Service Oriented Architectures with User Controlled Light Paths

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Our vision for networks

> **In the 1960s computing was dominated by central managed large mainframe computers and dumb terminals**
> - Users were charge by CPU minute and memory usage
> - A lot of research into optimizing CPU and memory usage

> **But starting in the 1970s at our universities and research centers, users could buy their own mini-computer**
> - Researcher could use computer as little or as much as they want with no additional charges
> - This led to concepts like UNIX, GUI developed ultimately culminating in the PC

> **Telecommunications and the Internet today is like computing in the 1960s**
> - Users are charged by bandwidth consumed and very centralized management

> **We believe the next generation of Internet will be as revolutionary as the PC**

Mashups and SOA

> The goal of SOA and Mashups is to deploy a range of services that encourage others to build applications which manipulate content and services, permitting users to work with the content and services in the manner of their choosing.

> Newer-gen apps such as location services Google Mashups, photo sharing (Flickr), social bookmarking (del.icio.us), and community networks (LinkedIn, MySpace) have raised user expectations.

> Users expect to be part of the creative flow of content and processes, not just discovers or consumers.

> CANARIE is extending this concept to the network to allow the user to control and manipulate the network
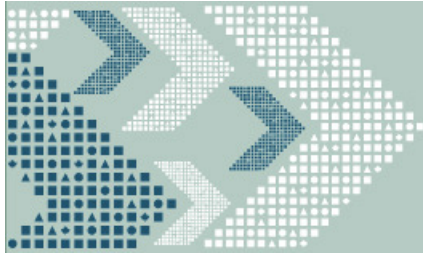
Driver for SOA networks

> **Increasingly more and more organizations are acquiring their own fiber networks**

– Universities, schools, hospitals, business

> **Acquiring fiber in the long haul is very expensive to light and obtain**

– Alternative is to use "dim fiber" –point to point wavelengths

– But want flexibility to do configuration and change management as with dark fiber

> **Increasingly science and business needs dedicated networks for specific applications and disciplines for high data volume grids**

– Want to be able to manipulate the network in the same way they can manipulate the application
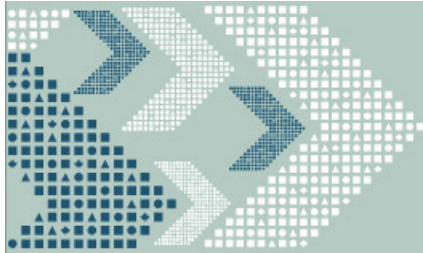
What is UCLP?

> **User Controlled LightPaths – a configuration and provisioning tool built around grid technology using web services**

> **User can combine together various links, routers and switches to produce a wide are network that is under their control using BPEL**

  – Articulated Private Network (APN)

  – Next generation VPN

> **Uses Service Oriented Architecture (SOA) and so network can be integrated with other web service applications**

> **With SOA instruments, devices, sensors and wireless devices can also be integrated**

  – **All under user control and architecture**
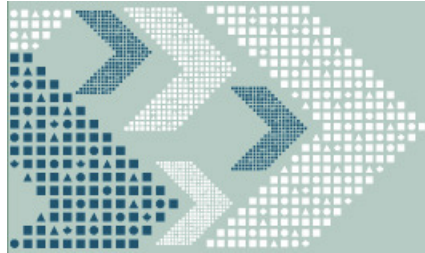
UCLP Objectives

