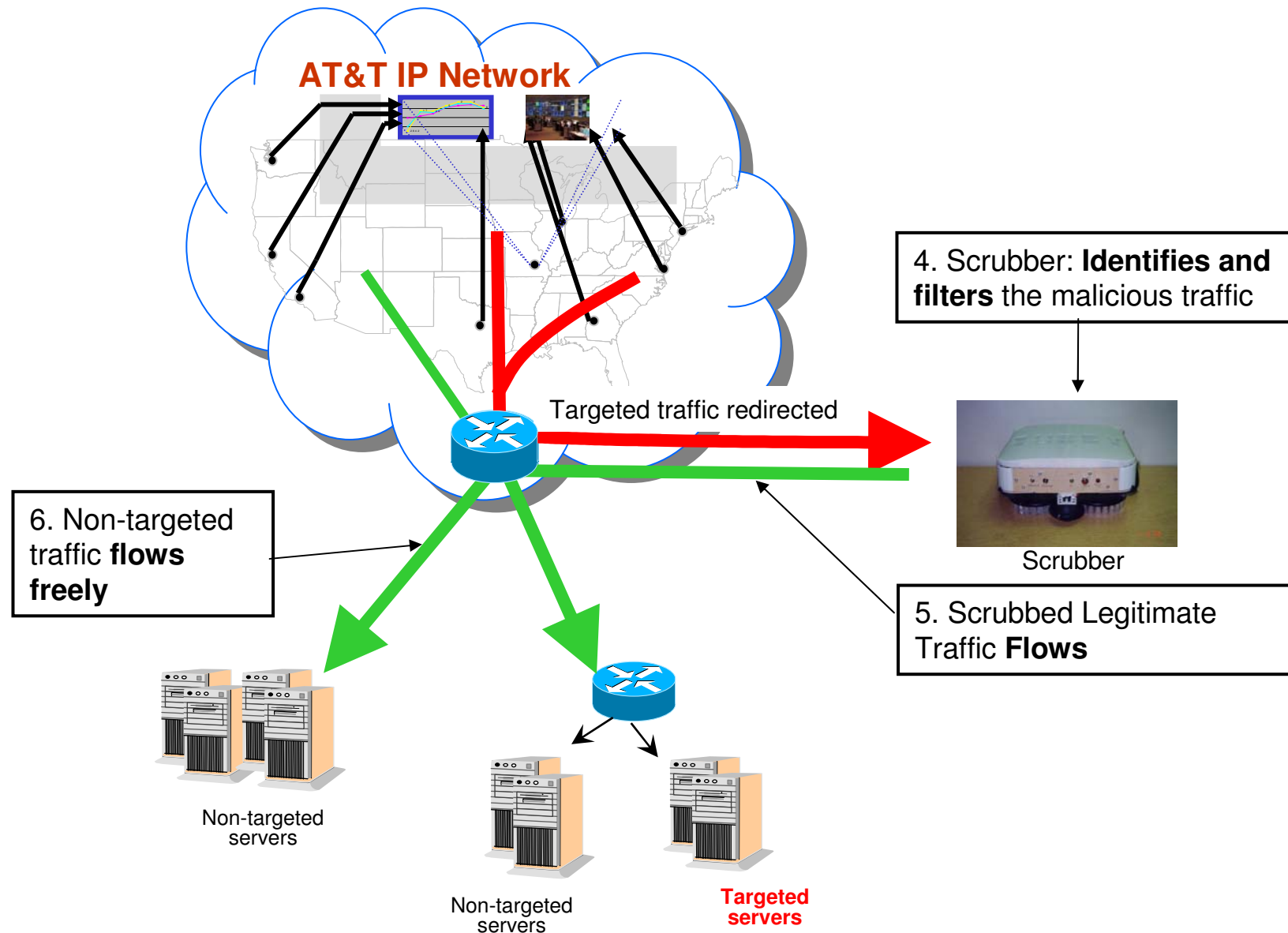
## Revolutionizing Security



# Example: AT&T DDoS Defense Diversion Overview

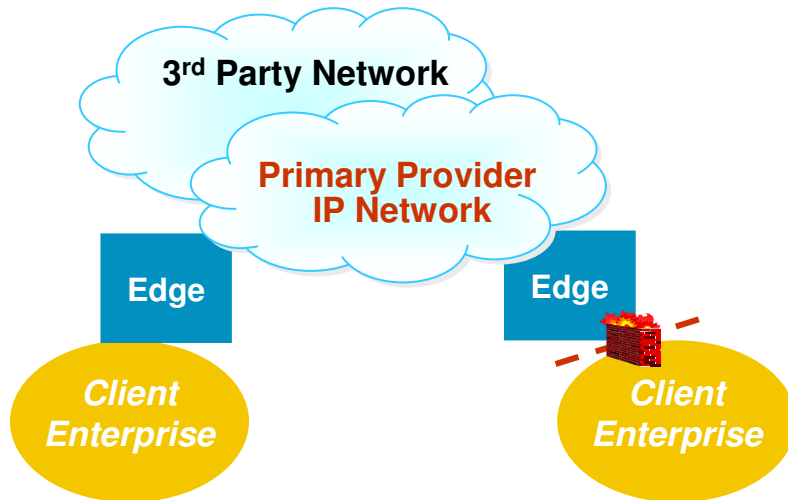


# Example: AT&T DDoS Defense Diversion Overview



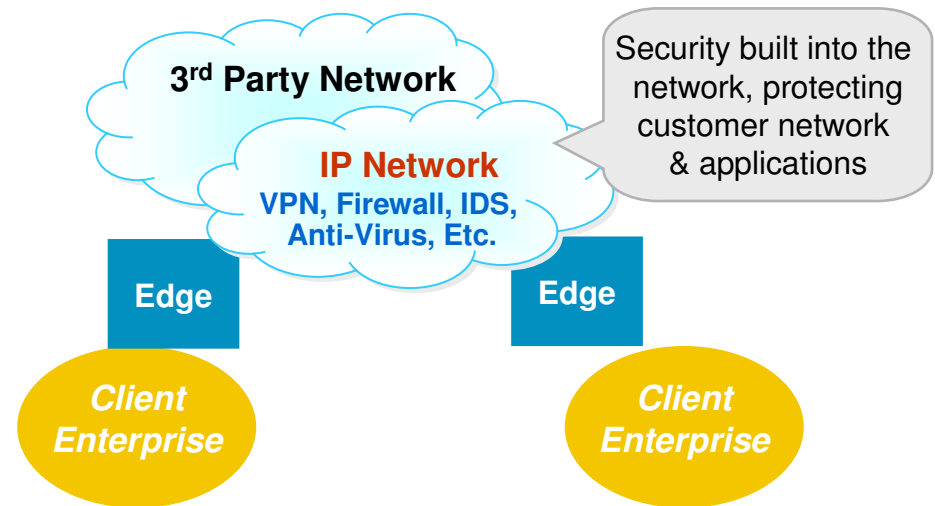
# Network Based Security

## Current State of Industry “Distributed Enterprise Edge Security”



- Client Security Investment at Edge
- IDS, Firewalls, Anti-Virus, Anti-SPAM Deployed by Customer
- Inefficient, Expensive, Non-Holistic
- Repetitive Across Client Base

