



TEQUILA Engineering Approach

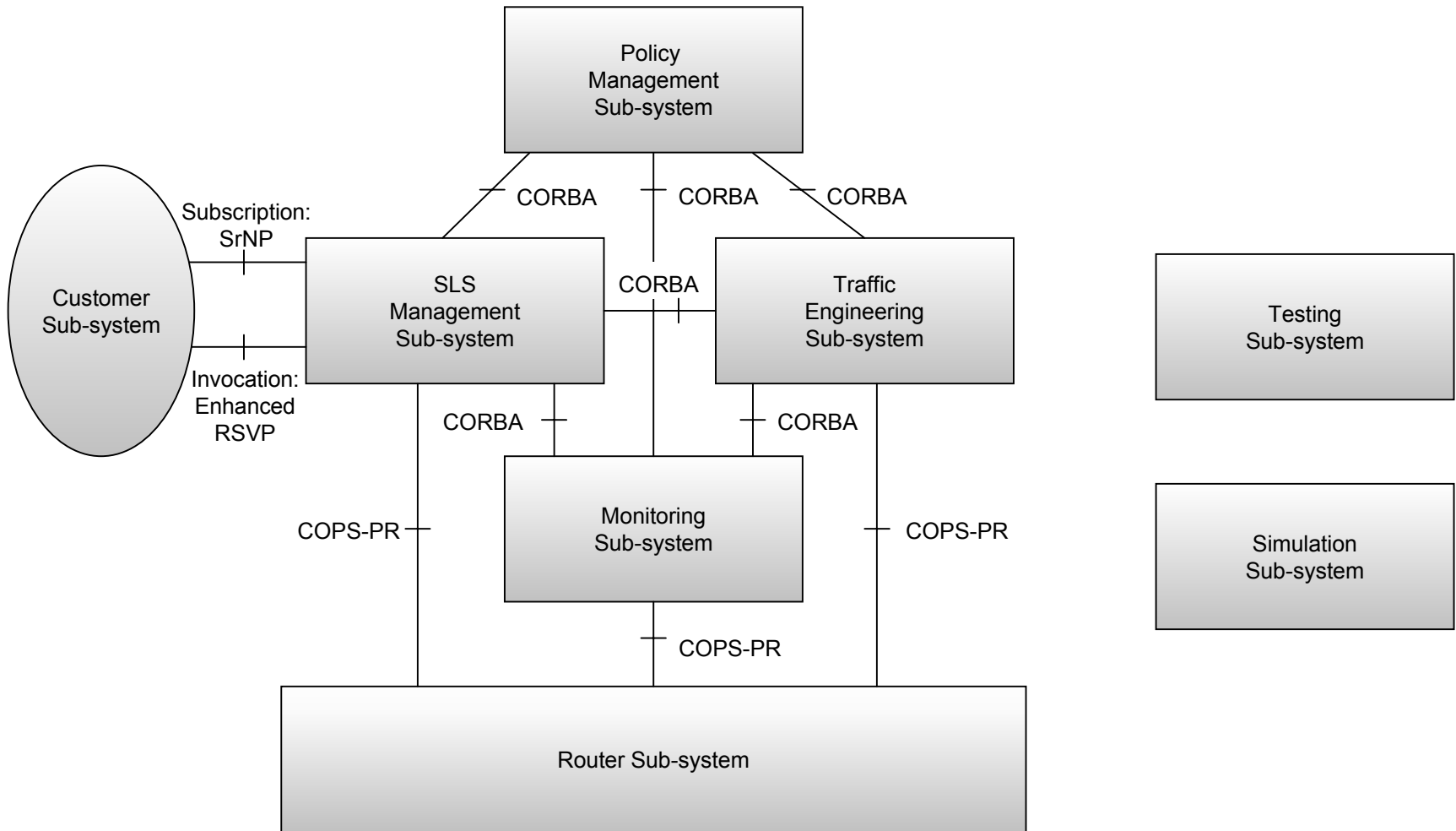
David Griffin

University College London, UK

Premium IP Cluster Joint Review, 3-4 April 2001

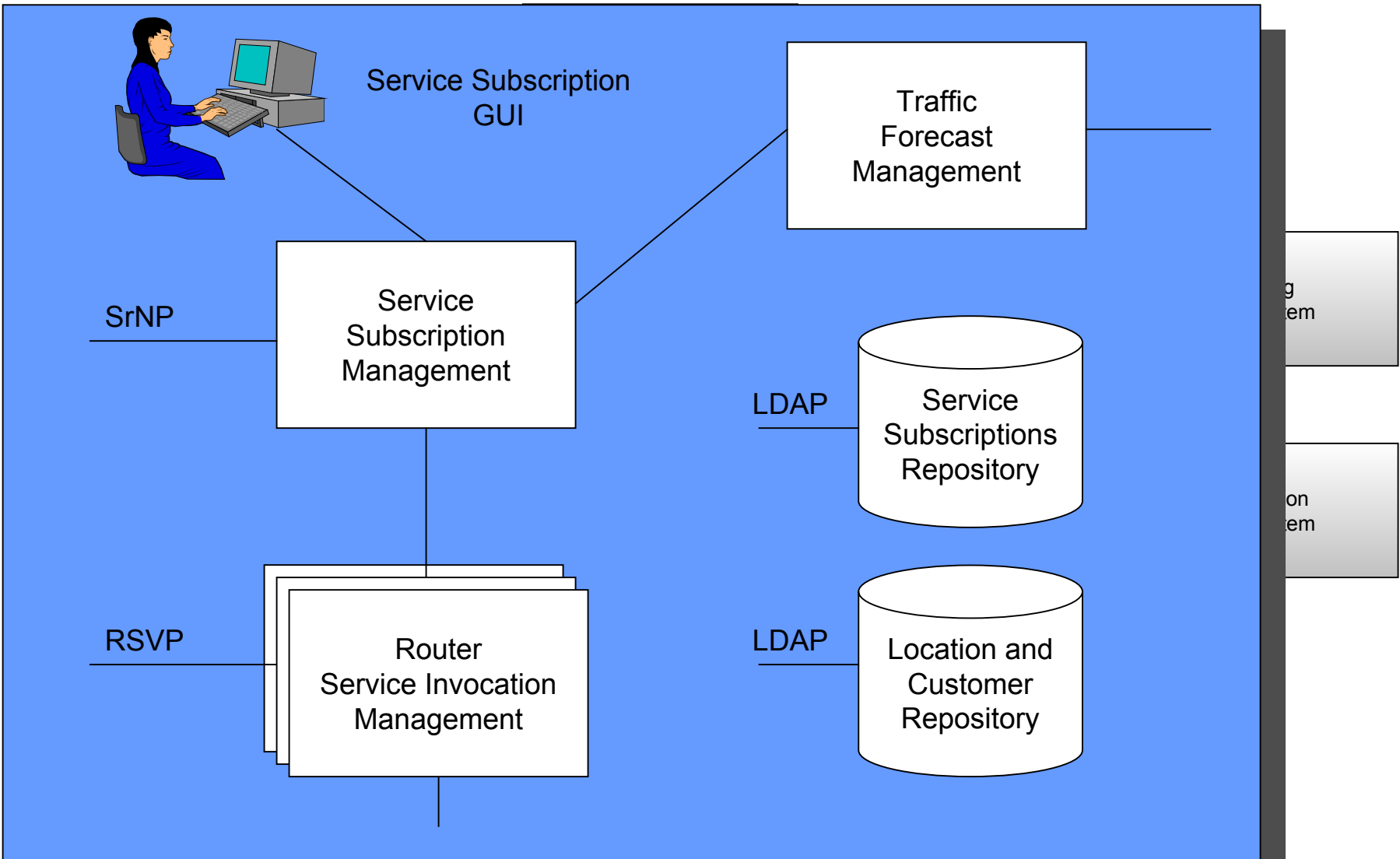


