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ANSA Phase III

A Flexible Network Architecture: proof of concepts via a demonstration

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Abstract

This is a presentation document about a demonstrator of a surveillance system. The demonstrator is used as a scenario to test and demonstrate the key ideas of the FlexiNet project. At first the document introduces several key technologies for implementing a flexible network architecture: switchlet, open signaling, open switching, virtual network, QoS based routing, group-based connection control, and active routers. Then it describes how these technologies are used in the demonstrator.

Although it is impossible to get the performance statistics from the demonstrator (because it is only a simulation), the flexibility of the architecture has been clearly shown.

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A Flexible Network Architecture

Proof of Concepts via a Demonstration

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Motivation

- **Input to FlexiNet project**
- **Test and demonstrate some key ideas of FlexiNet**
 - **module programming**
 - **introspection and reflection**
 - **dynamic code deployment**
 - **opportunity for mobile code**
- **Investigate scenario and understand binding model**
- **Identify research issues**



Background

- **A new market for the distribution of a variety of services over a single network**
 - domestic broadband access over fixed and wireless networks
 - costs of accessing network & transmission decrease
- **Heterogeneous networking in terms of services, protocols, control functions and devices**
 - telecommunication oriented network vs. Internet-like network
 - ATM vs ethernet
- **Requirement for rapid network innovation process**
 - currently, from prototype to large scale deployment takes about 10 yrs.



Flexible Network Architecture

- **Aim**

- sophisticated, conceptually simple architecture
- easy service creation and deployment
- support for heterogeneous networking
- support for Quality of Service (QoS)

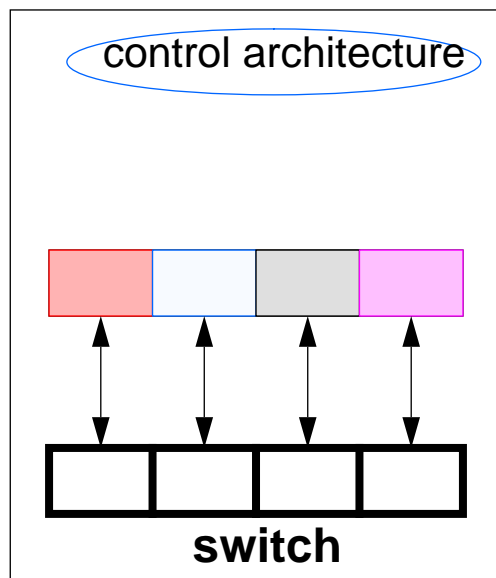
- **Approach**

- open interface to network elements
- open switching for flexible switch control architecture
- open signaling for connection control

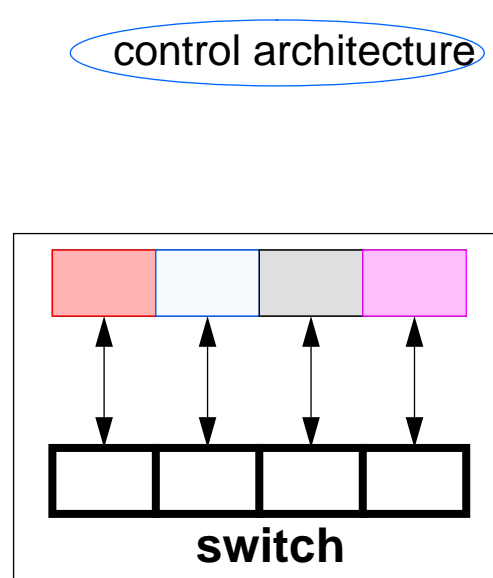


Open Switching: Switchlet

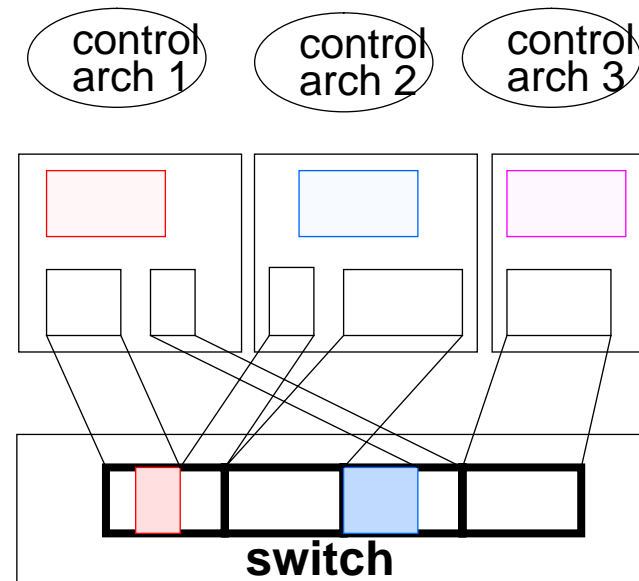
- Separating hardware switching functions from the call and connection control functions in the networks
- Encapsulate a subset of the physical switch resources with a particular control architecture