## Network “Intelligence and Security”



- Network-Based Solutions
- Efficient, Inexpensive, Holistic
- Non-Repetitive Across Client Base
- Total Cost of Ownership (TCO) Improvement

**CHALLENGE: Industry-wide Convergence Toward Network-based Solutions**

# Network Security Challenges

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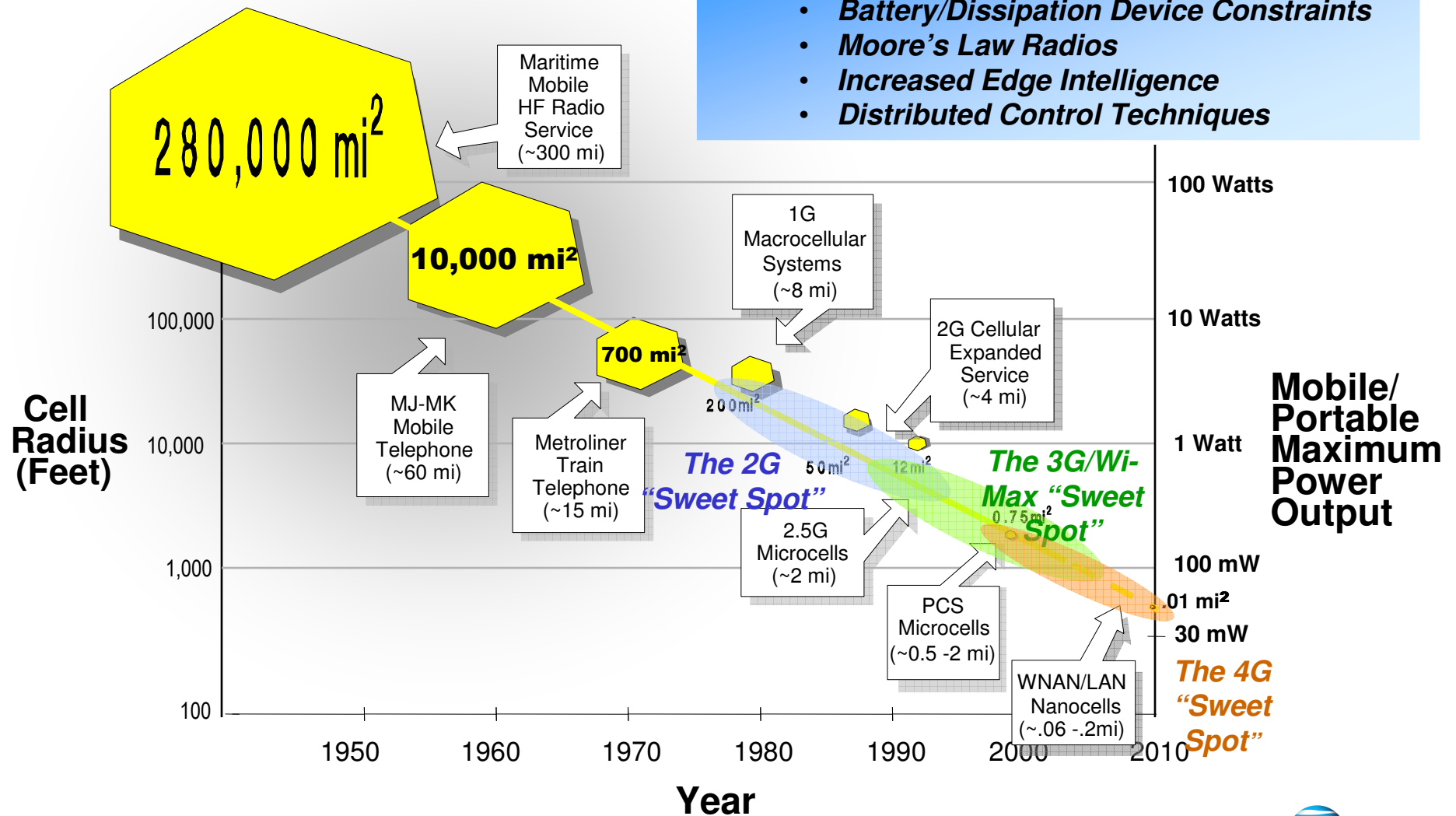
1. Eliminate **epidemic-style attacks** (viruses, worms, email spam) within 10 years – better **software code** is a critical component.
2. Develop tools and principles that allow construction of **large-scale systems for important societal applications** -- such as medical records systems -- that are **highly trustworthy** despite being attractive targets
3. Quantitative **information-systems risk management**  $\geq$  **quantitative financial risk management** within the next decade;

- 1. Network Architecture**
- 2. Network Management**
- 3. Security**
- 4. Wireless**
- 5. Knowledge-based Services**

