

InForum 2000

The Digital Landscape:
Challenges of the New Frontier

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The Landscape

- Ever Expanding Internet
- Very High Speed Networks
- Ubiquitous Wireless Access
- Inexpensive Powerful Computers
- Networked Actuators & Sensors
- Ever Increasing Functionality
 - Including Security, Authentication, etc.

More Landscape

- Emergent Nano and Bio-Technology
- Pervasive Digital Object Infrastructure
 - With information as a first-class network citizen
- Interacting Systems supporting Collaboration
- Inconspicuous & Effective User Interfaces
- Software Marketplace
 - component of a general information marketplace
- Harmonizing IT & Legal Systems

The Challenges

- **Understanding Your Information Context**
 - Computer, Software & What s happening in the Net
- **Configuring Your Context**
 - Selecting among Multiple Options
- **Nomadcity**
 - Seamless Mobile Interworking - before, during & afte
- **Teaching Children to Program Effectively**
 - Literacy directly affecting ones functionality

More Challenges

- **Making good use of Increased Bandwidth**
 - Speed at all levels including User Applications
- **Creating or Enabling National Infrastructure**
 - Achieving Critical Mass
- **Extensions to International Agreements**
 - Leading to a fully connected & interoperable world
- **Learning to Trust the Net**
 - Reliability, Security, Overall Performance

More Challenges

- **Building Reliable Software**
 - And Understanding How to do so
- **Designing Complex Systems for Performance**
 - With Sufficient Assurance a Priori
- **Building Hacker Proof Systems**
 - Inside the Net and Outside
- **Coping with Active Devices & Mobile Programs**
 - Including Mixed Heritage Systems

Still More Challenges

- **Building Meaningful Collections**
 - Organization of Information, Metadata Registries
- **Coping with Access to Unlimited Information**
- **Managing One's Own Information**
- **Achieving Interoperability at all Levels**
 - Particularly in the Software Marketplace
- **Integrating Virtual Worlds with Real Worlds**
 - As well as shuttling back and forth between them

Still More Challenges

- **Protected Public Dissemination & Leakage**
 - Virtually Impossible to Protect Public Content 100%
- **Malleable Content**
 - Works that are intended for others to build on
- **New Economic Models**
 - Based on Encouraging the Sharing of Information
- **Open Source Software**
 - Openness is Good, but How do creators get reimbursed

How Important is Network Speed?

- What does it enable?
 - That cant be achieved effectively at lower speed?
- How much is a doubling of capacity worth?
 - To the end user or organization that pays for it!
- Is there a natural limit to the bandwidth an individual can use?
 - If so, how can one determine what it is?

What Might be Enabled/Unleashed?

- **A true software marketplace**
 - This could render the current Microsoft issue moot
- **Multiplexed streams to the end user**
 - This would enable multiple choices easily selectable
- **Enhanced Supercomputer Interactions**
- **Interactive Access to high resolution data sets**
- **Collaboration on a scale not easily envisioned**

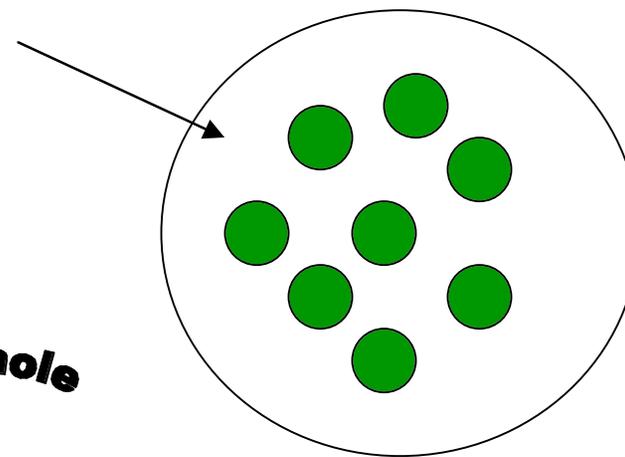
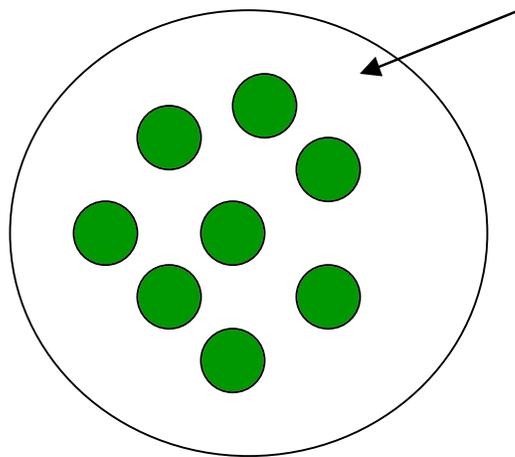
Software Marketplace

- User device is sold only with a bootstrap loader
- Pull in Software from the Net as needed
- Retain it when done - or not
- All software accessible by digital library techniques (i.e. metadata registries, handles, etc.)
- Wireless access when mobile, Computing at surrogate sites, Storage at Network Repositories
- Powerful model - need security & authentication
- But mostly, needs very high speed net to download large programs and data sets.