TEQUILA Engineering Approach: Overview



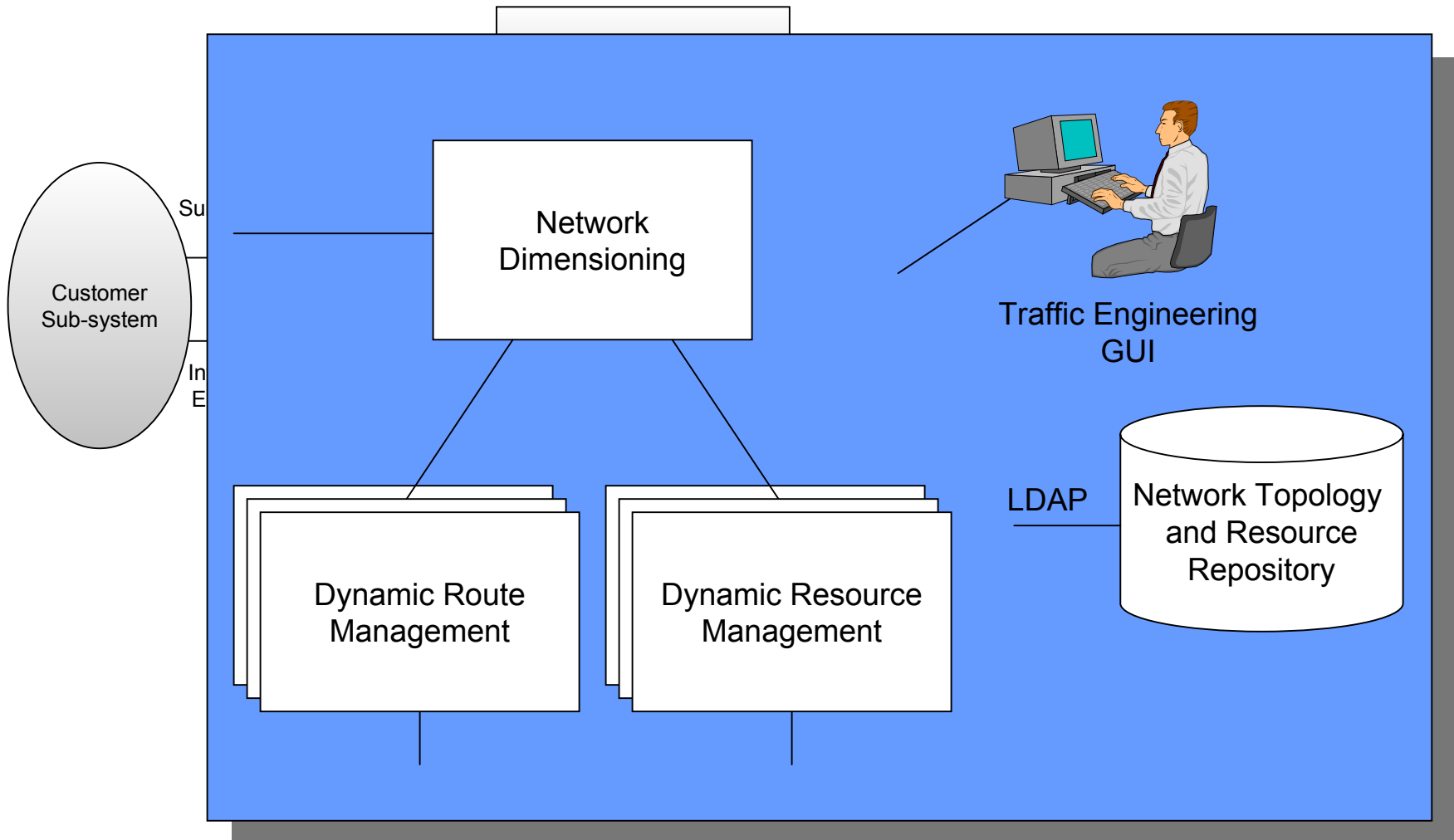


TEQUILA Engineering Approach: SLS Management Sub-system



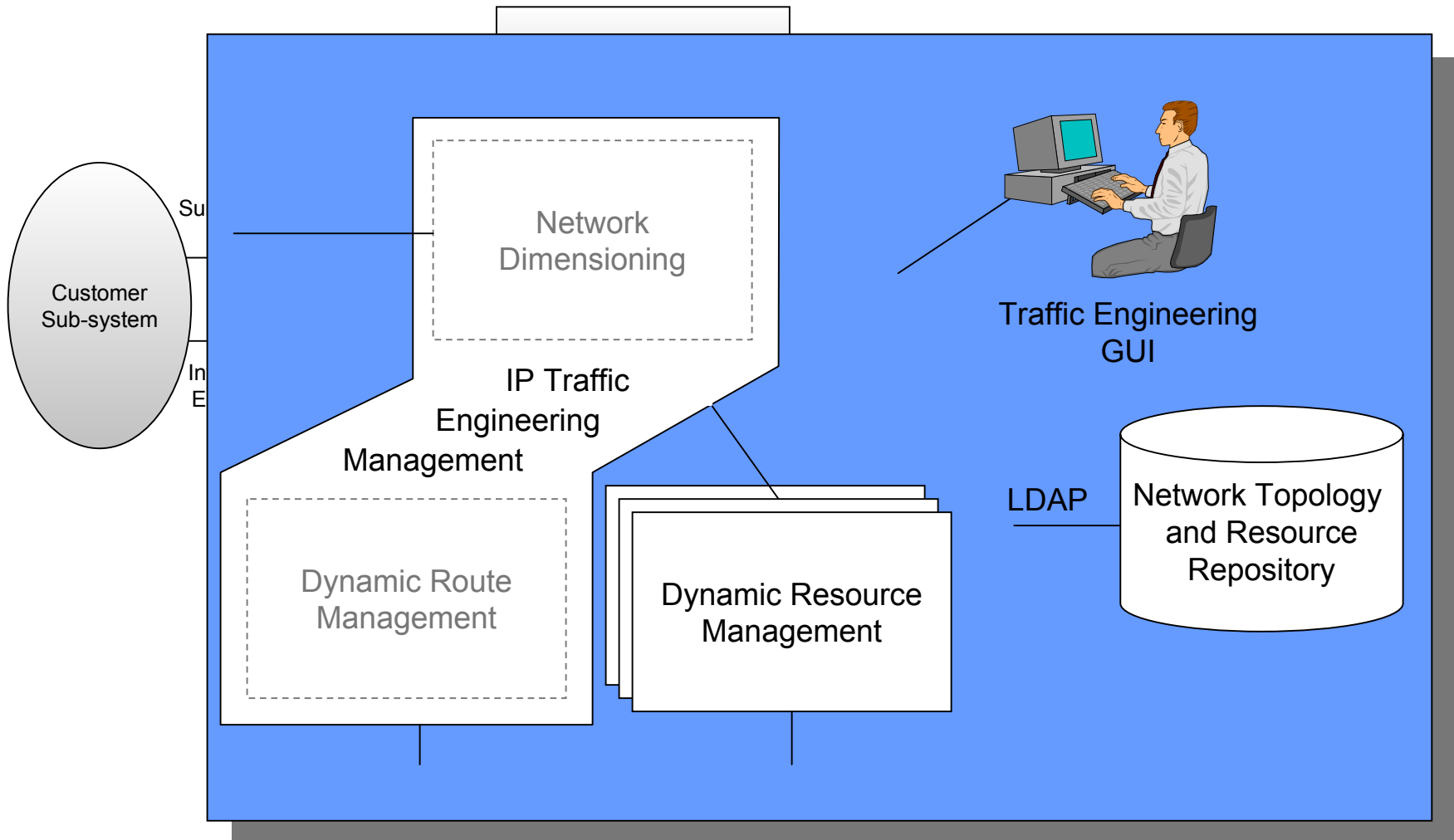


TEQUILA Engineering Approach: Traffic Engineering Sub-system