control policy is embedded in the physical switch



control architecture is separated from the physical switch

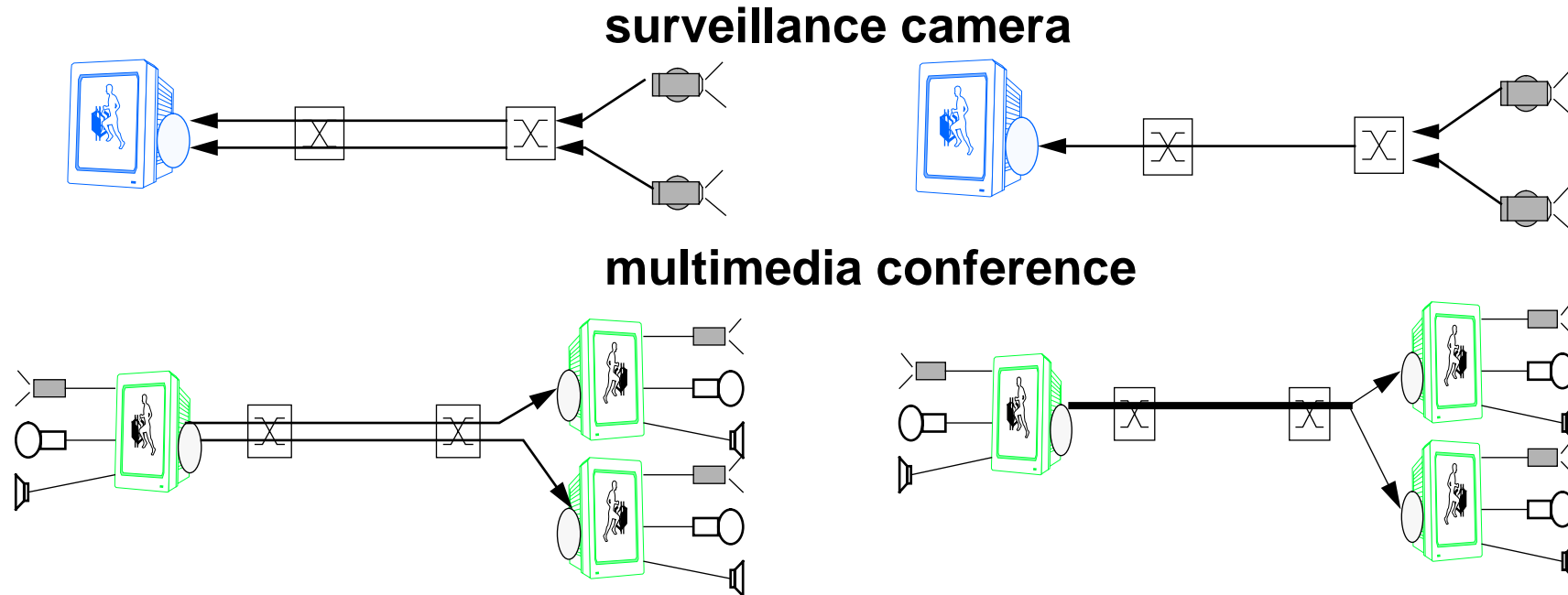


multiple control architecture can be operational simultaneously on the same switch