> **Allow institutions to integrate wavelengths and fiber from different suppliers and integrate with institution's network management domain**
>> – And offer VPNs to users
> **Create discipline specific re-configurable IP networks**
>> – Multihomed network which bypasses firewalls with direct connect to servers and routers
> **User controlled traffic engineering**
>> – Active replacement for Sockeye and Route Science
>> – Alternative to MPLS
> **Primary purpose is NOT dynamic switched optical networks**
> **Primary purpose is NOT reservation and leasing of wavelength resources**
> **Primary purpose is NOT end-to-end optical VPNs**
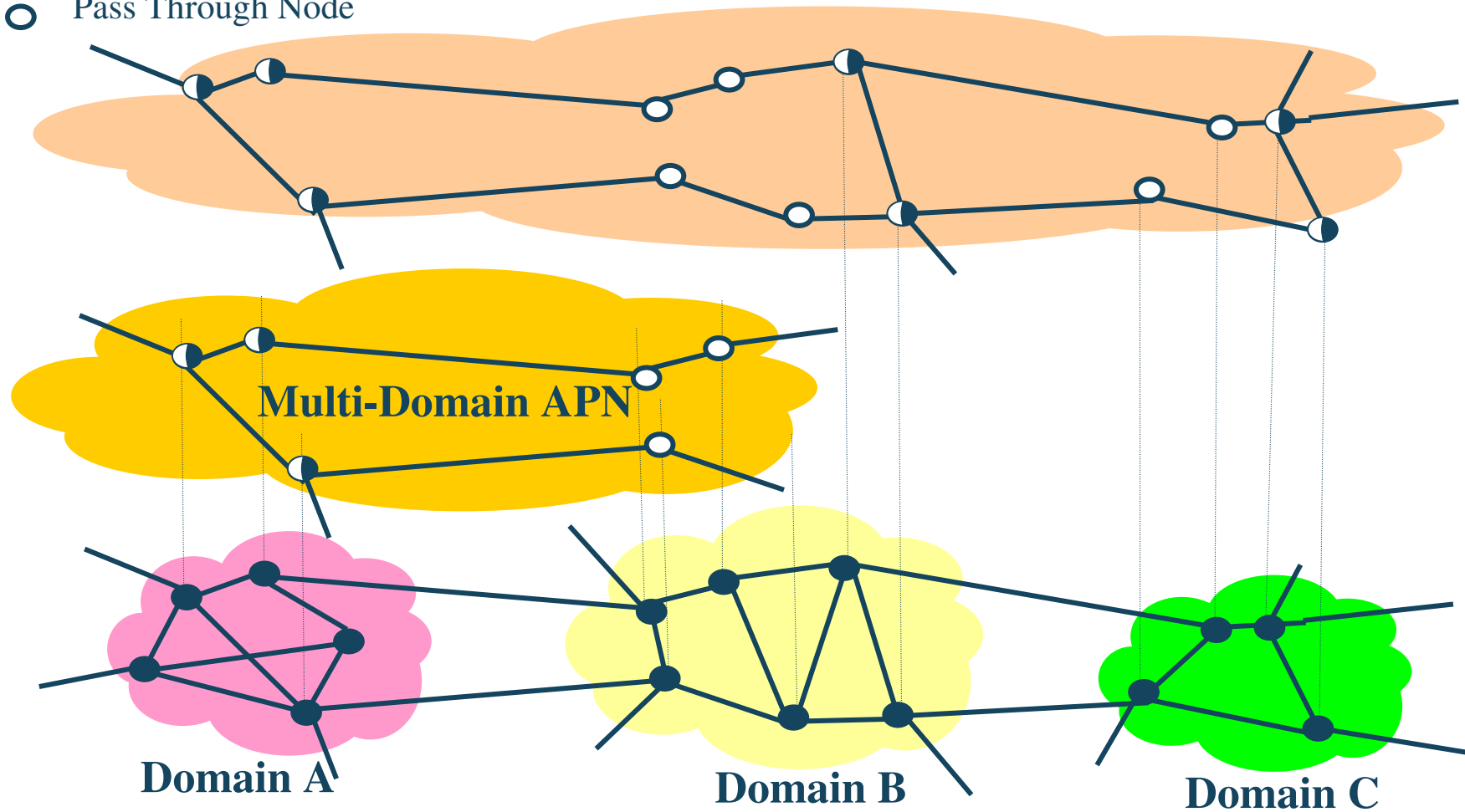> **Primary purpose is NOT inter-domain connection of lightpaths**