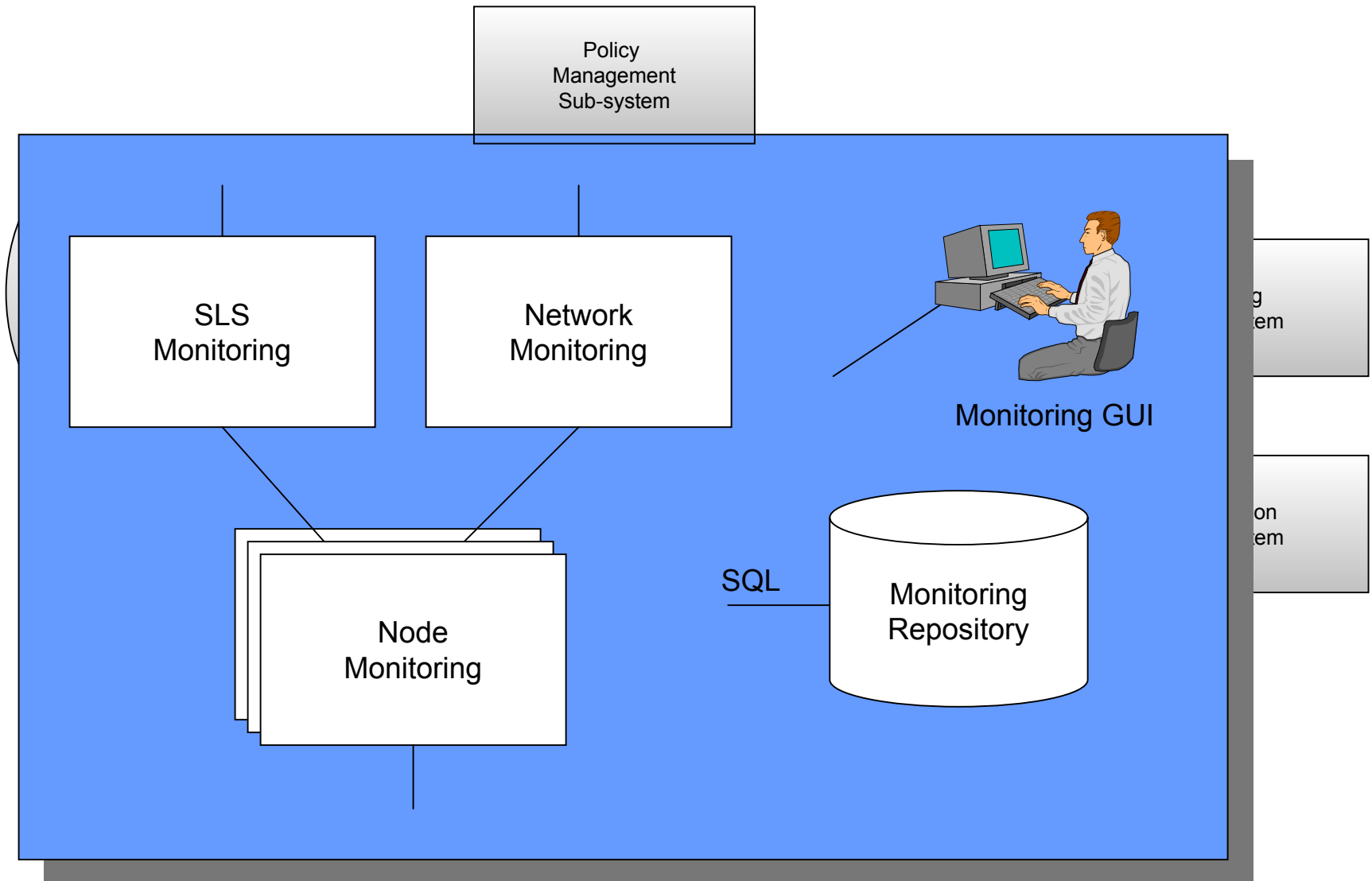


TEQUILA Engineering Approach: Traffic Engineering Sub-system



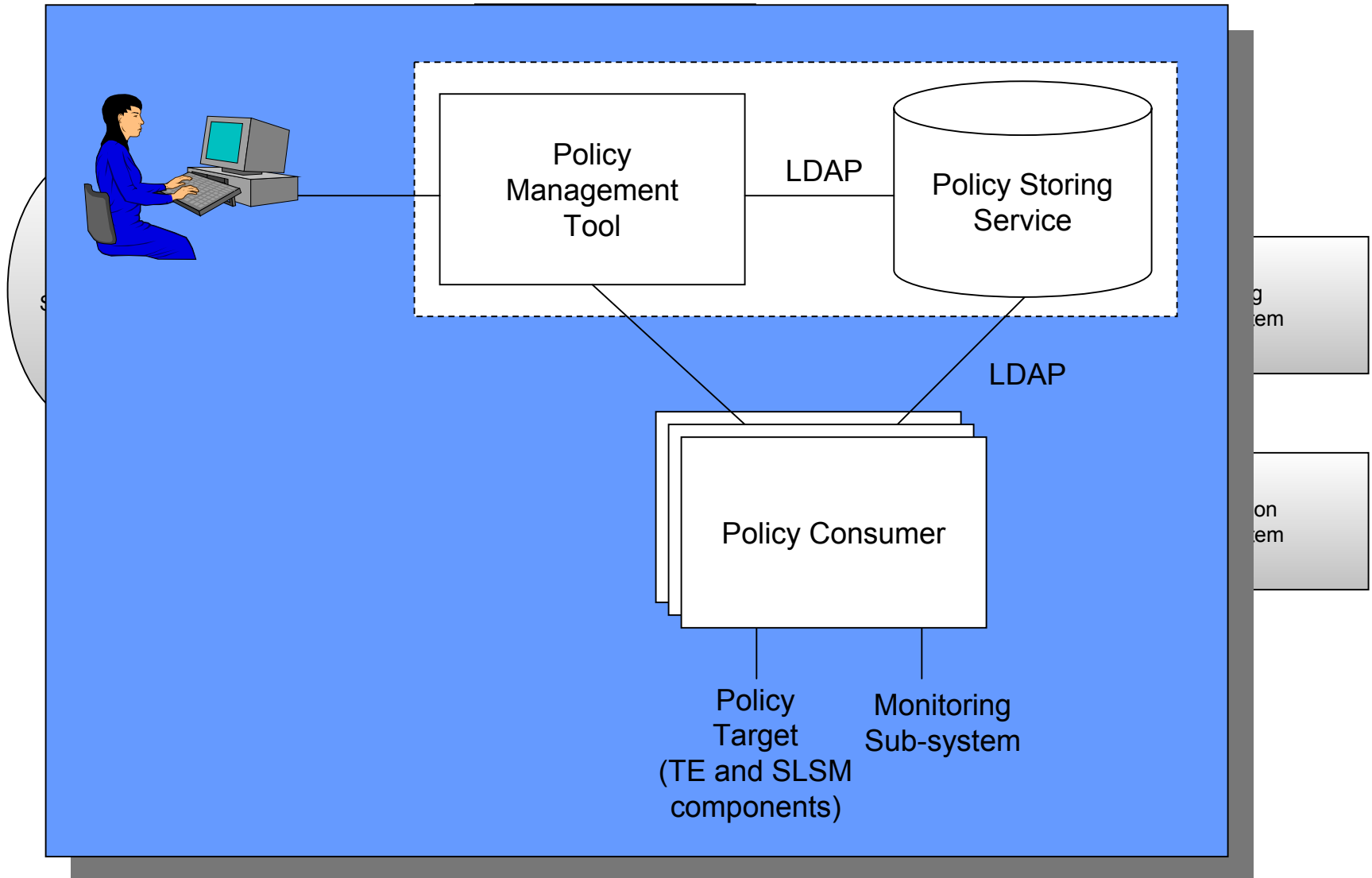


TEQUILA Engineering Approach: Monitoring Sub-system