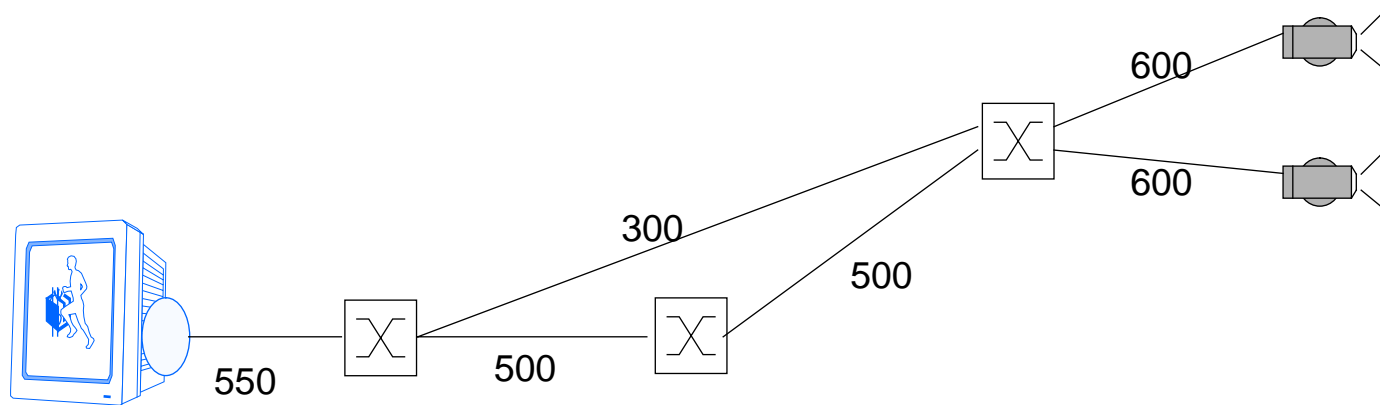
Application-Specific Connection Control

- **End-to-End connections:**
 - pros: confidentiality, stream-based quality guarantee
 - cons: waste resource, heavy network traffic
- **Group-Based connections:**
 - pros: less resources, less network traffic
 - cons: same quality, complex setting up



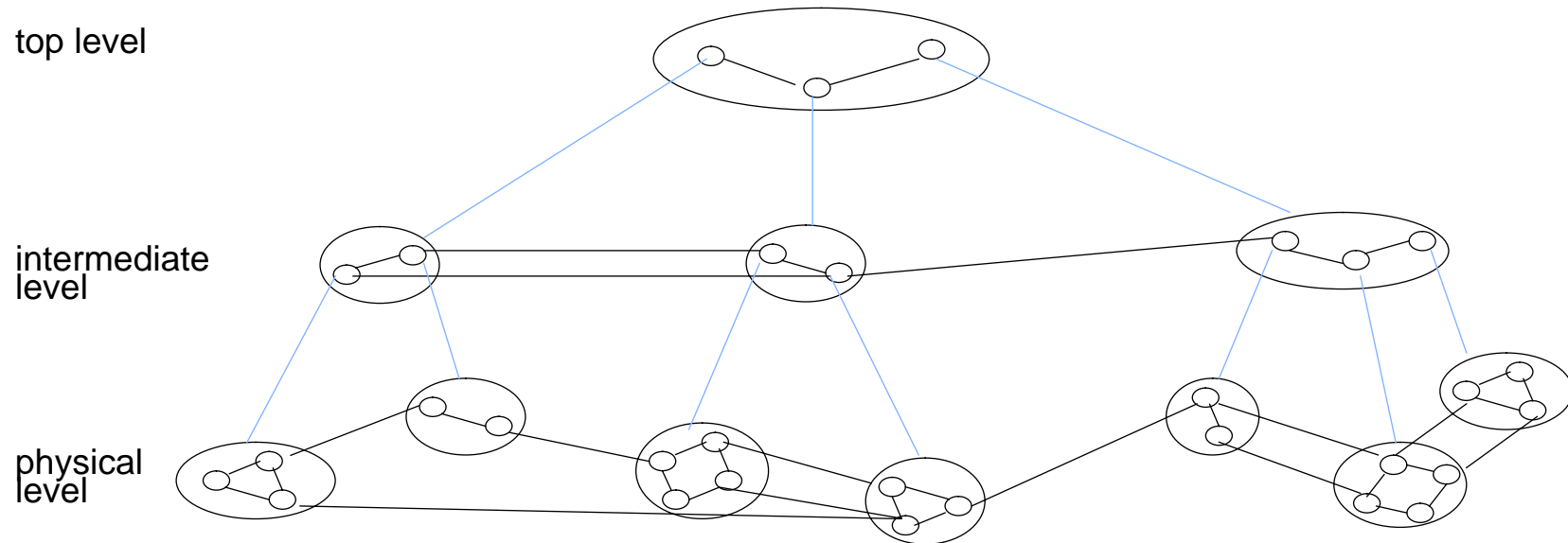
QoS based Routing

- Finding a path subject to multiple constraints
 - bandwidth, latency, jitters, and loss probability
- Routing information
 - knowledge of the connection topology
 - details of the QoS characteristics of links between nodes