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UCLP not a new idea

> **UCLP not a new idea (except to use web services)**
>   – Similar to GSMP, Y.1312/1313, L1VPNs

> **But UCLP uses web services which allows much tighter integration and coupling into customer's NMS (as oppose to carrier's)**

> **UCLP allows much tighter integration into customer's SOA applications particularly SCADA**

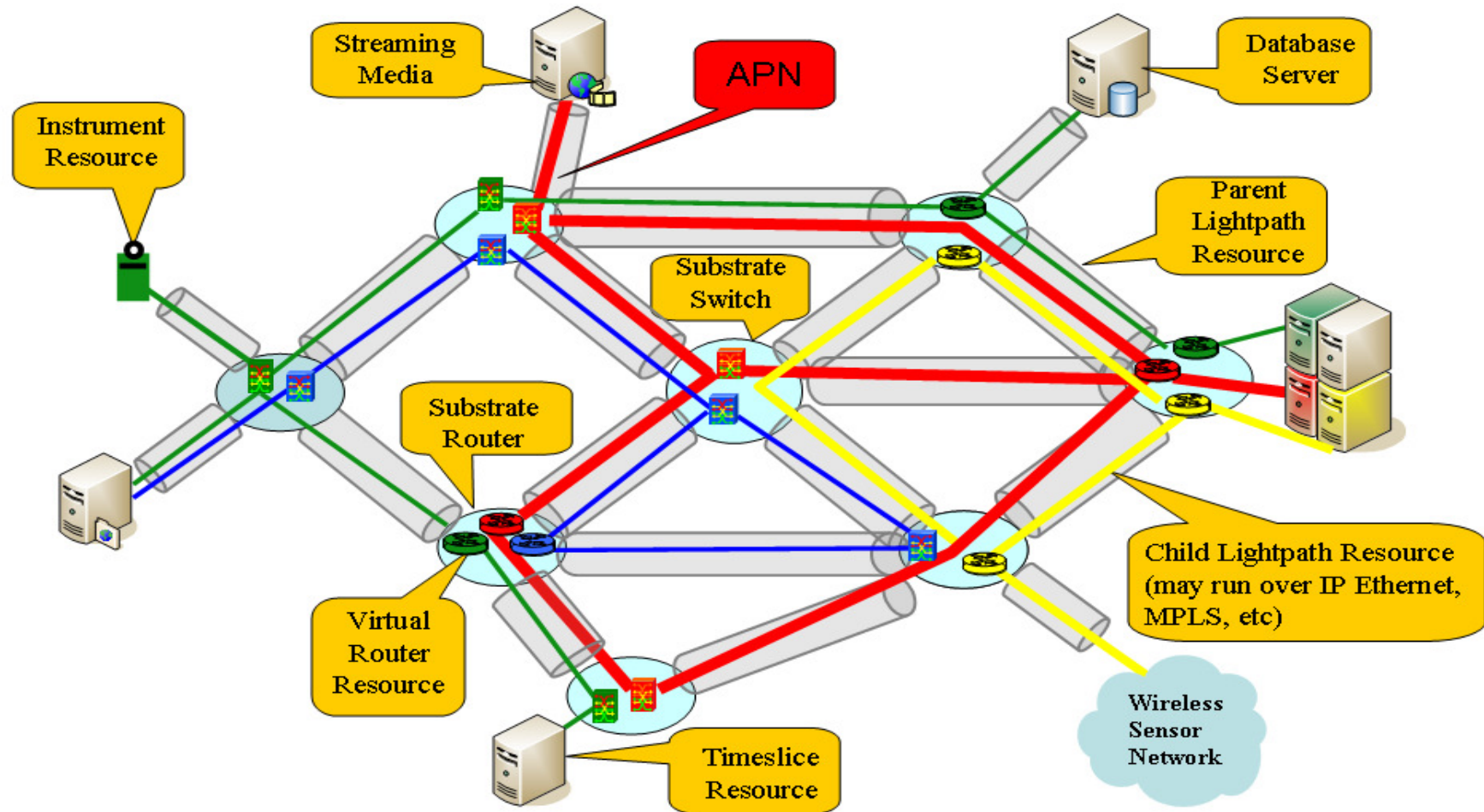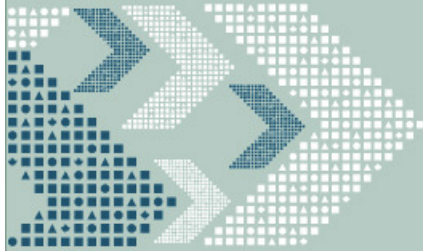> **With WS workflow network elements are just another WS workflow**