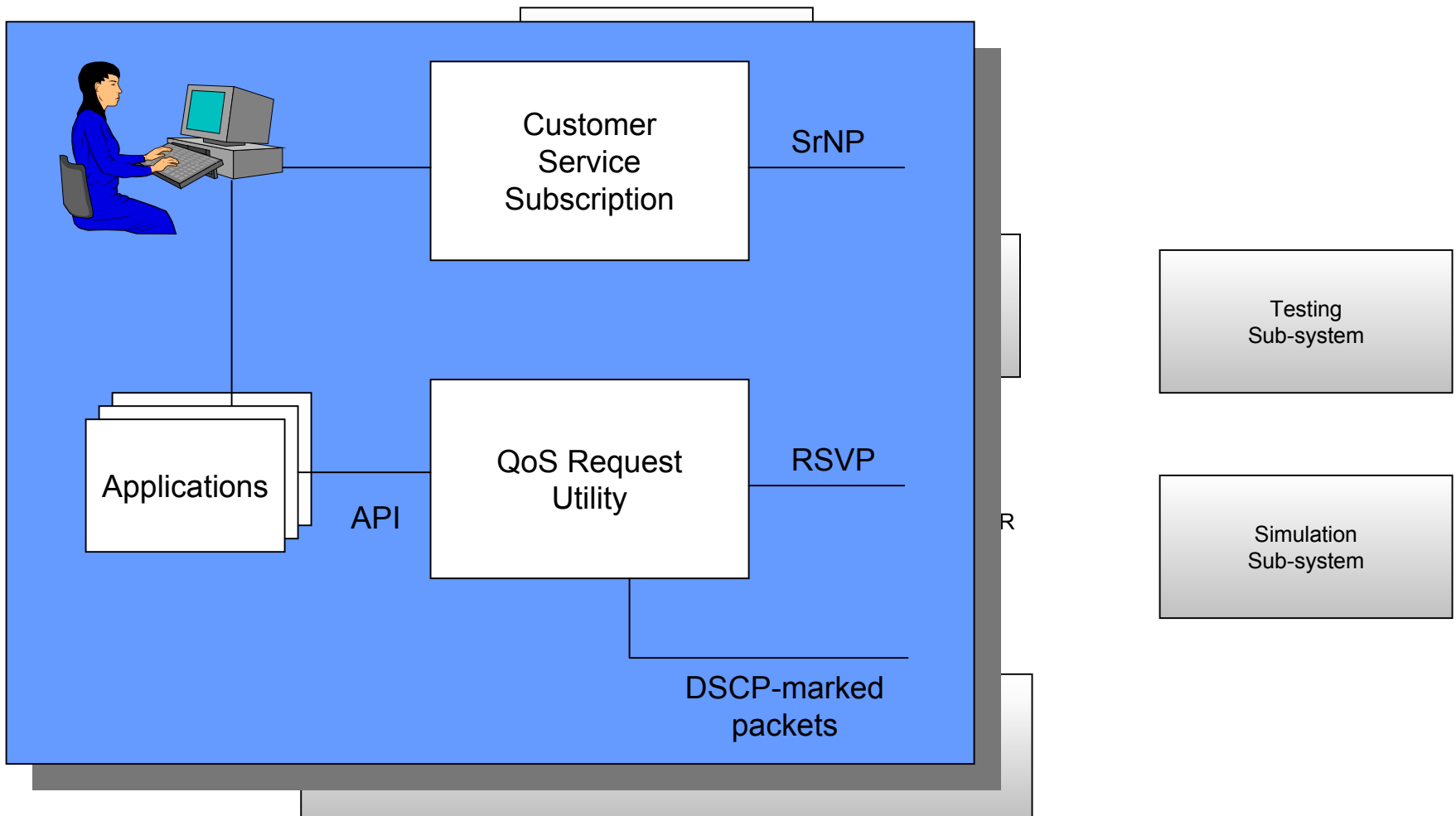


TEQUILA Engineering Approach: Policy Management Sub-system



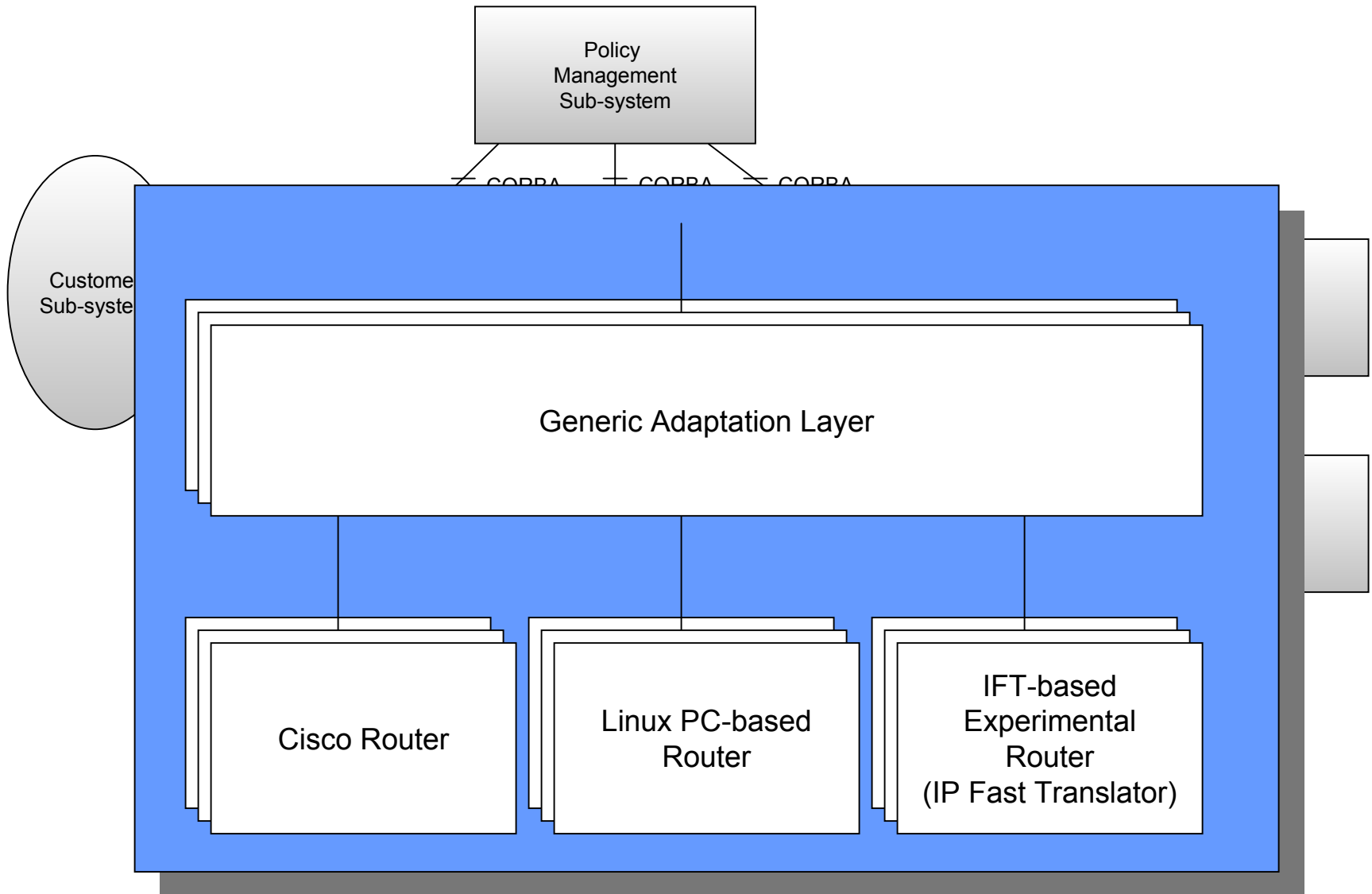


TEQUILA Engineering Approach: Customer Sub-system



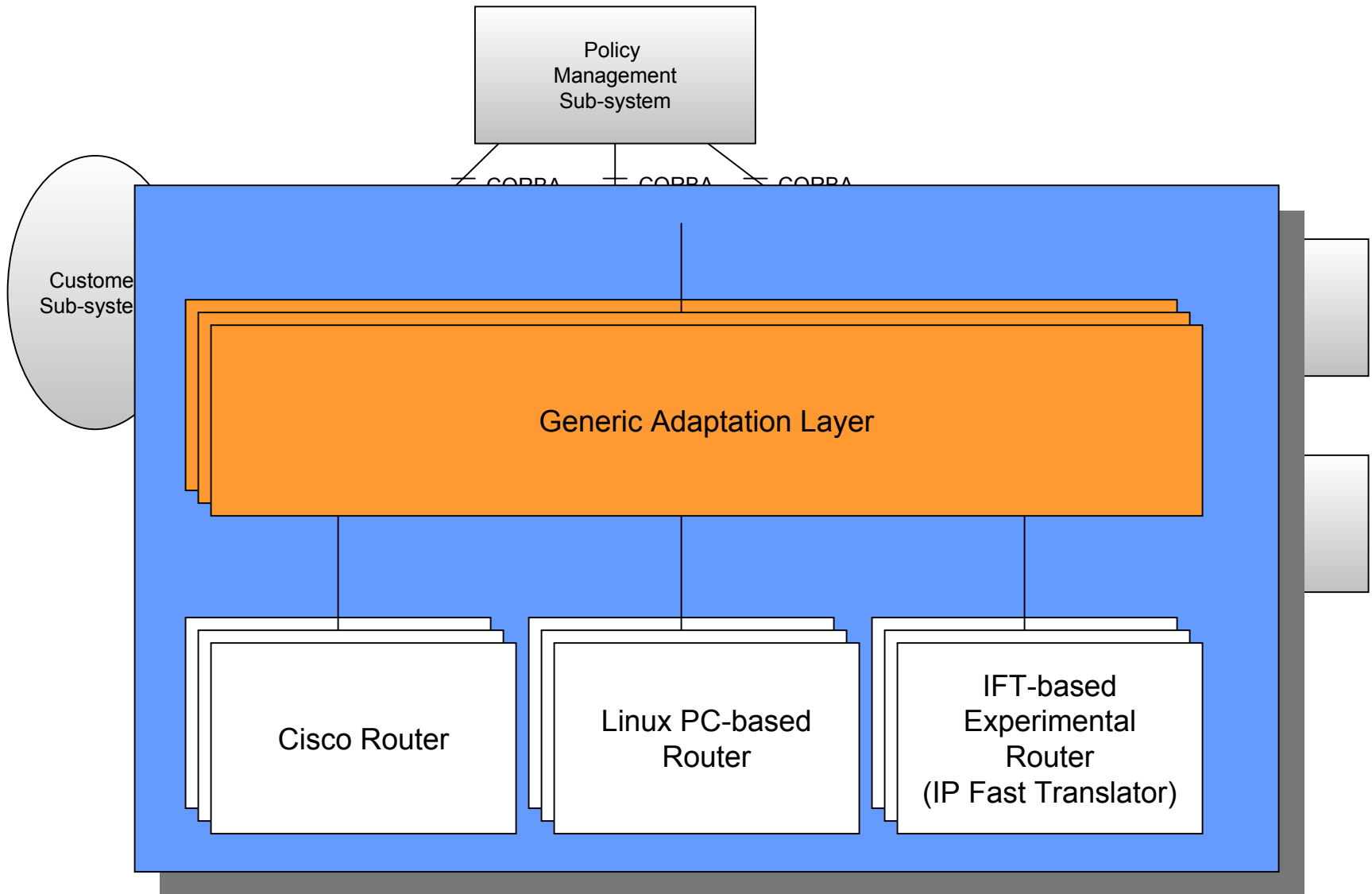


