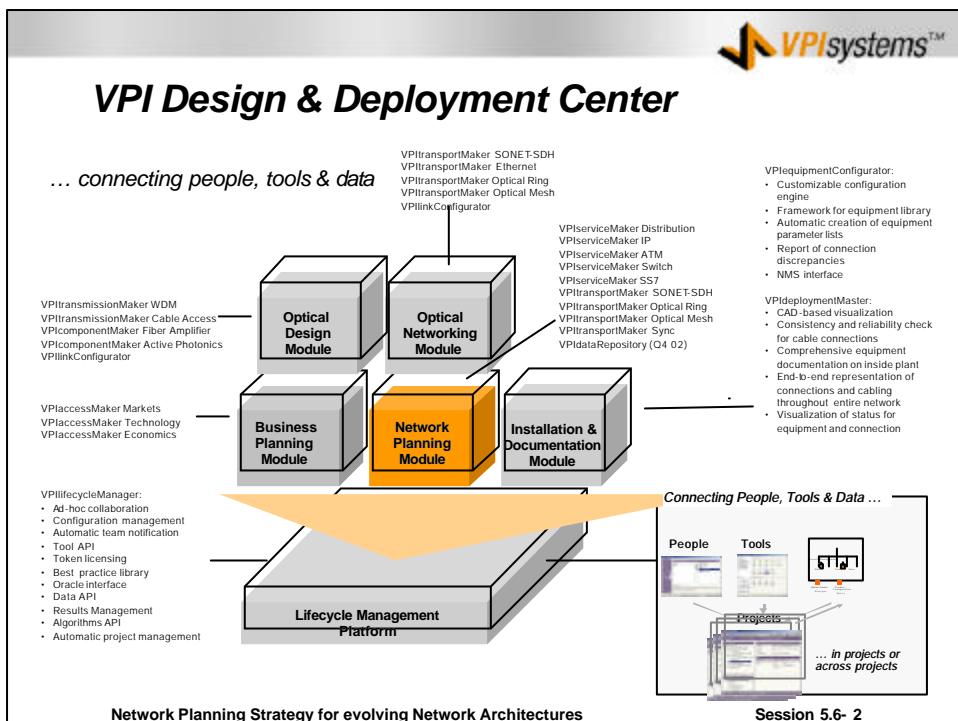**VPIsystems™**

ITU Seminar

Bangkok, Thailand , 11-15 November 2002

Session 5.6

VPI: Core Network Planning with VPIserviceMaker™ VPItransportMaker™ Traditional TDM and IP Networks

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VPIsystems™

VPI Design & Deployment Center

… connecting people, tools & data

VPItransportMaker SONET-SDH
VPItransportMaker Ethernet
VPItransportMaker Optical Ring
VPItransportMaker Optical Mesh
VPIlinkConfigurator

VPIequipmentConfigurator:
• Customizable configuration engine
• Framework for equipment library
• Automatic creation of equipment parameter lists
• Report of connection discrepancies
• NMS interface

VPIserviceMaker Distribution
VPIserviceMaker IP
VPIserviceMaker ATM
VPIserviceMaker Switch
VPIserviceMaker SS7
VPItransportMaker SONET-SDH
VPItransportMaker Optical Ring
VPItransportMaker Optical Mesh
VPItransportMaker Sync
VPIdataRepository (Q4 02)

VPItransmissionMaker WDM
VPItransmissionMaker Cable Access
VPIcomponentMaker Fiber Amplifier
VPIcomponentMaker Active Photonics
VPIlinkConfigurator

VPIdeploymentMaster:
• CAD-based visualization
• Consistency and reliability check for cable connections
• Comprehensive equipment documentation on inside plant
• End-to-end representation of connections and cabling throughout entire network
• Visualization of status for equipment and connection