Multi-domain

Partitioned Node
Pass Through Node

Multi-Domain APN

Multi-Domain APN

Domain A

Domain B

Domain C

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Lightpaths + SOA = UCLP

Streaming Media

APN

Database Server

Instrument Resource

Parent Lightpath Resource

Substrate Switch

Substrate Router

Child Lightpath Resource (may run over IP Ethernet, MPLS, etc)

Virtual Router Resource

Timeslice Resource

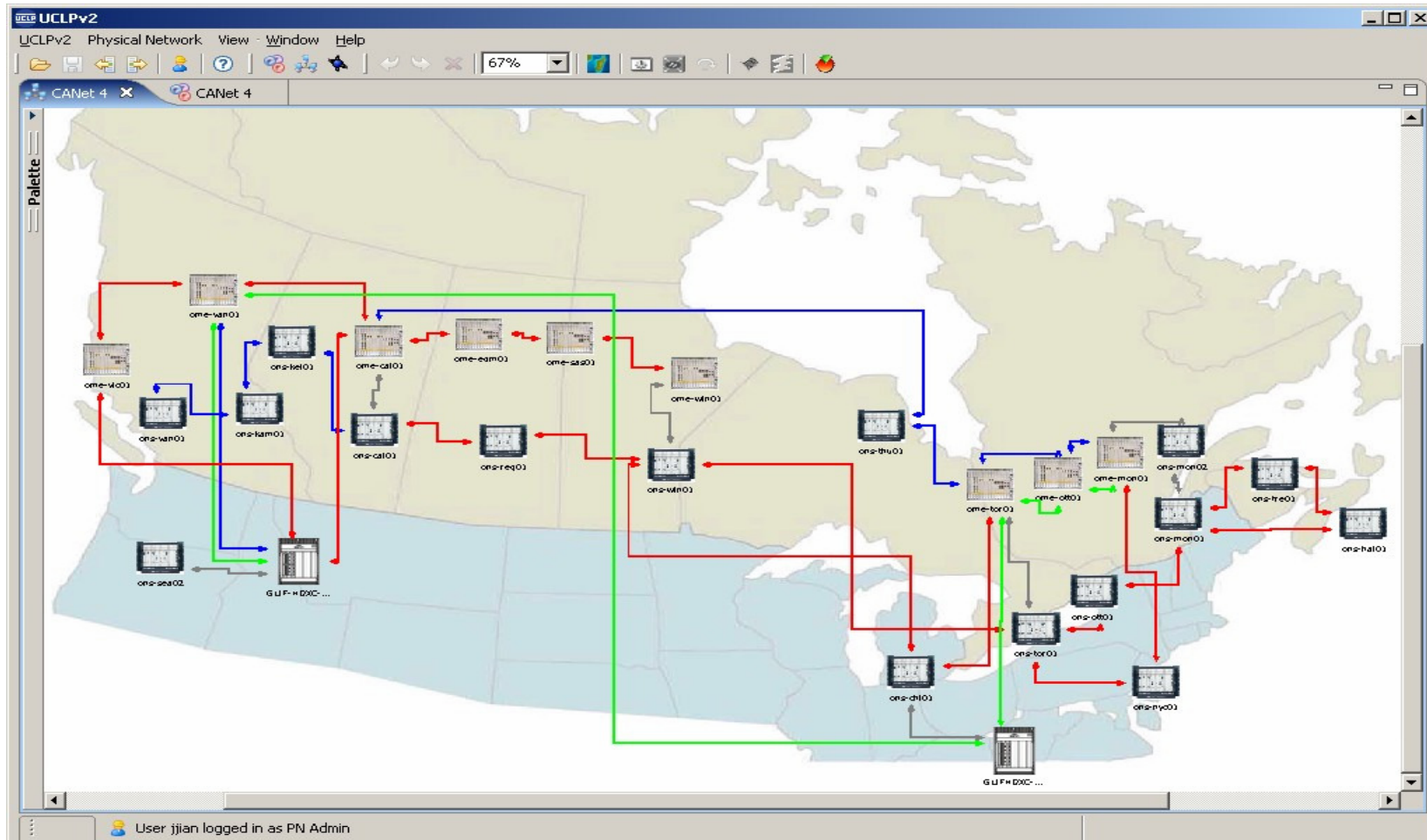Wireless Sensor Network

UCLP vs traditional network management

> **With UCLP**

– Network user and owner are the same

– Leasing network resources to other parties, including full control

> **Traditional approach:**

– Signalling protocols (O-UNI, GMPLS, etc.) for establishing end-to-end connections for users

– No access to underlying resources for the user

Physical Network Editor

Detail APN creation

Eucalyptus Participatory Design Studio Grid – using UCLP and SOA

> **Carleton Immersive Media Studio (CIMS), Carleton University, Canada**

The Participatory Design Studio will allow architects and industrial designers at multiple locations to collaborate in real time by sharing computational resources, geometry datasets, and multimedia content.
The expected result is the development and field testing of a Service Oriented Architecture utilizing User Controlled Light Paths (UCLPv2) on CA*net 4 that provides university architecture staff and students in Ottawa and Montreal with on-demand simultaneous shared access to visualization, modeling, and visual communication tools. The project is innovative because commercially available architectural tools not originally intended for long-distance use will become easy-to-use powerful enablers of long-distance design participation.

Source: Maxine Brown

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Eucalyptus Network (APN)

Source: Gabriel Wainer

Eucalyptus SOA

PDSF Management Web Services

- Manages the resources and users

- Users interact with the system by engaging in sessions

- selecting people s/he wants to interact with and the resource that supports the interaction (e.g. High-Def VideoConference)