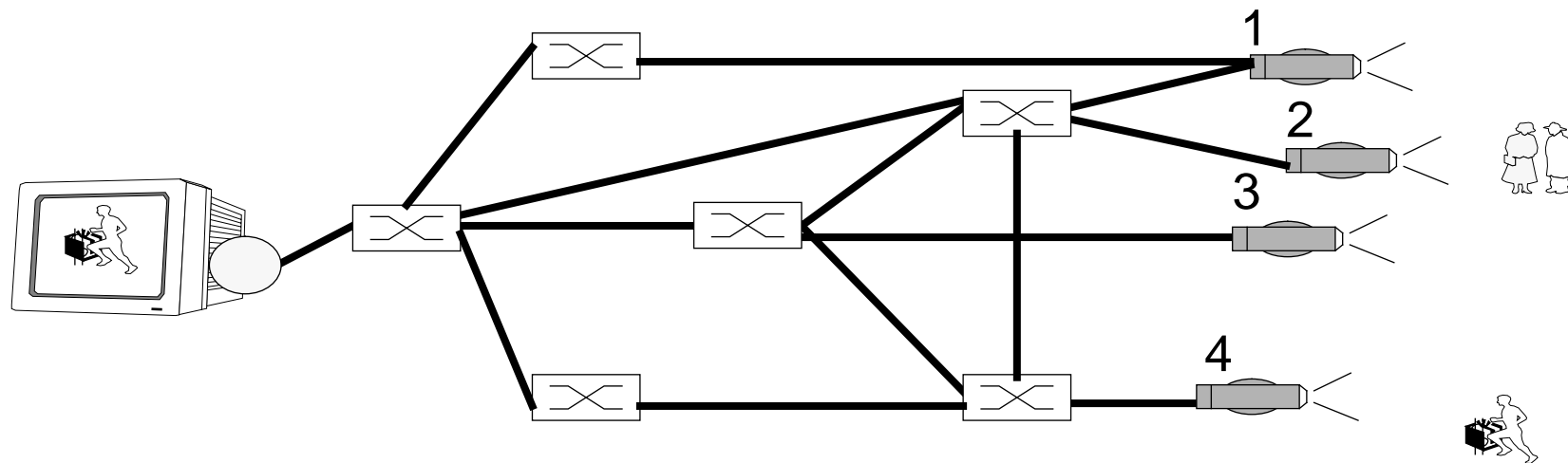
Logical Network

- **Appropriate view to different level of users**
- **Multilevel network topology**
- **Multilevel binding protocol**
- **Scalable to a large number of network components**



Example: a surveillance camera system

- A set of cameras and a single monitor
- At any point the monitor can only show one camera's pictures
- Operator should be allowed to switch cameras
- Operator should be able to choose the quality of service



Objects

Management

Information Repository
Connection Manager
Connection Server
Channel Server
Remote Control