Optical Design Module

Optical Networking Module

VPIaccessMaker Markets
VPIaccessMaker Technology
VPIaccessMaker Economics

Business Planning Module

Network Planning Module

Installation & Documentation Module

VPIlifecycleManager:
• Ad-hoc collaboration
• Configuration management
• Automatic team notification
• Tool API
• Token licensing
• Best practice library
• Oracle interface
• Data API
• Results Management
• Algorithms API
• Automatic project management

Connecting People, Tools & Data …

People   Tools

Projects

… in projects or across projects

Lifecycle Management Platform

Network Design Tasks

Service characterization & Traffic modeling
- different service categories
- QoS/CoS description
- self-similarity and statistical multiplexing
- Poisson/non-Poisson type traffic

Real time applications
- (e.g. VoIP, Video conferencing)
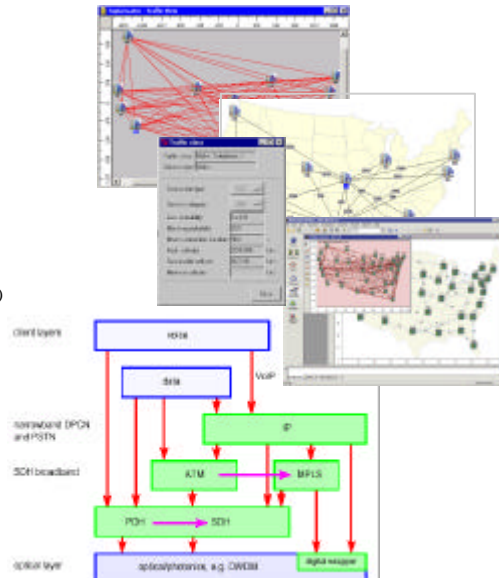- end-to-end delay constraints

Service aggregation & segregation
- Service clustering (e.g. VP classification, FECs)
- "best-effort" traffic

Dimensioning autonomous systems
- routing optimization (based on OSPF)
- network link and node dimensioning

Design of ATM/IP/MPLS networks
- QoS related routing
- traffic engineering

Traffic, Equipment and Facility Modeling

Traffic generation

- ✓ Point to point bandwidth demand matrices provided by user
- ✓ Derived from IP access network designs
- ✓ Forecast based on user population and a distribution model (like the gravity model, distribution factors to AS gateways and tera-pops)

Routers

- ✓ Router modeling
- ✓ Core fabric capacity (switching) and cost
- ✓ Types of interface cards, port granularity, and costs
- ✓ Can model multiple types of routers
- ✓ User definable
- ✓ Default vendor library

Traffic classes

- ✓ Aggregated traffic
- ✓ Different levels of QoS
- ✓ Per Diff-Serv Classification as default
- ✓ Over booking (blocking) allowance factor
- ✓ Multiple traffic matrices representing multiple busy hours
- ✓ VPN traffic of each type

Link facilities

- ✓ TDM Circuits
- ✓ Layer 2 connections: ATM, FR, Ethernet, etc.
- ✓ User definable
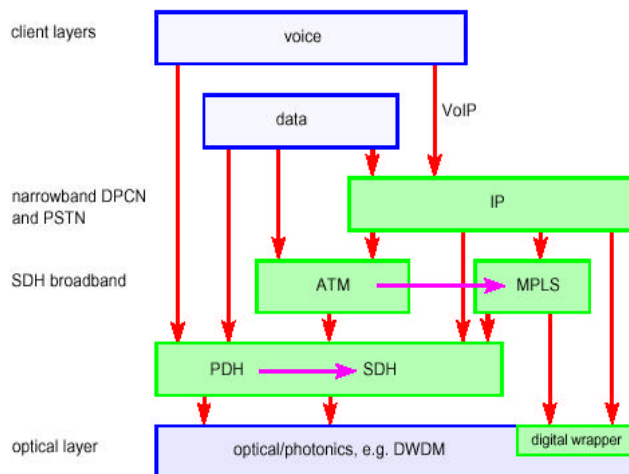- ✓ Transport bandwidth and cost