- Status of sessions, resources, and users can be acquired through these management services
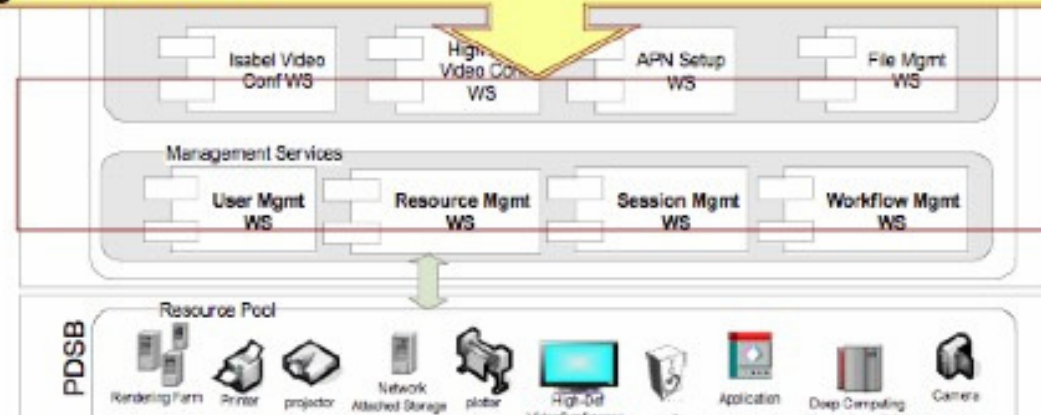