TEQUILA Engineering Approach: Router Sub-system



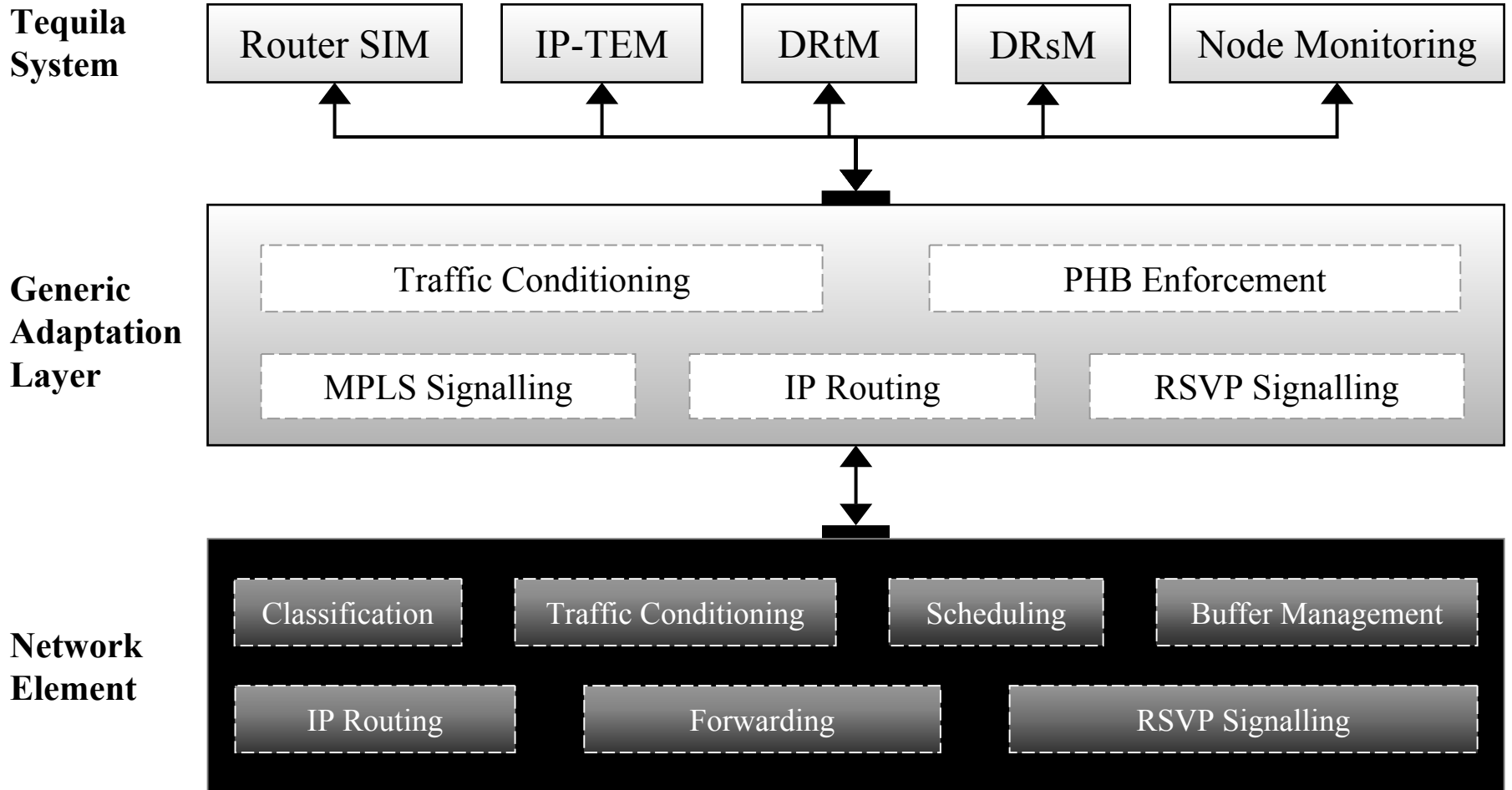


TEQUILA Engineering Approach: Router Sub-system





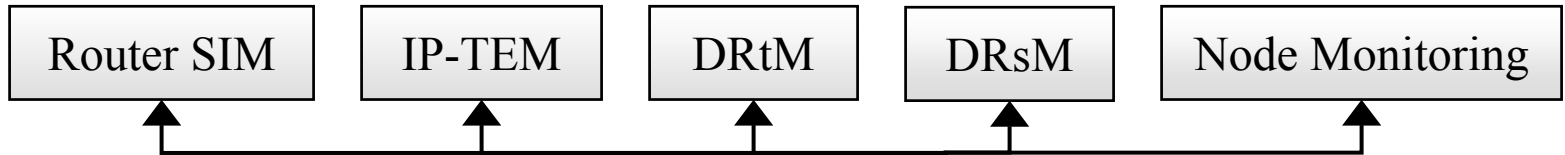
Generic Adaptation Layer Functional Model