Resources

Switch
Camera
Monitor
Sink End
Source End
Channel

Control Architecture

Manual Control
Automatic Rotation

Non-functional

Network Map



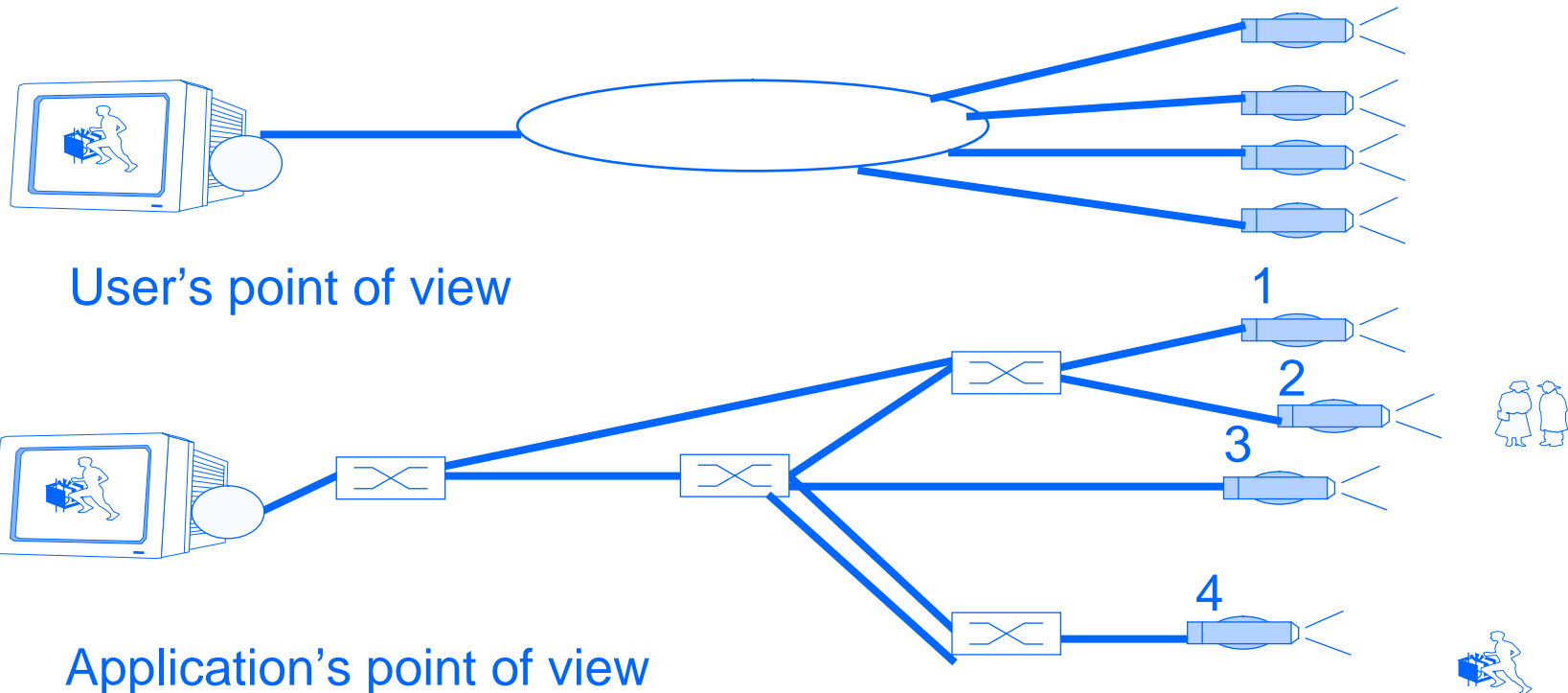
Demonstration Script

- **Switchlet concept and multilevel network**
 - show the virtual network topology
- **QoS-based subnet selection**
 - select a set of cameras with different quality
- **Group- and QoS-based connection control**
 - set connection with different quality
- **Source-driven routing**
 - select a camera
- **Rapid switching between cameras**
 - switch from one camera to another
- **Open switching: dynamic change switch control policy**
 - start rotate control policy
 - not fully implemented: issues with dynamic download code and security