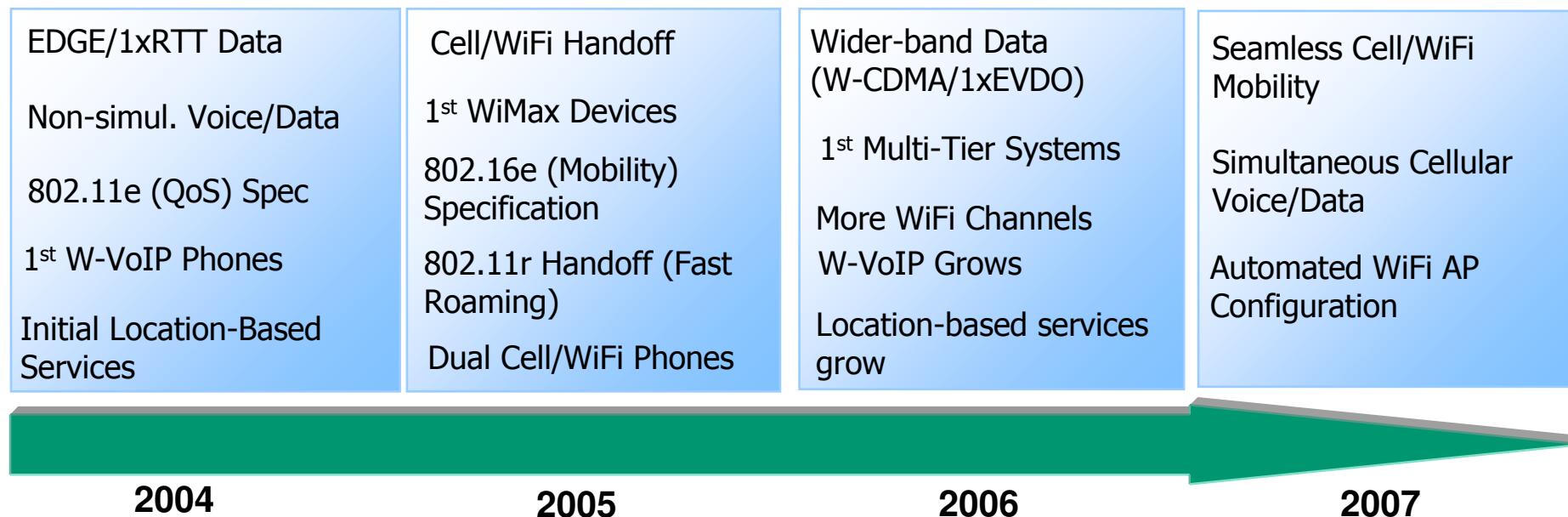
# Cell-Based Coverage Area Trends

## CHALLENGES

- Increased Bandwidth Demand/User
- Battery/Dissipation Device Constraints
- Moore's Law Radios
- Increased Edge Intelligence
- Distributed Control Techniques