Eucalyptus APN
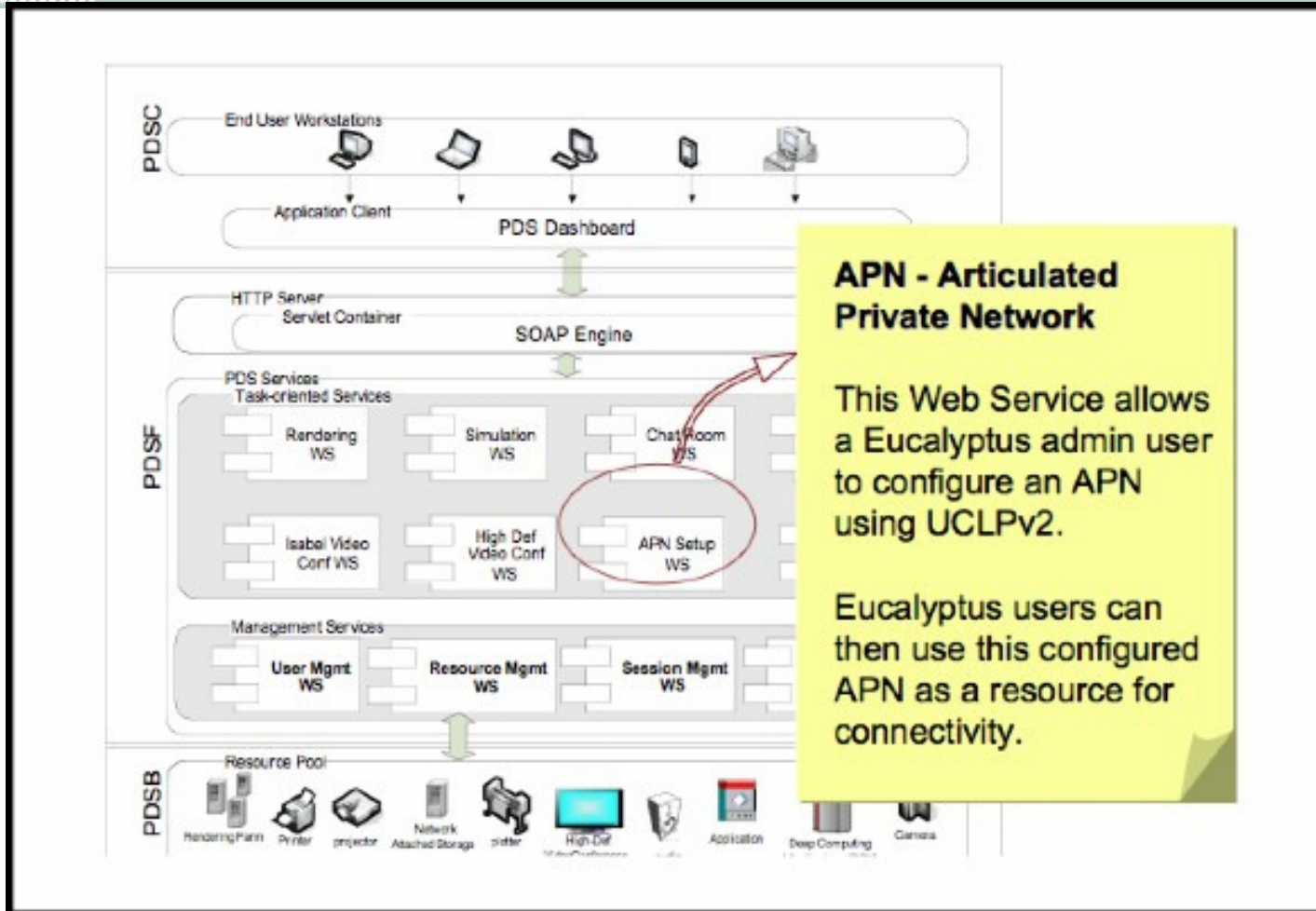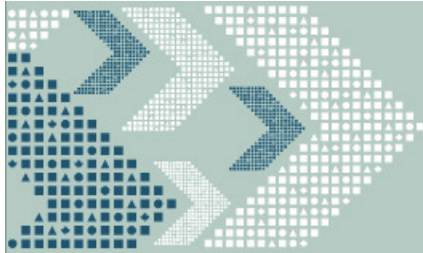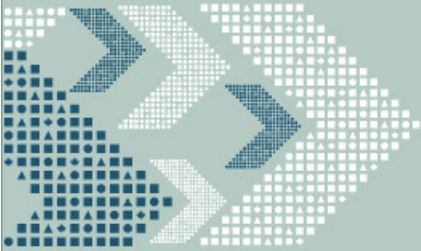
Problem