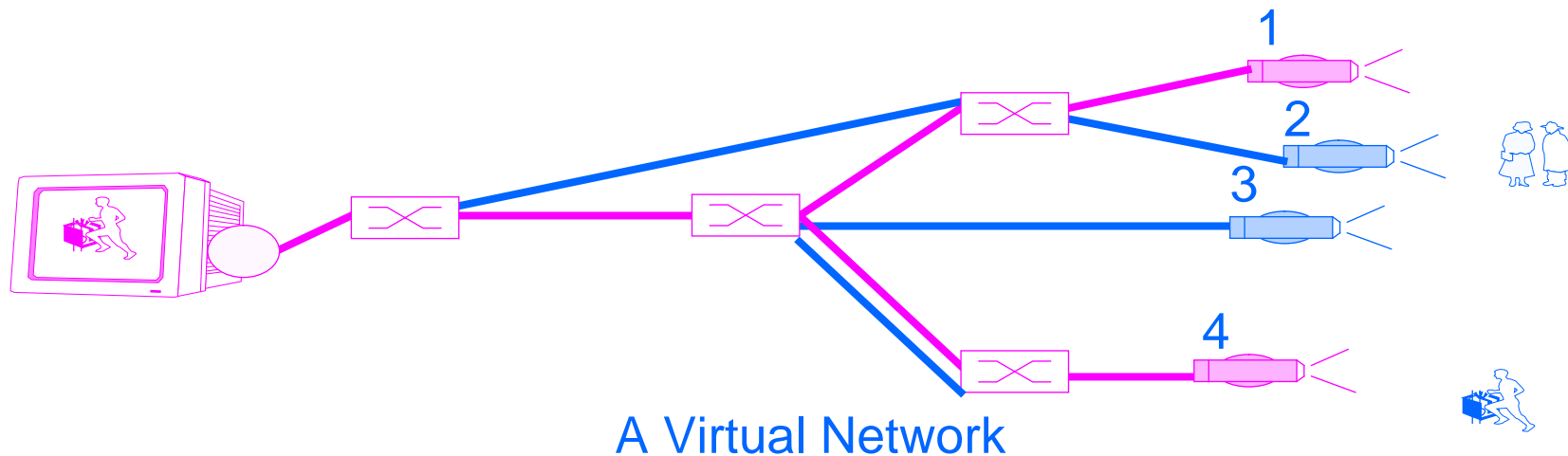
Virtual Network

- Using Switchlet to deploy a virtual network on the physical network
- Control policy: rotating through cameras unless operator interferes
- Each channel has its own features, e.g. bandwidth
- Network topology and channel features are known to application
- Network topology is transparent to end-users



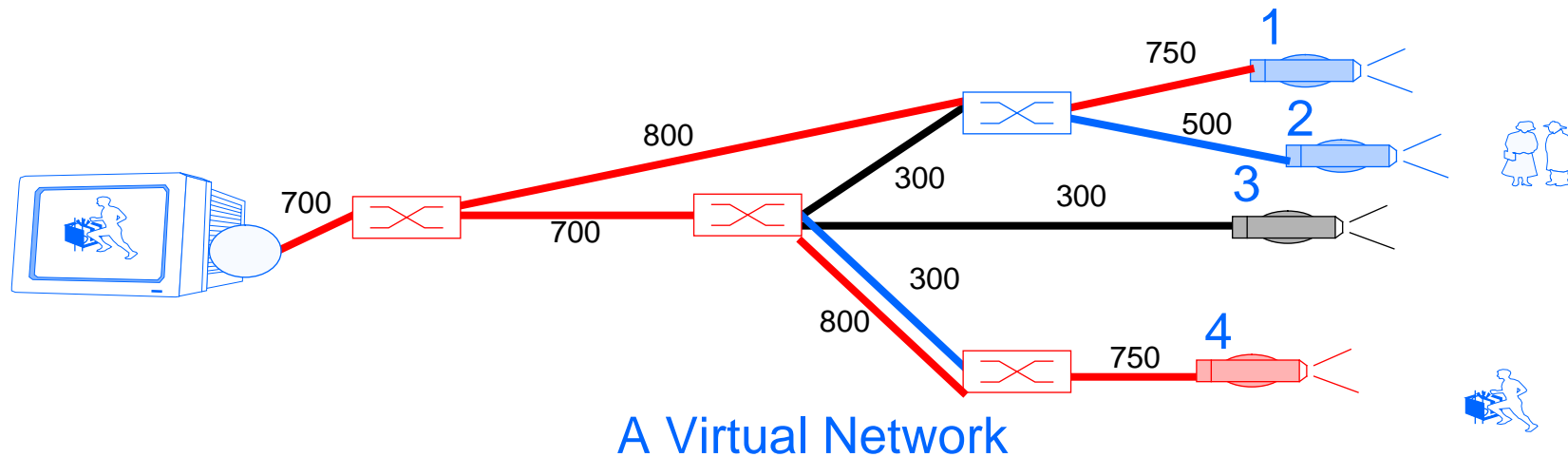
Group-Based Connection Control

- User selects a set of cameras in a session
- Connection control policy:
 - sharing as many channels as possible
 - minimum total connection length between monitor and selected cameras
- Advantages:
 - reduced processing short connection setup time
 - less resource, less network traffic