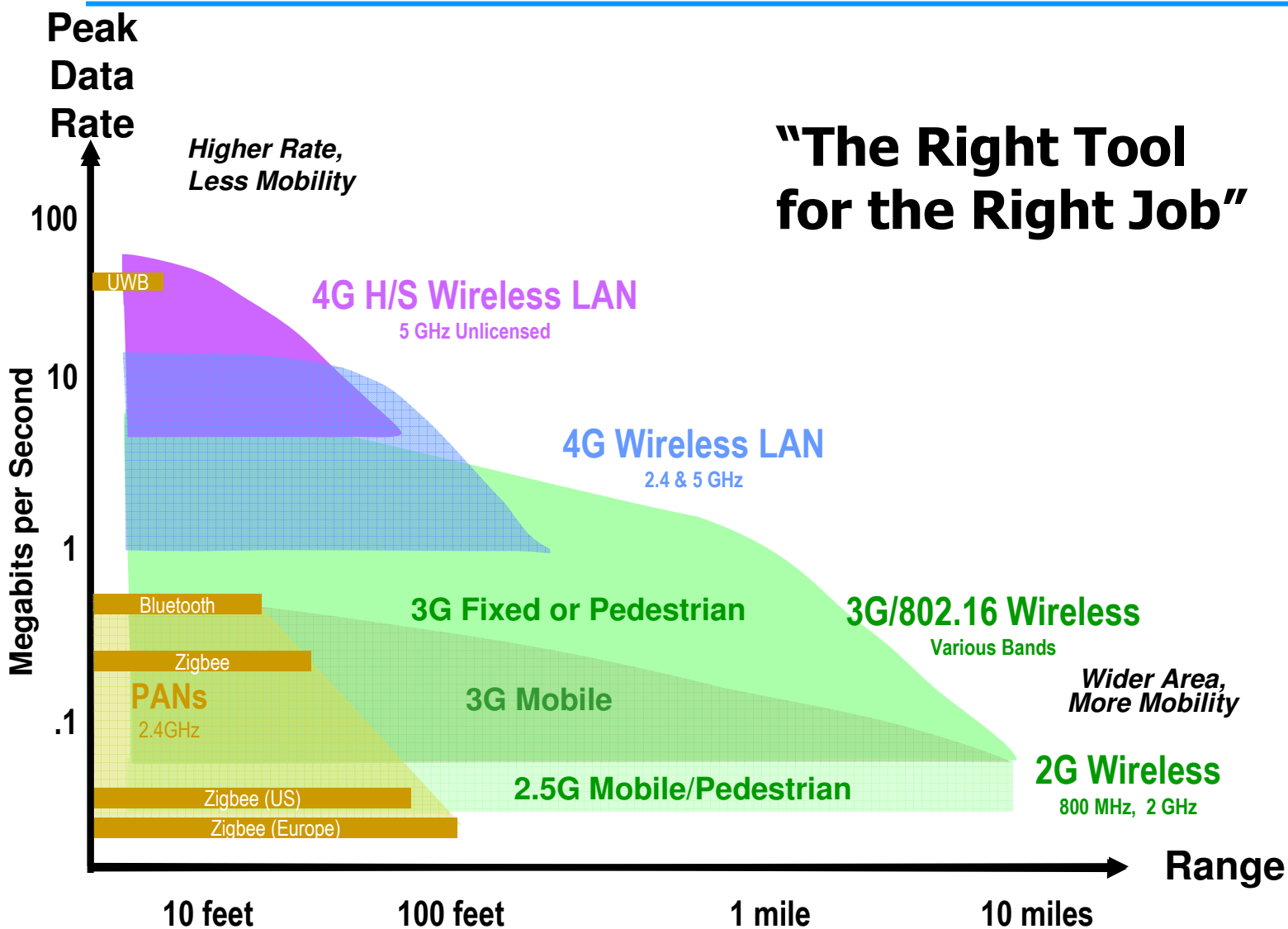


# Wireless Technology Evolution

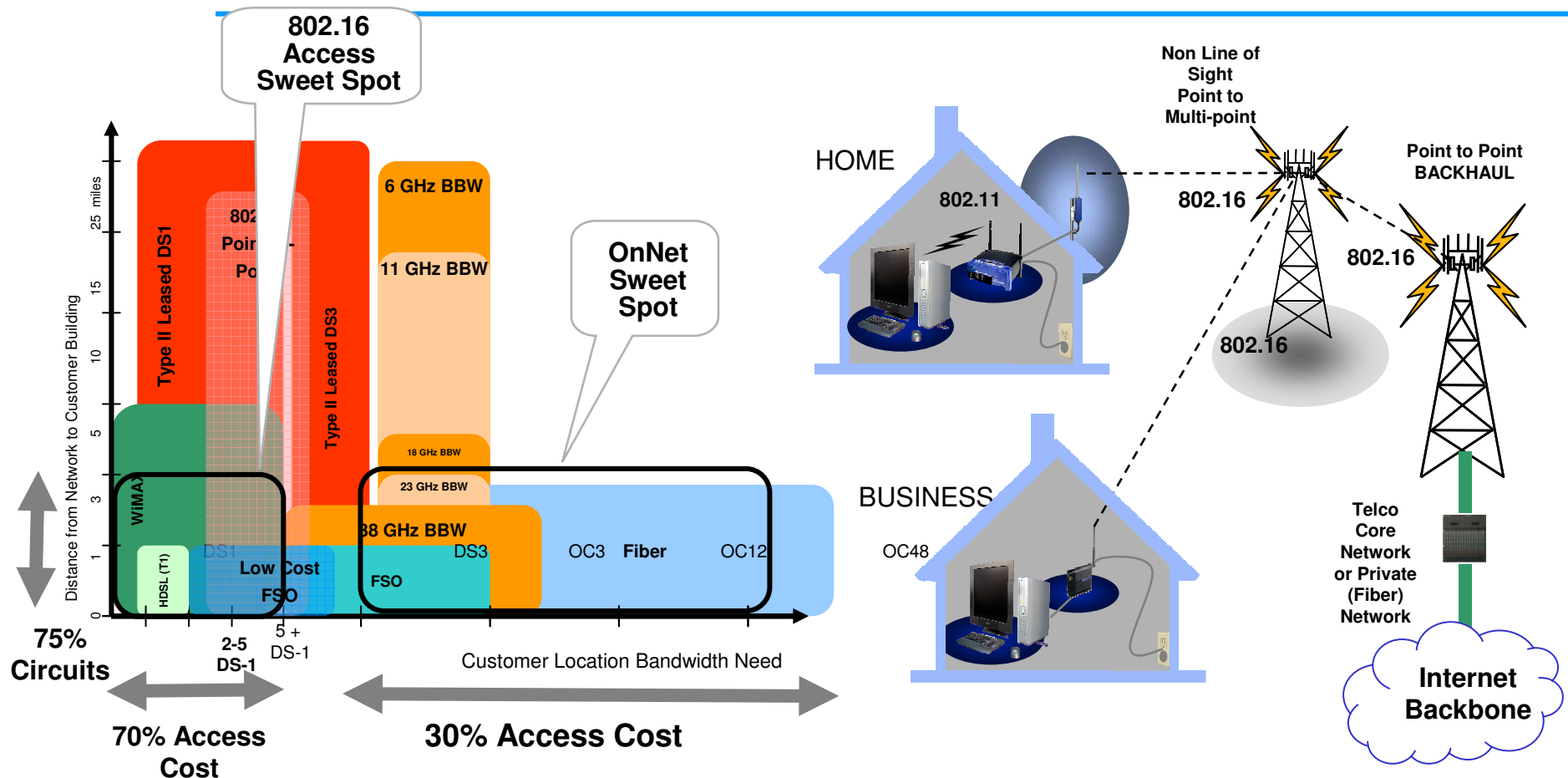


- *Cellular networks*: bandwidth improvements; simultaneous voice/data operation
- *Wireless LANs*: bandwidth improvements; automated management; fast handoffs
- *Wireless MANs*: 802.16/WiMax for access/WiFi backhaul; evolving to mobility support
- *Devices*: Hybrid voice, data, multimedia devices; Open OS environment; multiple radios evolving to software-based radio
- *Services*: Audio & video content, enterprise productivity applications, seamless mobility, location-based services