> **Universities and Telephone companies face the same problem of small number of heavy users consuming expensive Internet bandwidth**

> **University solution is to cap bandwidth from dormitories and/or block types of traffic**

> **Telecom solution is to build a two tiered Internet or doing volume capping**

   – A high speed un-congested channel for the telco traffic particularly aimed at carrying video

> **Universities can play a leadership role in piloting new last mile (hundred feet) architectures that address problems of dormitories**

   – May serve as possible model for telcos

> **University students are ideal early adopters and were instrumental in diffusion of the Internet throughout larger community**

One possible solution

> **Following is example of one possible solution**
>> – There may be others- this is not intended to be definitive or exclusive

> **Work with a few universities on a small number of pilots where interested students can lease or control dedicated fiber/copper to university colo point**

> **They can directly peer with other students in the dormitory across a "white light" switch or user controlled VLAN switch; and/or**

> **Connect to service providers of their and/or setup point to point user controlled VLANs to other students across Internet 2, CA*net 4, GLORIAD, GLIF, SURFnet, i2Cat, KREOnet, etc**

> **Primary application would be collaborative video such as YouTube, Venice, Xunlei and/or CineGrid**

What is user controlled networks?

> **Tools that allow user to do their own layer 1 & layer 2 configuration and management e.g.**
> – University of British Columbia transmorgifier
> – HEAnet (Ireland UCLP deployment) links VLANs with MPLS tunnels

> **Not a new idea – many overlay networks work like this e.g. Skype, Kazaa, BitTorrent**

> **In essence we want to extend peer to peer overlay network to physical domain**

> **By extending user control to physical network, user can control their own routing and bandwidth**
> – Big advantage is that provider of physical facility cannot do packet filtering or blocking at layer 1

> **UCLP in addition allows users to manage virtual routers, switches, server nodes so that they can do their own routing and topology**
> – UCLP is a generic peer to peer network management tool for creating "underlay" networks as opposed to "overlay" networks