Network Planning Module

Network Planning Module
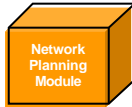
Inside

VPIserviceMaker™ Distribution

VPIserviceMaker™ IP

VPIserviceMaker™ ATM

VPIserviceMaker™ Switch

VPIserviceMaker™ SS7

VPItransportMaker™ SONET-SDH

VPItransportMaker™ Optical Rings

VPItransportMaker™ Optical Mesh
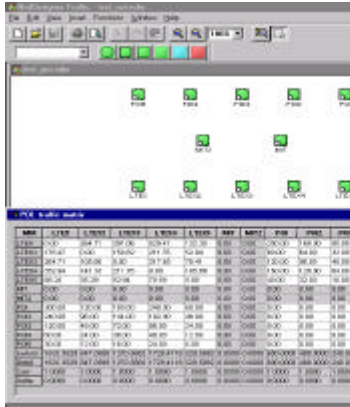
VPItransportMaker™ Sync
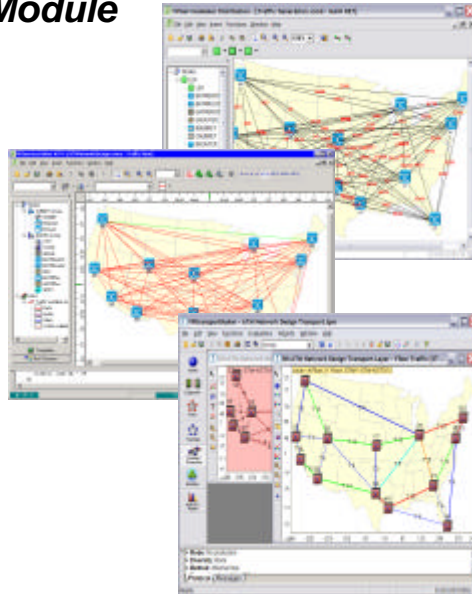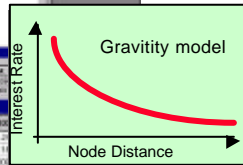

Network Architecture: Layers & Technologies

client layers — voice

data — VoIP

narrowband DPCN and PSTN — IP

SDH broadband — ATM → MPLS

PDH → SDH

optical layer — optical/photonics, e.g. DWDM — digital wrapper

Source: BT

VPI*service*Maker™ Distribution

Service Matrix Calculations

Typical Applications
- Calculation and updating of service matrices using
  - Homogeneous or gravitation models
  - Target factors or interest factors
  - Kruithof balancing

Interest Rate / Node Distance — Gravitity model

Network Planning Strategy for evolving Network Architectures   **Session 5.6- 7**

VPI*service*Maker™ Switch/SS7

Breakdown analysis

40% breakdown
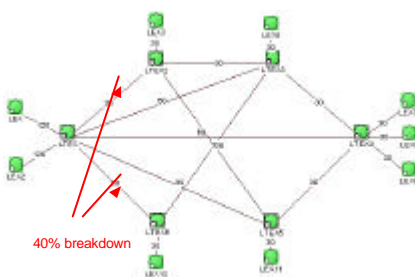
Routing table generation

Typical Applications
- Embedded circuit switched networks
- Hierarchical and non-hierarchical switched networks
- Restructuring of traditional networks
- Multi-carrier networks (POI)

Network Planning Strategy for evolving Network Architectures   **Session 5.6- 8**
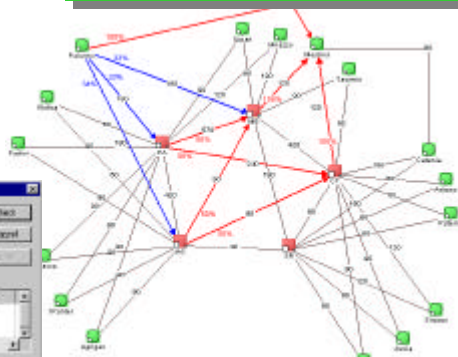
VPI*service*Maker™ Switch