# Field of Use for Next-Generation Systems



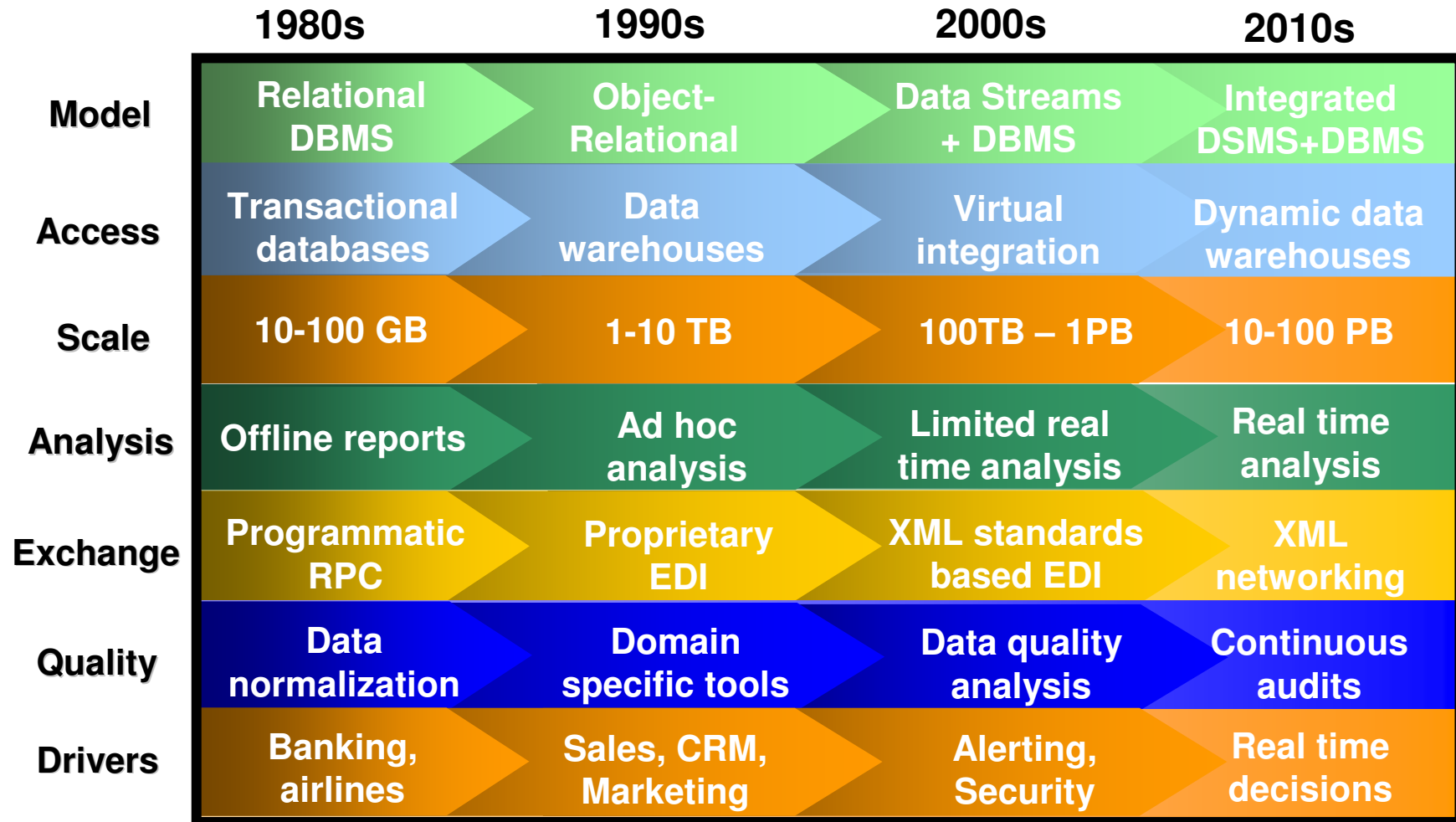
# Broadband Wireless Access



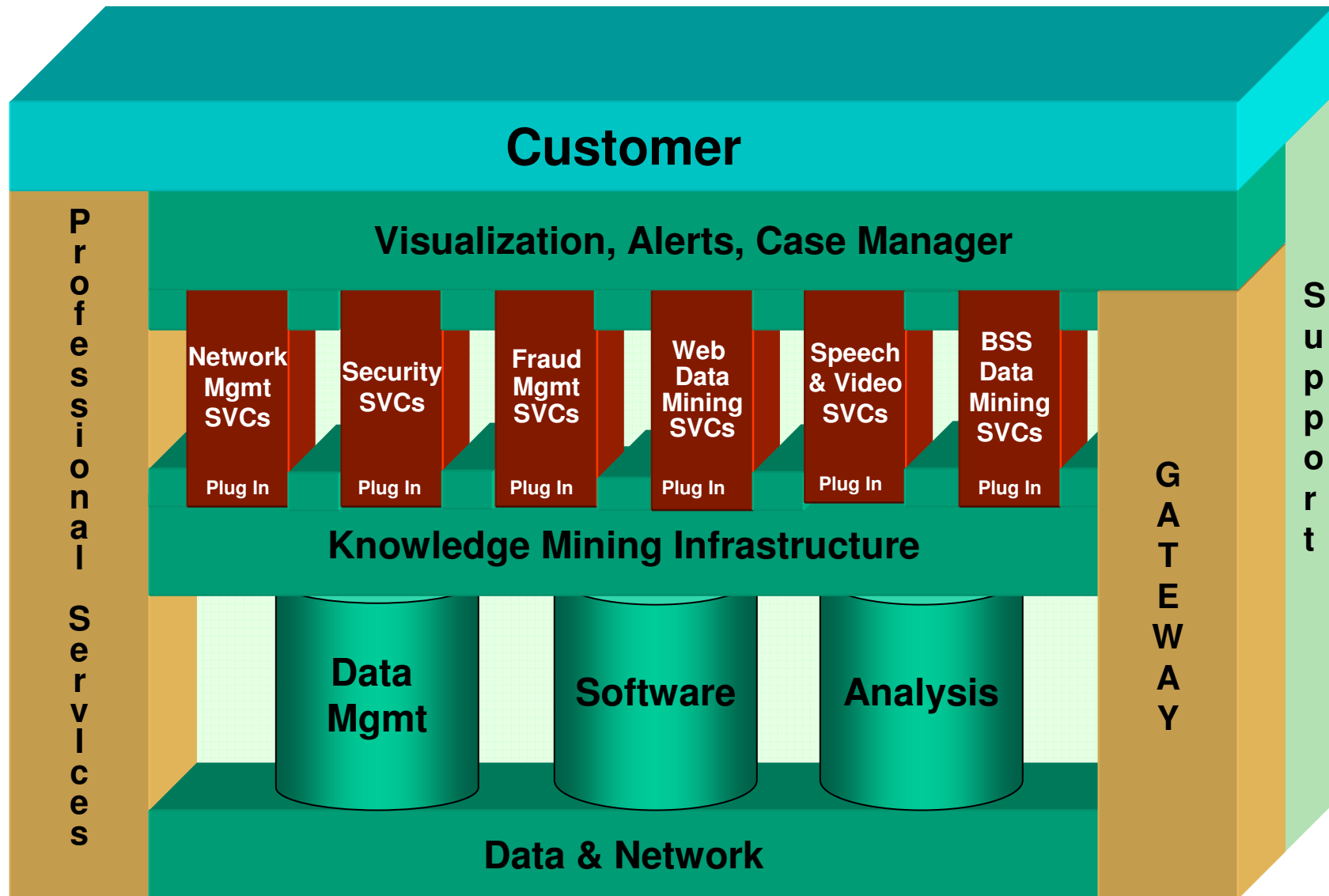
**Wireless Internet Will Be Big -- Driving Mobility**

- 1. Network Architecture**
- 2. Network Management**
- 3. Security**
- 4. Wireless Direction**
- 5. Knowledge-based Services**