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University colo details

Only the contracted Service Provider provides return signal

Campus Network

GLORIAD GLIF

Student computer

OXC

TDM or WDM return

Passive Optical Splitter or UCLP Ethernet switch

Yahoo

Active laser & optional CWDM on student computer

University Colo Node

User Controlled or Owned Fiber

Service provider can be several km away
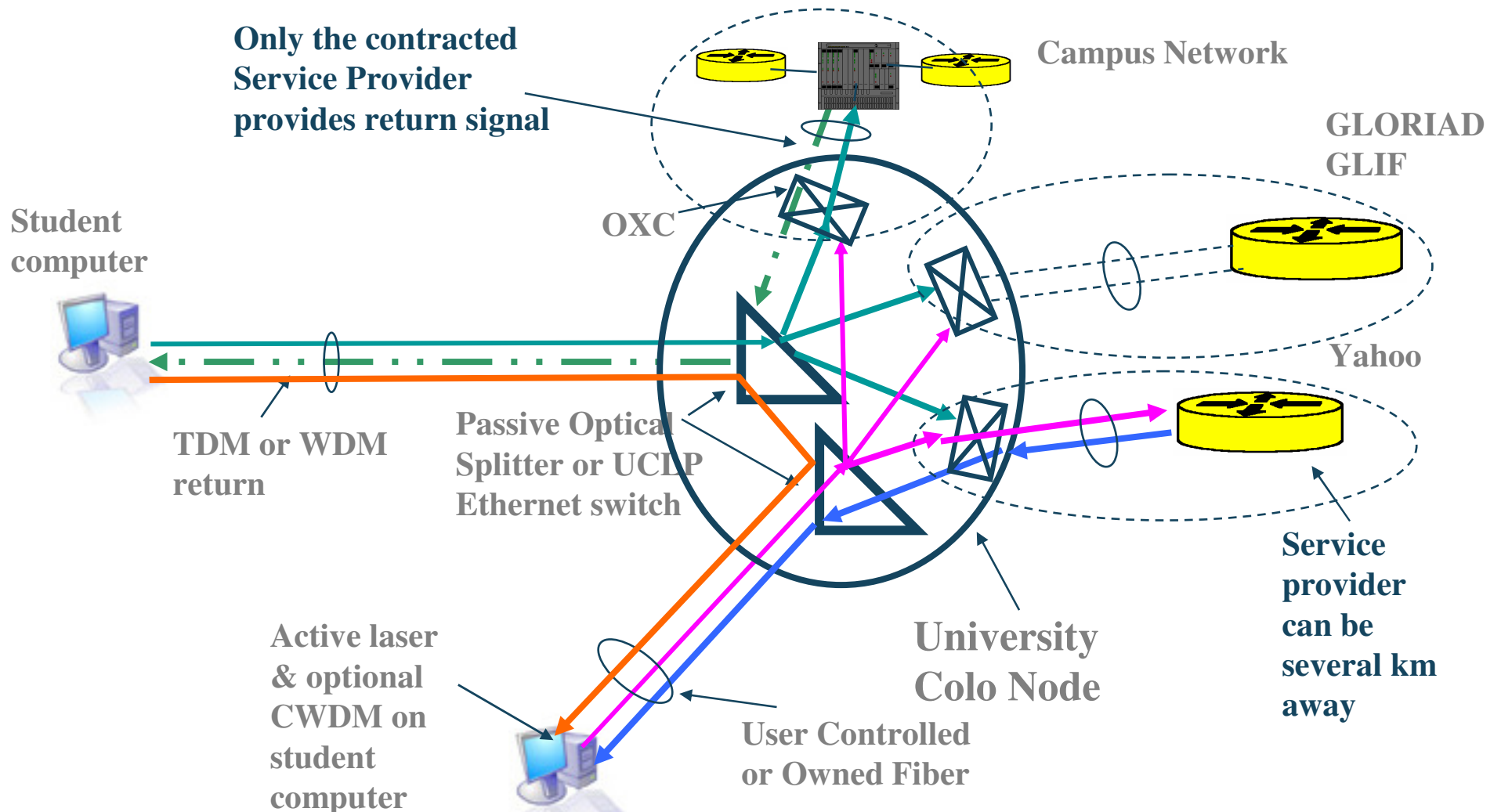
Student Empowered Network with UCLP

University C

University Residence

Internet transit provider

University A

University Residence

YouTube or CineGrid server

CA*net 4 UCLP switch

University Neutral Colo switch/RPON

UCLP Virtual Router Under control of students

University Neutrol Colo switch/RPON

ORAN- CA*net 4 Lighpaths

University B

CA*net 4 UCLP switch

Dark Fiber

Internet transit or content provider

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