Use Case: Restructuring a Mid-Sized Network

Inputs:
• Partially structured existing network topology
• Traffic matrix
• Additional conditions (e.g. min./max. # of transit exchanges, cost parameters)

Results:
• Well structured 2-level voice backbone
• 3 transit exchanges, 29 high capacity trunk groups (down from 46)
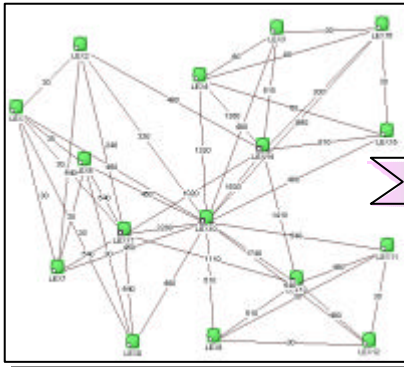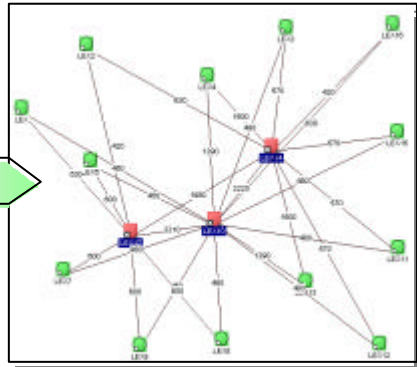
VPI*service*Maker™ ATM

ATM traffic classification

Telephony   Video conference   LAN emulation

CBR SVC   BR-rt SVC   CBR PVC   ABR SVC   BR-nrt SVC

VP Class1   VP Class 2   VP Class n
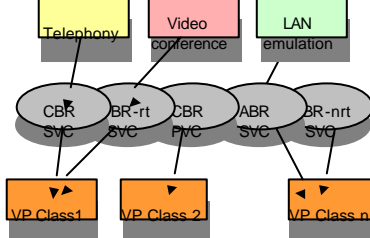
Typical Applications
• ATM multi-service networks
• Frame Relay backbone networks
• Carrier, enterprise and campus with
• intelligent service mix and separation
• cost-optimized topology
• well balanced routing and trunk sizes
• sufficient spare capacity for protection

Traffic matrices
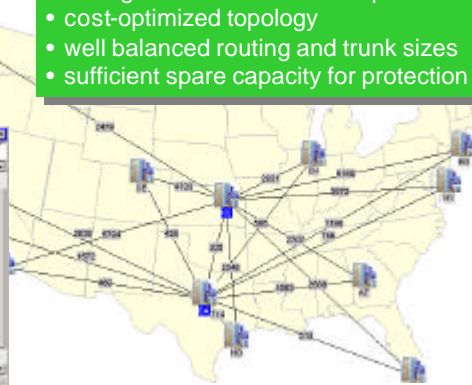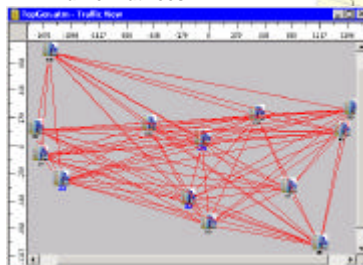
VPIsystems™

VPIserviceMaker™ IP
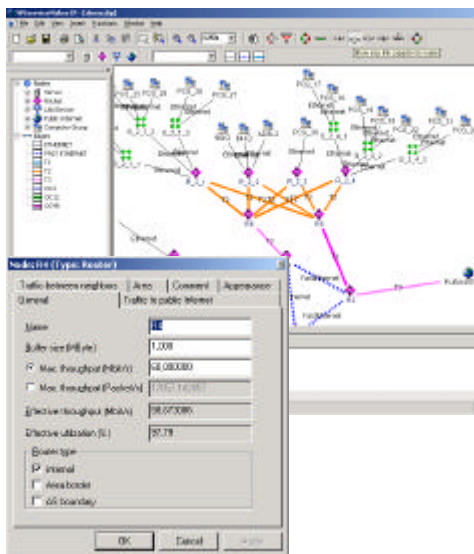
Typical Applications
- Plan, optimize, extend and investigate IP networks:
- Define subscribers (eg. modem, DSL or LAN based) and characterize their services requirement traffic volume
- Distribute services into traffic flows between servers, edge and core routers, gateways
- Aggregate traffic flows and size trunks