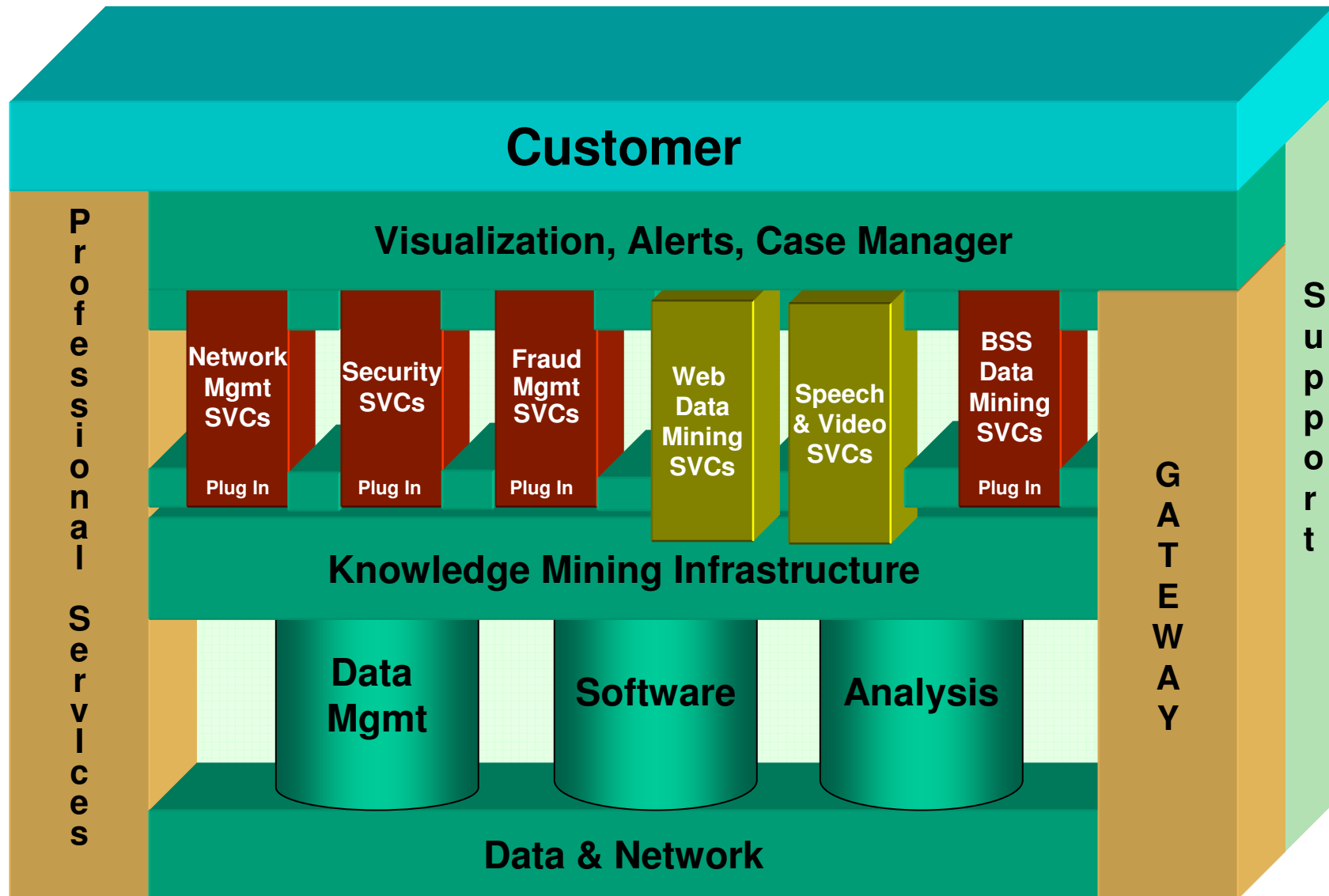
# Evolution and Future of Data Management