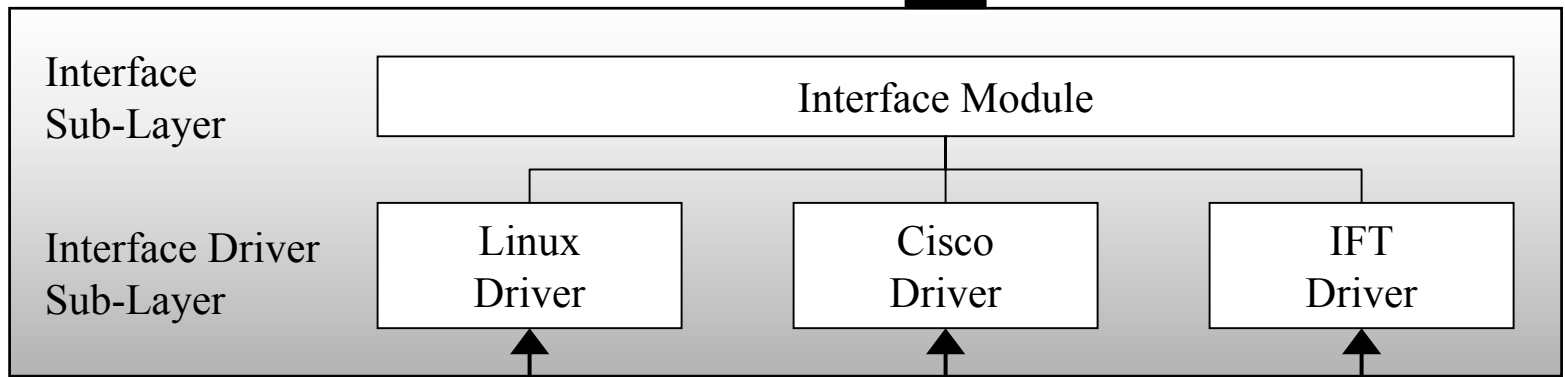
Generic Adaptation Layer Architecture

Tequila System



COPS

Generic Adaptation Layer



kernel sockets, RAPI

SNMP, CLI

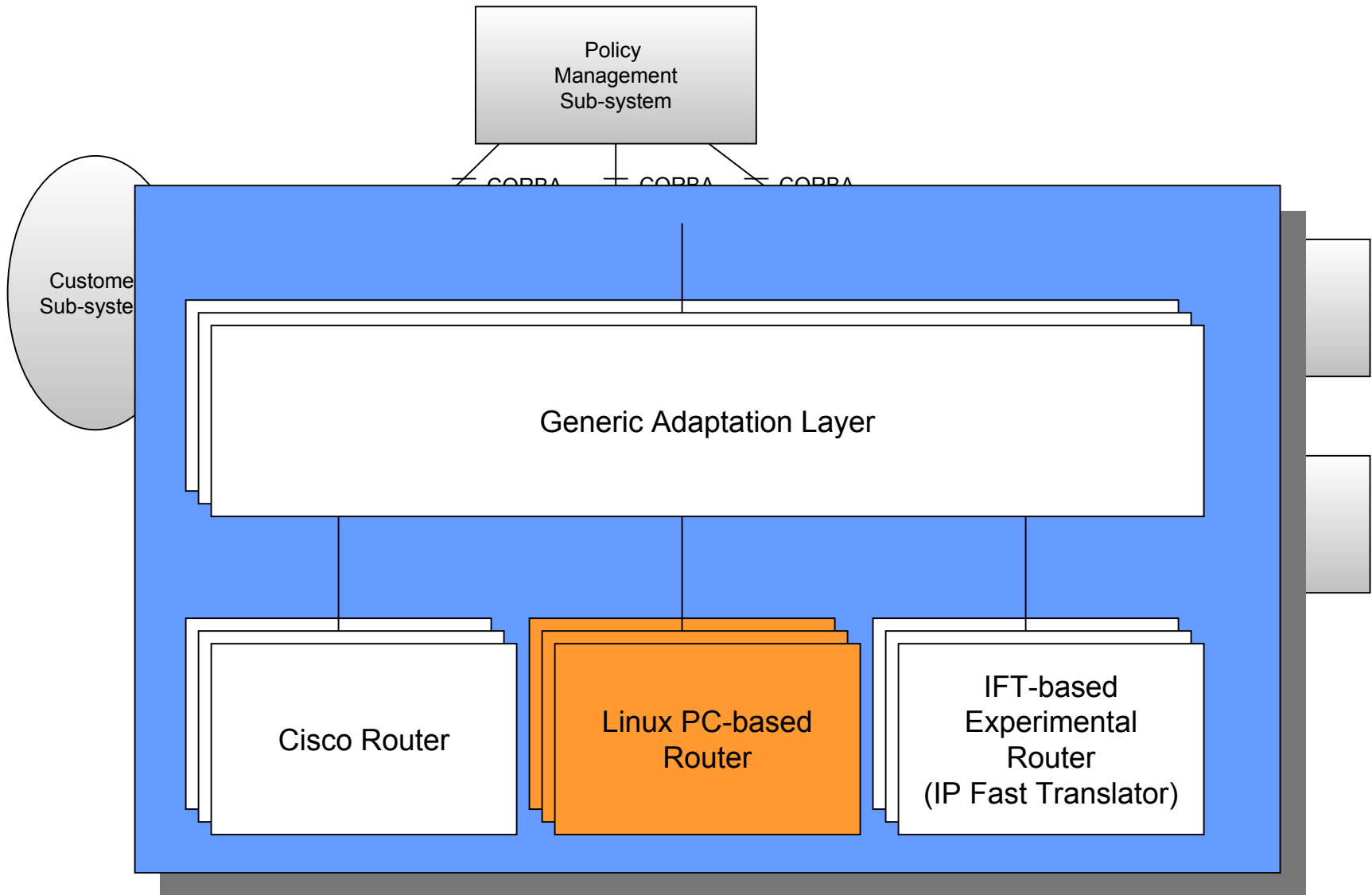
RPC

Network Element





TEQUILA Engineering Approach: Router Sub-system





Linux enhancements

DiffServ over MPLS

- DiffServ
 - DSCP based classification and marking (DONE)
- MPLS signaling: RSVP for Traffic Engineering
 - Interoperability Linux and Cisco NE's (to be done)
 - Merged Linux and BSD daemons
 - Explicit Route and MPLS signaling support (DONE)
 - Enhancements to support DiffServ signaling (DONE)
- Diffserv over MPLS forwarding
 - Based on existing Linux MPLS best effort only code
 - Added DiffServ support (DONE)
 - Added multiple routing table support (DONE)
 - Added packet and byte counters at LSP level (DONE)

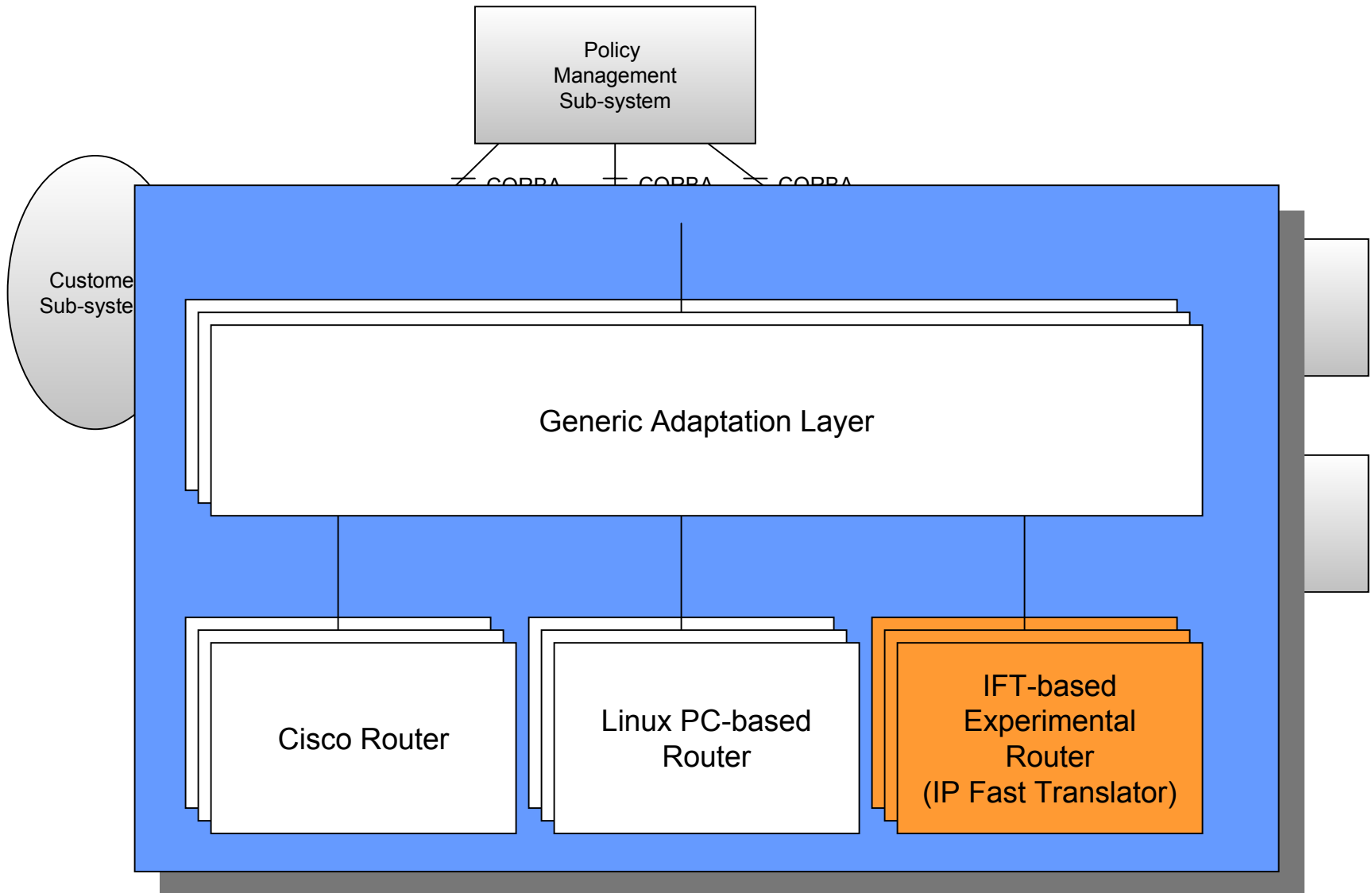


Linux enhancements IP Traffic Engineering

- IP TE-capable routers
 - Support for RFC2370 and TE extensions for OSPF
 - Use of existing routing daemon
- COPS-PR
 - PDP: IP Traffic Engineering Manager
 - PEP: IP TE-capable router
 - Use of existing COPS-PR source code