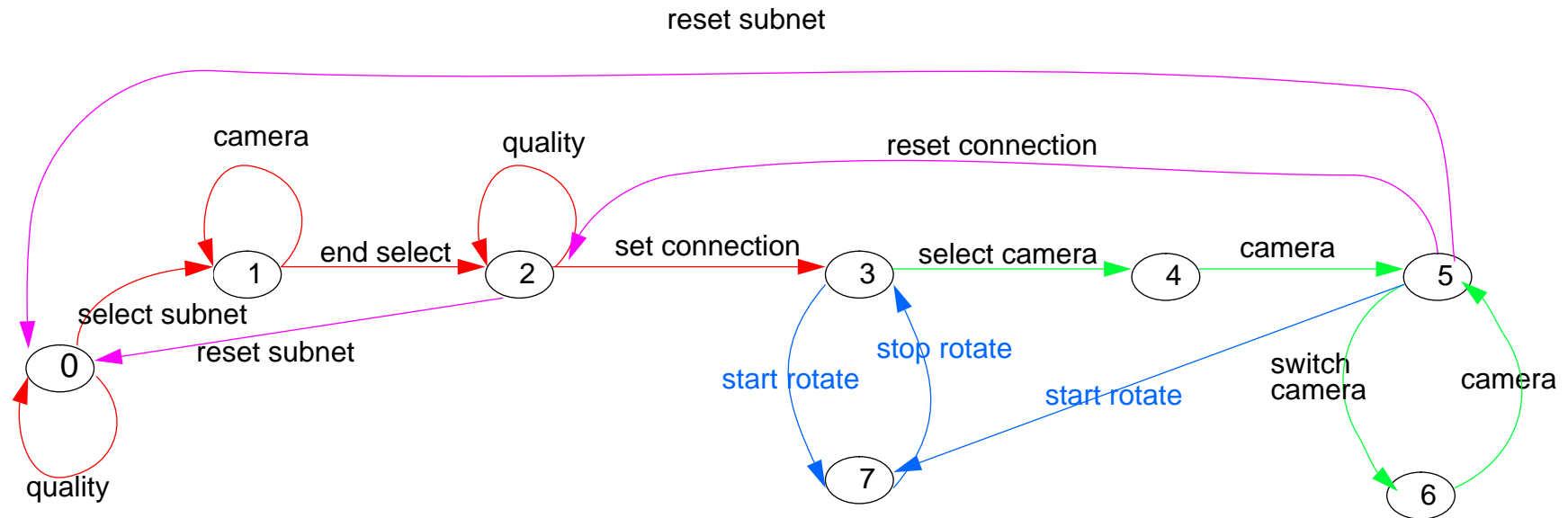
QoS Based Routing

- Source routing: topology of network, bandwidth of channels
- Mapping between user specification to network properties
 - **high quality: >700**, **normal: >500**, **low: <500**
- Find a cheapest connection that can satisfy user's requirement



Procedure for Setting Up and Tearing Down

- **Select a subnet based on given cameras and quality**
- **Set up connection (group-based)**
- **Set up control policy**
 - operator selection
 - automatic rotation
- **Reset connection**
- **Reset subnet**