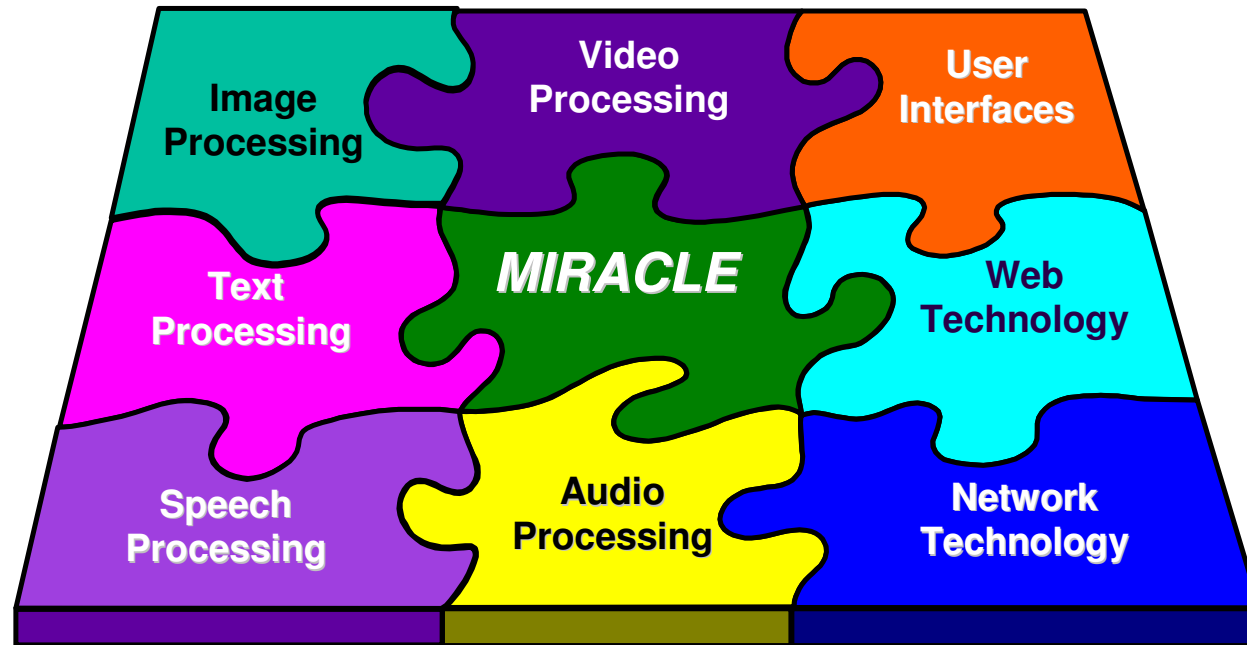
# Service Oriented Framework



# Services Over IP Framework



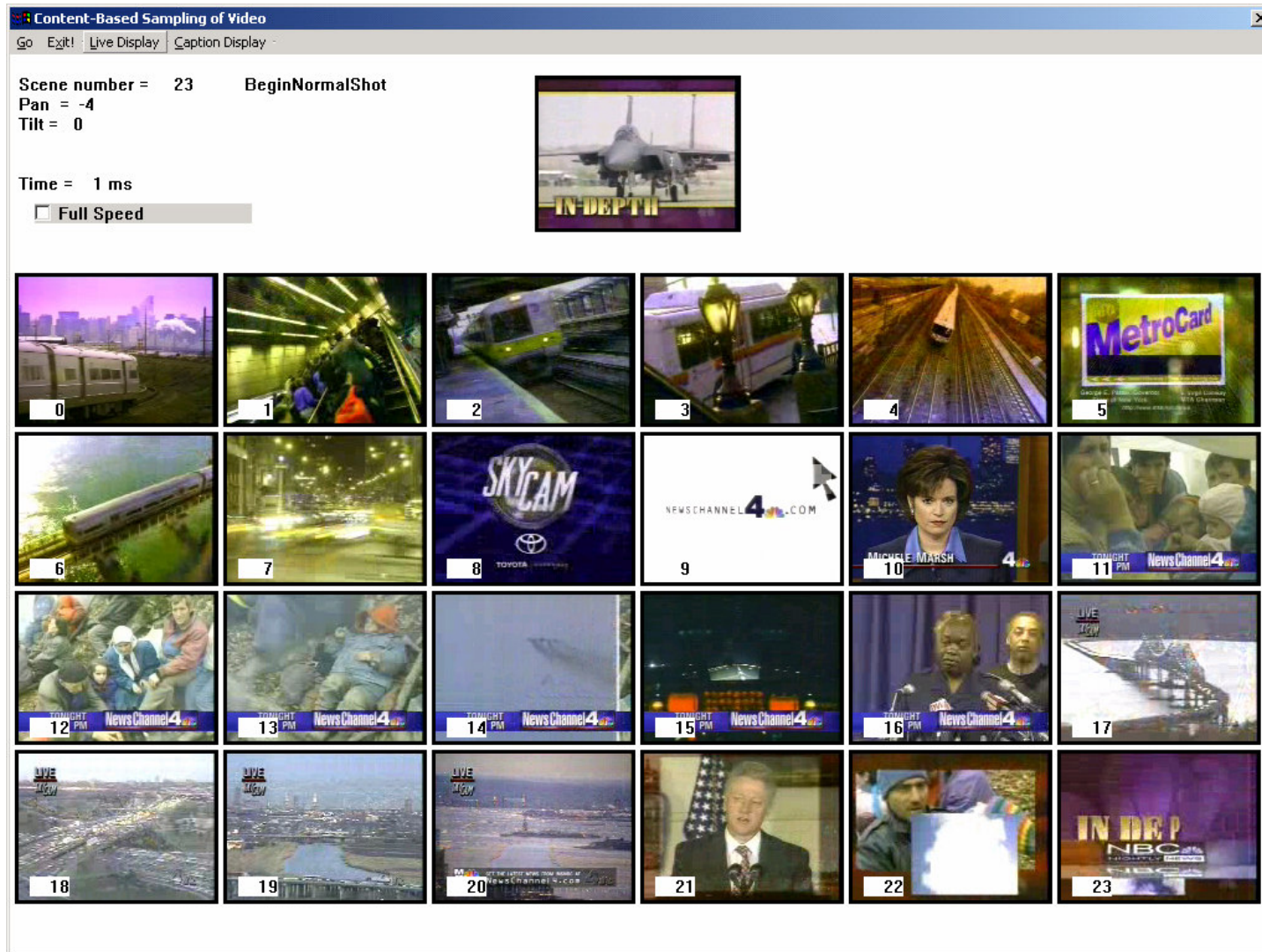
# Multimedia Information Indexing



**MIRACLE** – A platform aimed at creating the technologies for automated and content-based indexing of multimedia information for intelligent, selective, and efficient retrieval and browsing using IP technology

**MIRACLE: M**ultimedia **I**nformation **R**etrieval by **C**ontent  
- Bringing all the technologies together

# Video Indexing: Content-Based Sampling



# Miracle Video Search Engine

The screenshot displays the Miracle Video Search Engine interface within a Microsoft Internet Explorer browser window. The browser's address bar shows the URL: <http://miracle.research.att.com/projects/miracle/query.aspx?textsrc=CC&term=%22Tsunami+vicims%22>. The search results page features a search bar with the text "Tsunami victims" and a "search" button. Below the search bar, there are links for "Captions", "Speech", "Transcripts", and "Movies". The results are categorized under "Broadcast TV Closed Captions" and show "Results 1-10 of 54 programs for 'Tsunami victims'".

The search results list several programs:

- Nightly News** (Saturday, January 15, 2005, 1 day ago, full program): Later in the broadcast we'll report on where fundraising stands with **tsunami victims**. We turn to another example, the power of nature, this time in the American west. The search killed in an avalanche in Utah. Michael okwu reports.
- Today Show** (Friday, January 14, 2005, 2 days ago, full program): A few days later in December, he is packing Red Cross parcels to go to the Far East. A few days later we have a photograph of h in a Nazi uniform. He's one step forward and up. He is not ignorant ever things that go on. He is going to the army and that's the best.
- World News Tonight** (Thursday, January 13, 2005, 3 days ago, full program): Many thousands of people are still missing. The U.N. also said that one half of the **tsunami** under 15.
- International Newsfirst** (Thursday, January 13, 2005, 3 days ago, full program): Neal Connery, itv news, Cape Town. Doreen: U.S. president George Bush says the A significant difference for **tsunami victims** in southern Asia, and he says the work being image around the Indian Ocean region, parts of which are largely Muslim. Joining the trying to lend a hand. The CBC's Steven puddicombe reports from Indonesia.
- Today Show** (Thursday, January 13, 2005, 3 days ago, full program): Harry and brother William were photographed boxes relief supplies for **tsunami victims**.

Overlaid on the right side of the browser window is a Windows Media Player window. It is playing a video clip titled "Clip: video" with a duration of 00:12 / 21:17. The video shows a group of people, including children, standing in front of a damaged building, likely a school, after a tsunami. The video player includes standard controls like play, stop, and volume.