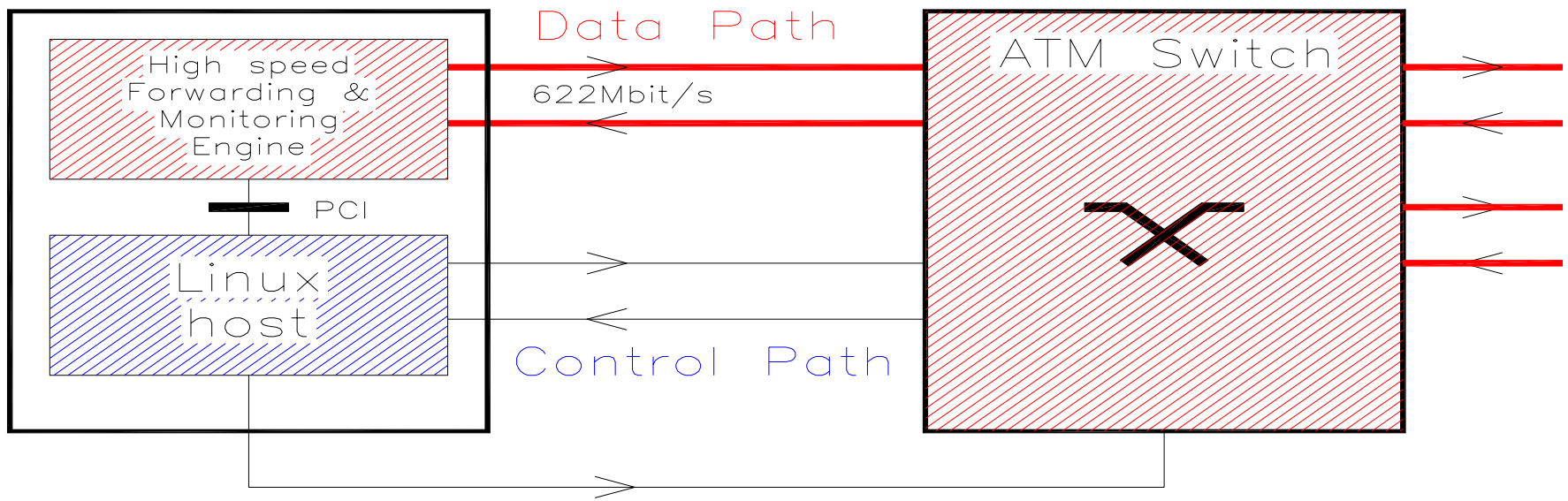
TEQUILA Engineering Approach: Router Sub-system





IFT Experimental Router

- Hardware-based classification and forwarding speeds up TEQUILA experimental routers
- Using “IP Fast Translator” from FTR&D



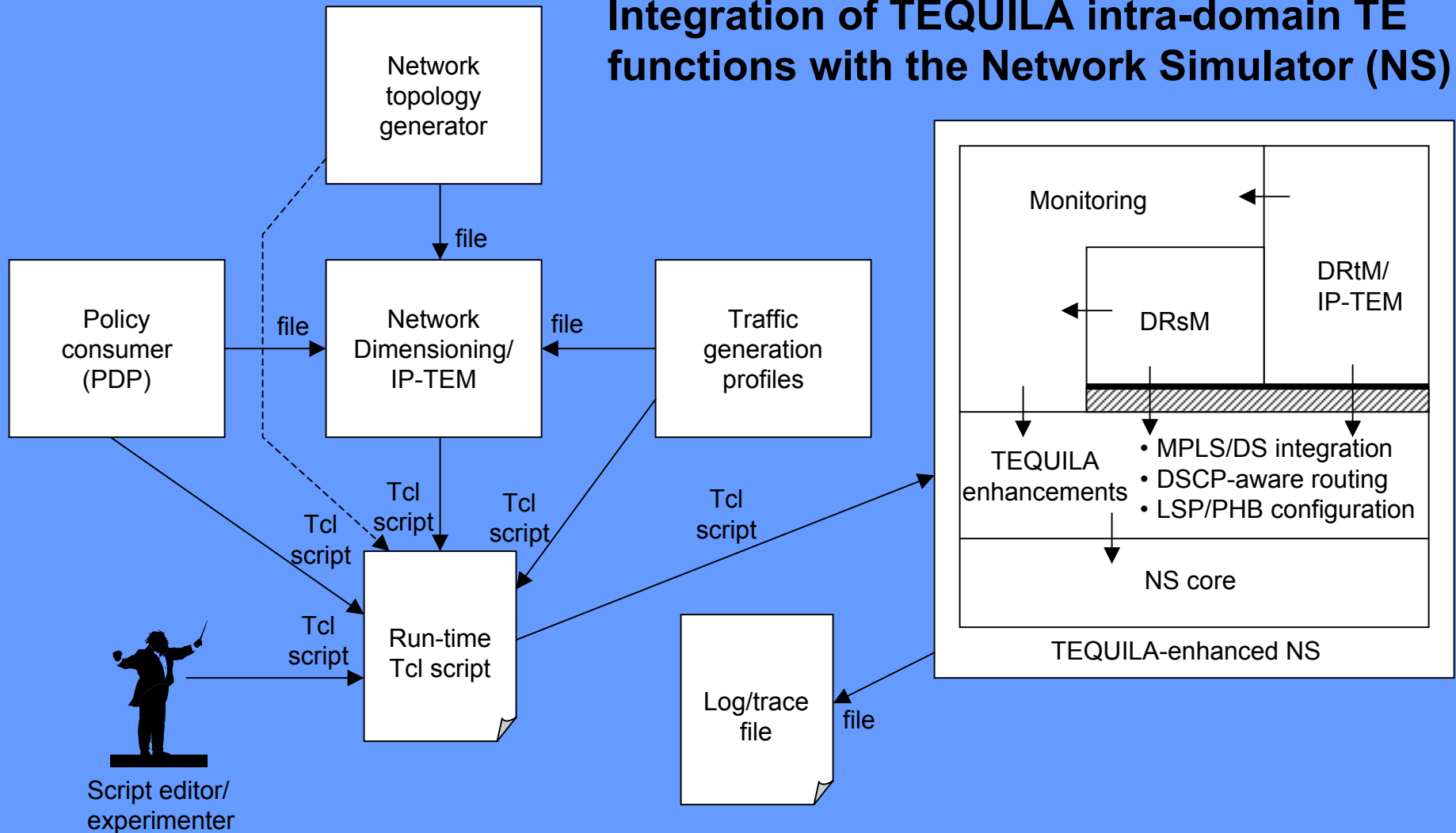


- **MPLS capabilities:**
 - Push, pop and swap operations on two levels of labels
 - EXP field tagging
 - TTL update (LSR) and TTL exchanges between IP and MPLS layers (LER)
 - Use of the LLC/SNAP header instead of 2 levels of MPLS headers at the LER egress
- **Multi-path forwarding:**
 - Based upon a SA/DA hashing mechanism
- **Linux enhancements:**
 - Migration of the control memory driver to Linux



TEQUILA Engineering Approach: Simulator Sub-system

Integration of TEQUILA intra-domain TE functions with the Network Simulator (NS)