Network Planning Strategy for evolving Network Architectures   Session 5.6- 11

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VPItransportMaker™Sync

Typical Applications
- Plan and optimize clock distribution (PDH,SDH,SONET)
- Design backup clock signal routes
- Analyze network failure scenarios

Clock distribution tree

Failure scenario simulation

Network Planning Strategy for evolving Network Architectures   Session 5.6- 12

VPI*transport*Maker™ SONET/SDH Design

Multiple Client/ Demand Layers:
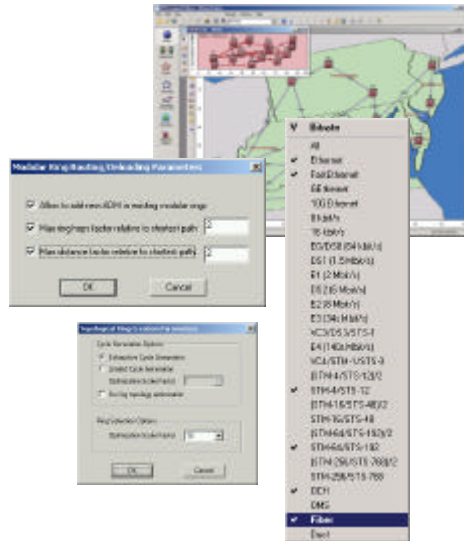SONET/SDH, optical, PDH and
Ethernet

Design Options:
Topology optimization
Equipment libraries for every network
layer
Comprehensive routing options

**Comprehensive Restoration
Options:** 1+1, Shared, Pre-emptible,
unprotected, N x 1 path protection

**Comprehensive ring, mesh and
hybrid capabilities**

VPI*transport*Maker™ Optical Ring Design

**WDM with wavelength banding and
OADMs**
• 2F and 4F Optical BLSR
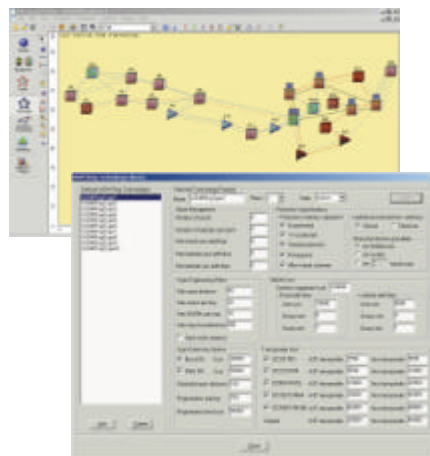• 2F Optical UPSR

Cost driven WDM ring design

Enhanced visualization of results

Detailed List Of Material
OADMs , WDMs , Tx/Rx, etc…

**Different protection schemes per
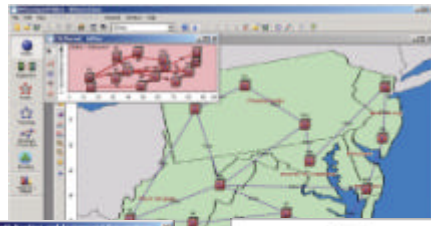demand:**
unprotected, dedicated, shared,
pre-emptible

Flexible protection granularities

VPItransportMaker™ *Optical Mesh Design*

Optimum ULH/standard system deployment

• Optimum placement of WDM systems, based on optical demands
• Cost-optimum design and topology optimization

Optimized wavelength routing and assignment

• User specifiable conversion assumptions
• Different protection options
• Greenfield and embedded scenarios