# Enhanced Conferencing – Speech Mining

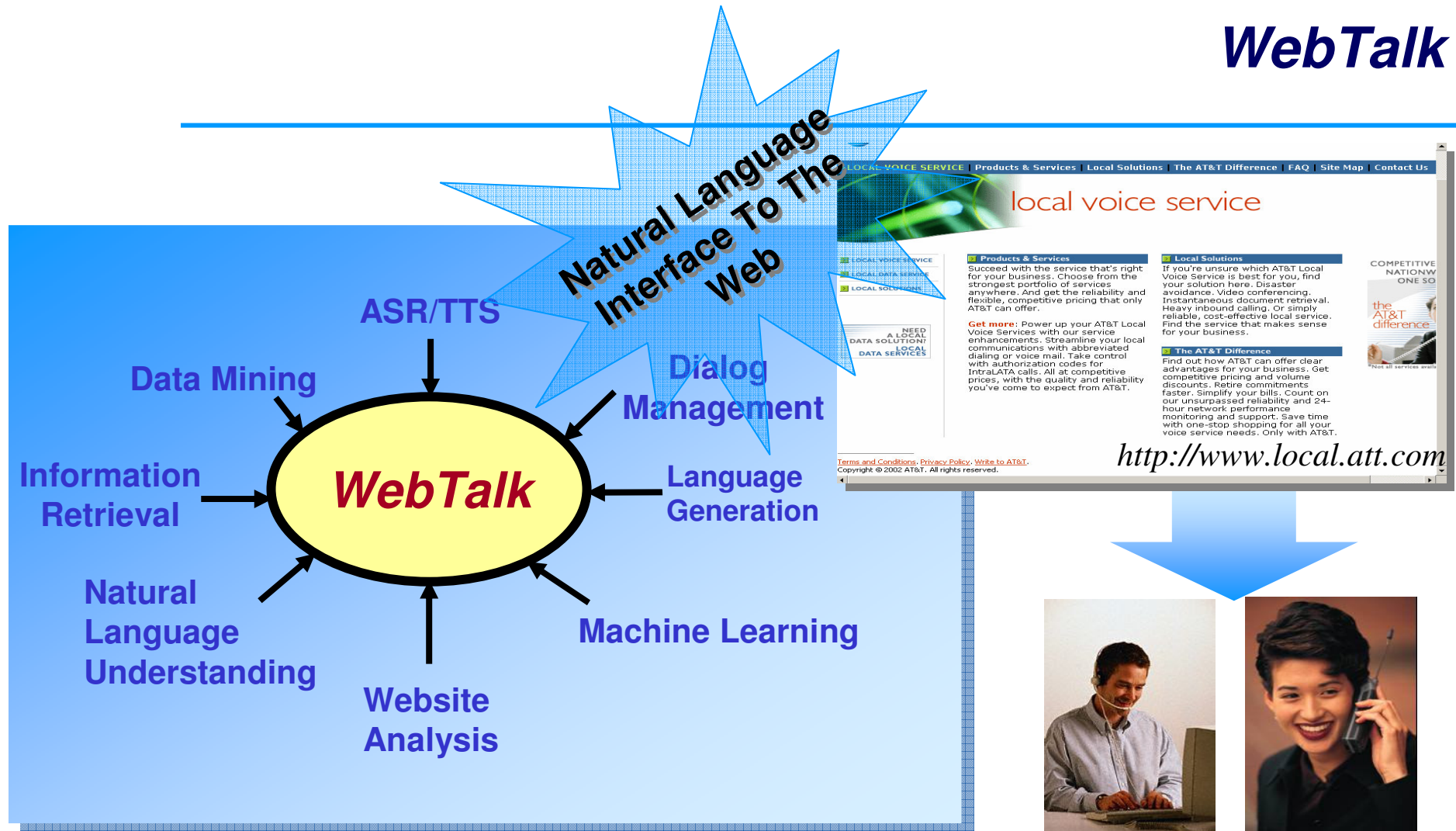
The screenshot displays the AT&T E\*Communications Meetings web interface. At the top, the AT&T logo and 'E\*Communications' text are visible, along with a 'Logged In: Gerald Karam, AT&T Labs' status. The main navigation bar includes 'Home', 'Meetings', 'Help', and 'Logout'. Below this, a secondary bar shows 'Meeting Place', 'Change Meeting', 'Delete Meeting', 'Meeting Summary', 'Participants', and 'Secure PINs'. The central area is titled 'Meeting: Pitney Bowes' with a status of 'In Progress'. It lists meeting details: Host (Gerald Karam), Bridge # (999) 555-2400, Date/Time (08/19/04 10:54 AM EDT), and Duration (0 hrs 20 mins). A 'Conference Recorder' section shows 'Recording...' with 'Record' and 'Pause' buttons. A 'Call Control' panel on the left includes buttons for 'HOLD', 'MUTE', 'HANG UP', 'LOCK MEETING', and 'END MEETING'. A 'Participant List' shows 'Gerald Karam' and 'Karrie Hanson'. A 'Meeting Documents' section lists 'Shared Meeting Documents' and 'My Documents'. A 'Touch Tone Help' section provides instructions for phone controls. A 'Recorded Conference Search and Playback' window is overlaid on the bottom right, showing a search for 'protocol' with results and a playback timeline.

## ■ **VOIP conferencing**

Enabling powerful new conferencing features

- Meeting recording
- Multi-meeting support
- SpeechLogger keyword search
- Email/IM notification
- Meeting Security

**SpeechLogger™ is used to manage conference recording and searching**

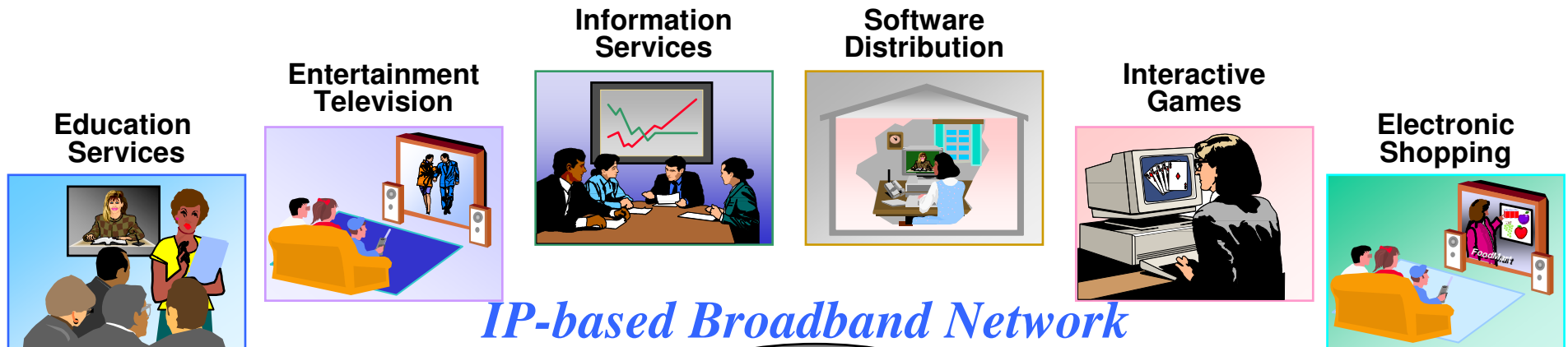


**Automatic spoken dialog  
system building based on a set  
of Web pages**

**WebTalk**

# Converged Model

## Multimedia/Multi-application Transparency



## Wired/Wireless Service Integration

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# Thank You!



**[www.att.com](http://www.att.com)**