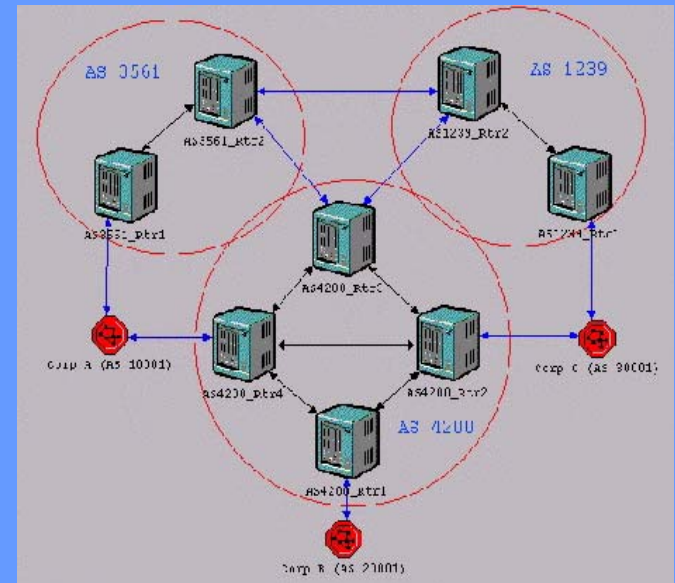




TEQUILA Engineering Approach: Simulator Sub-system

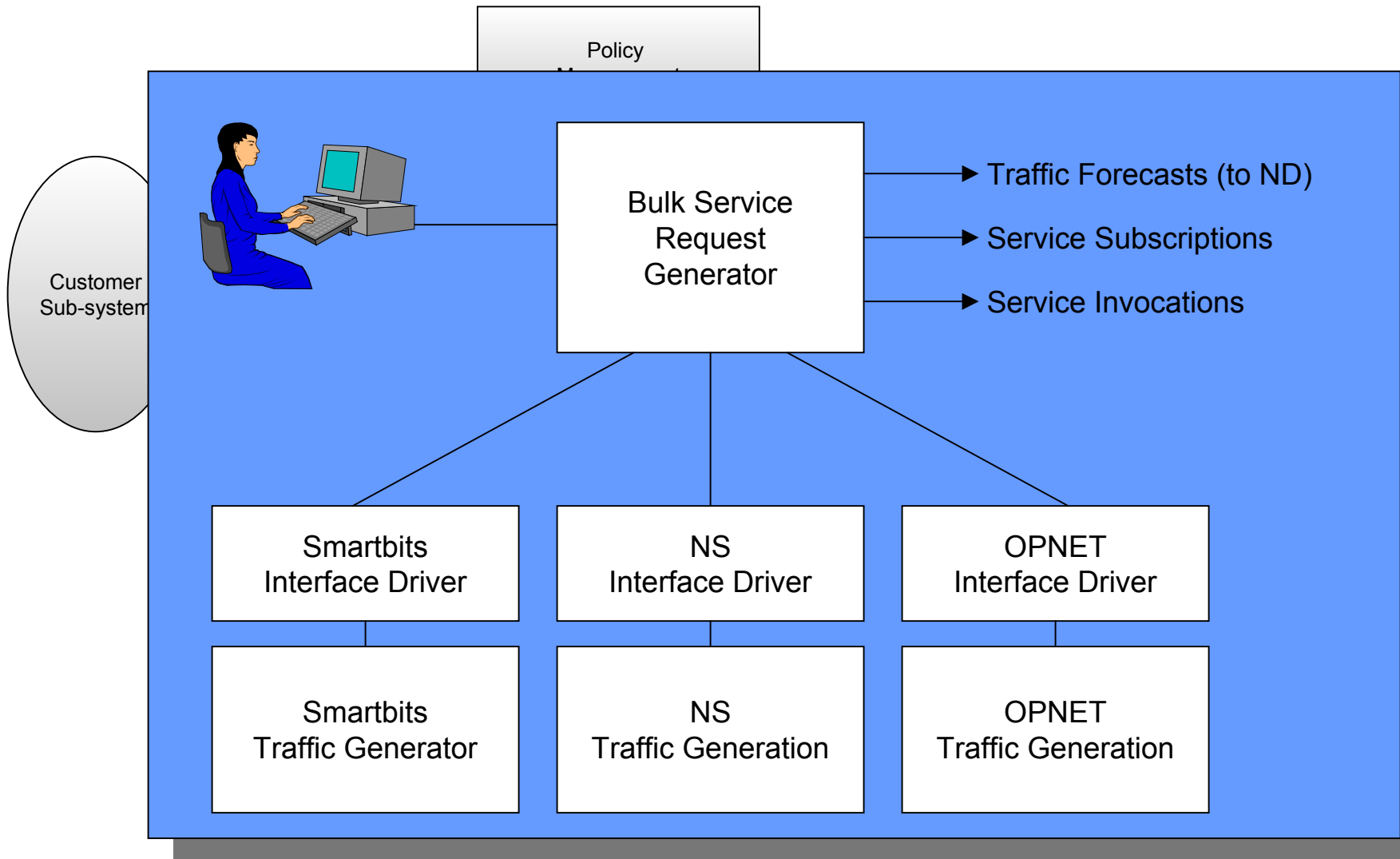
Inter-domain Traffic Engineering Simulations with OPNET

- Implementation of QoS-enhanced BGP
 - peers exchange QoS information in addition to topological data
 - delay, bandwidth, TOS byte info, etc.
 - Exchange of information described in IETF drafts:
 - `draft-jacquetnet-qos-nlri-02`
 - `draft-jacquetnet-qos-ext-bgp-00.txt`
 - BGP peers run a modified route decision process



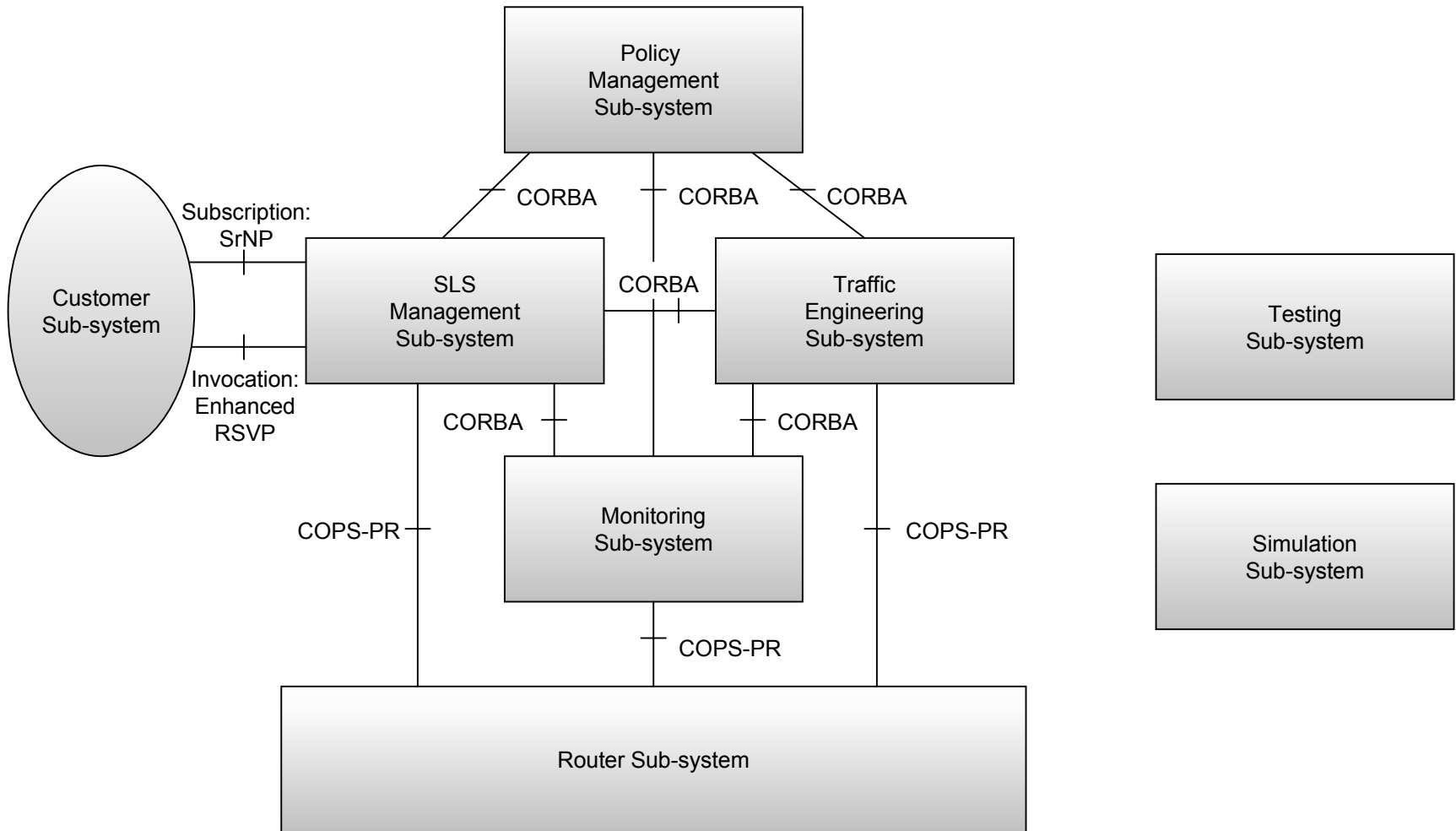


TEQUILA Engineering Approach: Testing Sub-system





TEQUILA Engineering Approach: Summary





TEQUILA Engineering Approach: Summary

- Eight sub-systems, 32 components
 - Deploys TEQUILA algorithms and protocols (c.f. D.1.1, D1.2)
 - Additional infrastructure: e.g. customer, testing sub-systems
- System spans from low-level router enhancements through traffic engineering systems to service and policy management solutions
- Design complete, implementation now underway
- Incremental roll-out of system releases
 - 4 major releases: April '01, July '01, Sept '01, Feb '02
- Deployment in TEQUILA testbeds and in simulation environments



TEQUILA Engineering Approach: Demonstrations

- Two demonstrations to follow:
- Service Negotiation
 - Live demo of SLS negotiation between Service Subscription Management and Customer Service Subscription components
- Linux Enhancements for DiffServ over MPLS
 - Slide show of screenshots from demonstration at IMEC, November 2000
 - 10 node testbed of enhanced Linux-based PC routers + Smartbits traffic generation and analysis