Comparing the Internet Architecture & the Digital Object Infrastructure

Heterogeneous
Networks

Heterogeneous
Information Systems



Seamless Whole

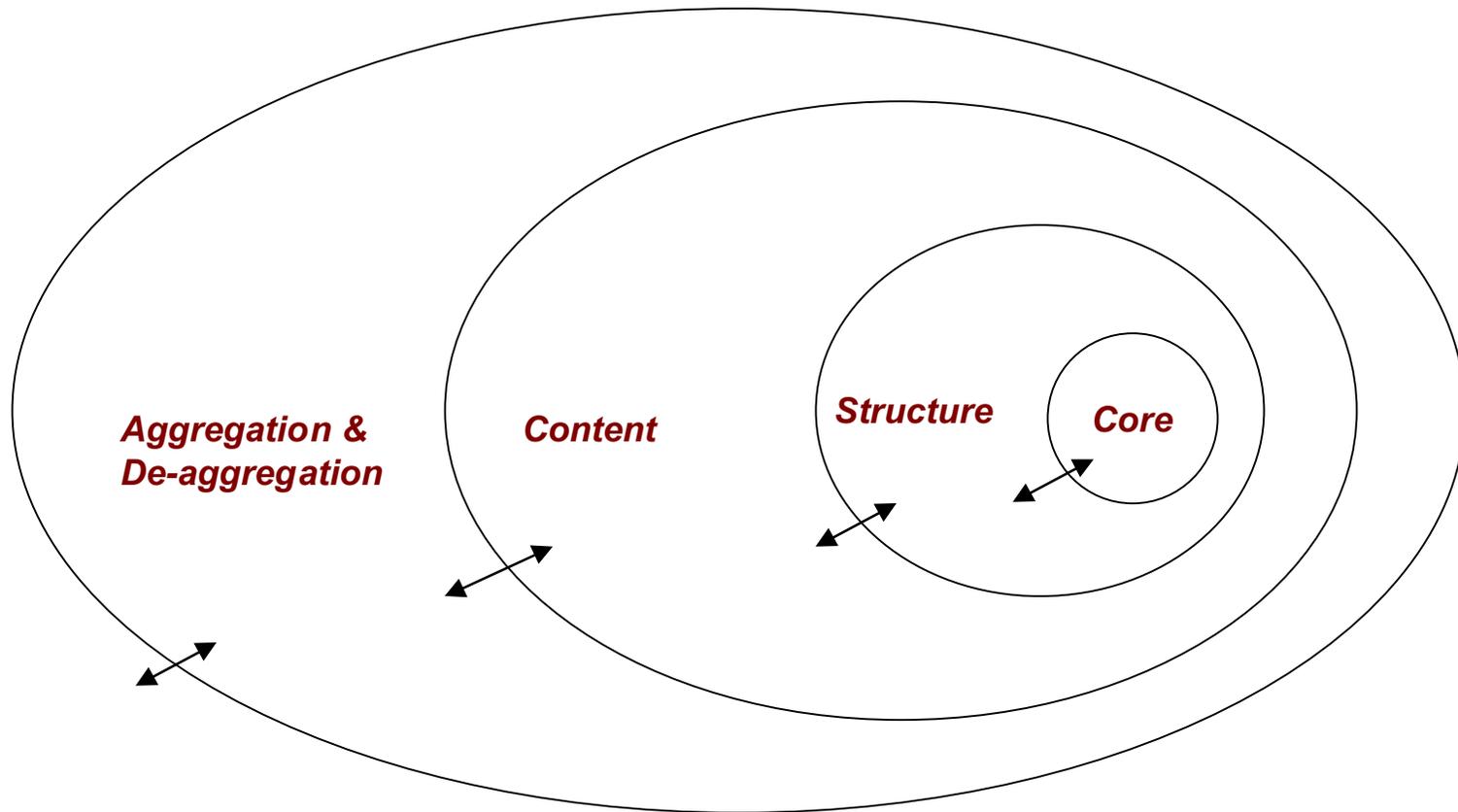
Internet objective
Best-effort Packet Delivery

Seamless Interoperability

Key Attributes of the Infrastructure

- Structured Information as **Digital Objects**
- Persistent, Unique and resolvable Identifiers
- **Repositories** to store Digital Objects
- **Stated Operations** for each object including terms and conditions by the owner
- Integrated in an open-architecture system
- In a network environment

Nesting of Repositories



*Core Interface must be present at each level
Other levels could be separately defined later*

Key Technologies

- Repositories
- Generic Resolution System for Unique Ids
 - The Handle System is available on the Net at www.handle.net
- Metadata Registries
- Authentication Systems
- Protection Systems

Concluding Remarks

- How to Achieve Coherence in the National Information Infrastructure as it Develops?
- Enabling IT Entrepreneurs to innovate and still achieve interoperability in new areas
- Maintaining the discipline to support long-term fundamental IT and scientific research more generally in the face of a booming economy
- Finding Incentives to retain the best minds in pursuit of long-term fundamental research