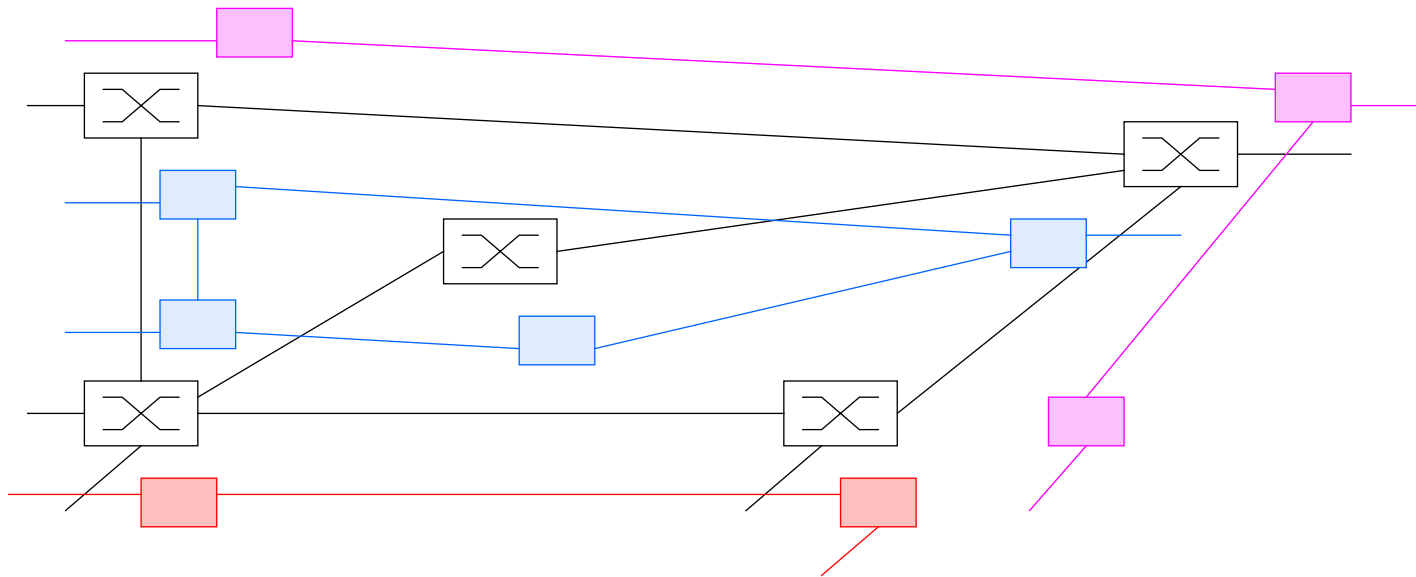
Summary

- **Several new concepts for flexible network architecture have been proved through the surveillance camera system**
 - open switching: switchlet
 - group-based connection control
 - QoS based routing
 - multilevel architecture
- **Performance statistics cannot be done via this demonstration**
- **Important issues:**
 - dynamic loading code from remote site
 - security issues related to remote loaded code
 - resource reservation and management



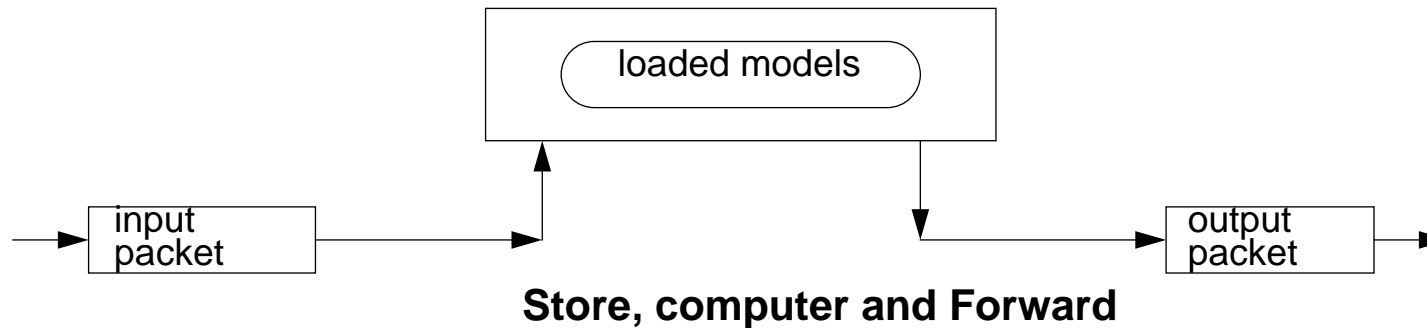
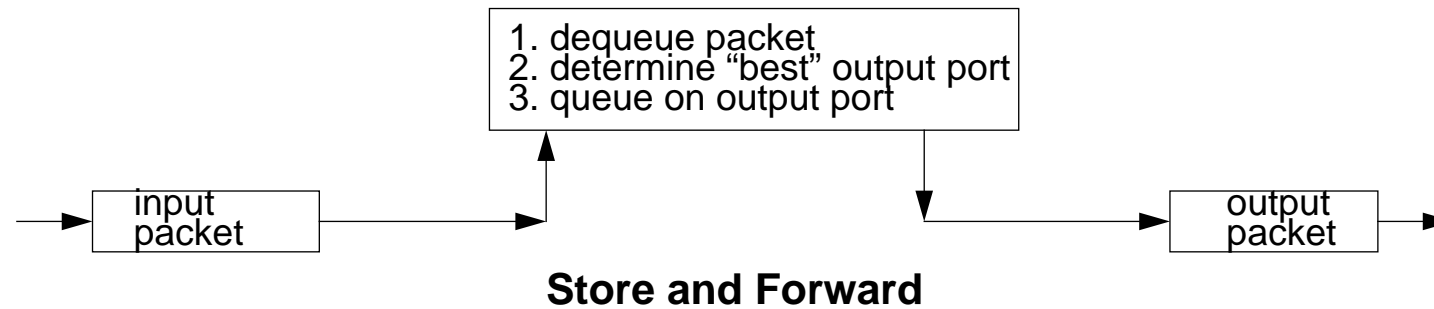
Switchlet Based Virtual Network

- A virtual network shares network resources with others
- Multiple virtual networks deployed on the same physical network
- Each virtual network can potentially use different control architecture
- Control architecture can be created dynamically on demand
- Easy to introduce new control architecture for new applications



Active Routers

- ‘Store and forward’ ==> ‘store, **compute**, and forward’
- Dynamic load and evaluate programs
- Evolve more quickly to provide new network services



- capsule approach: program is attached in each packet
- programmable switch approach: program is loaded dynamically

