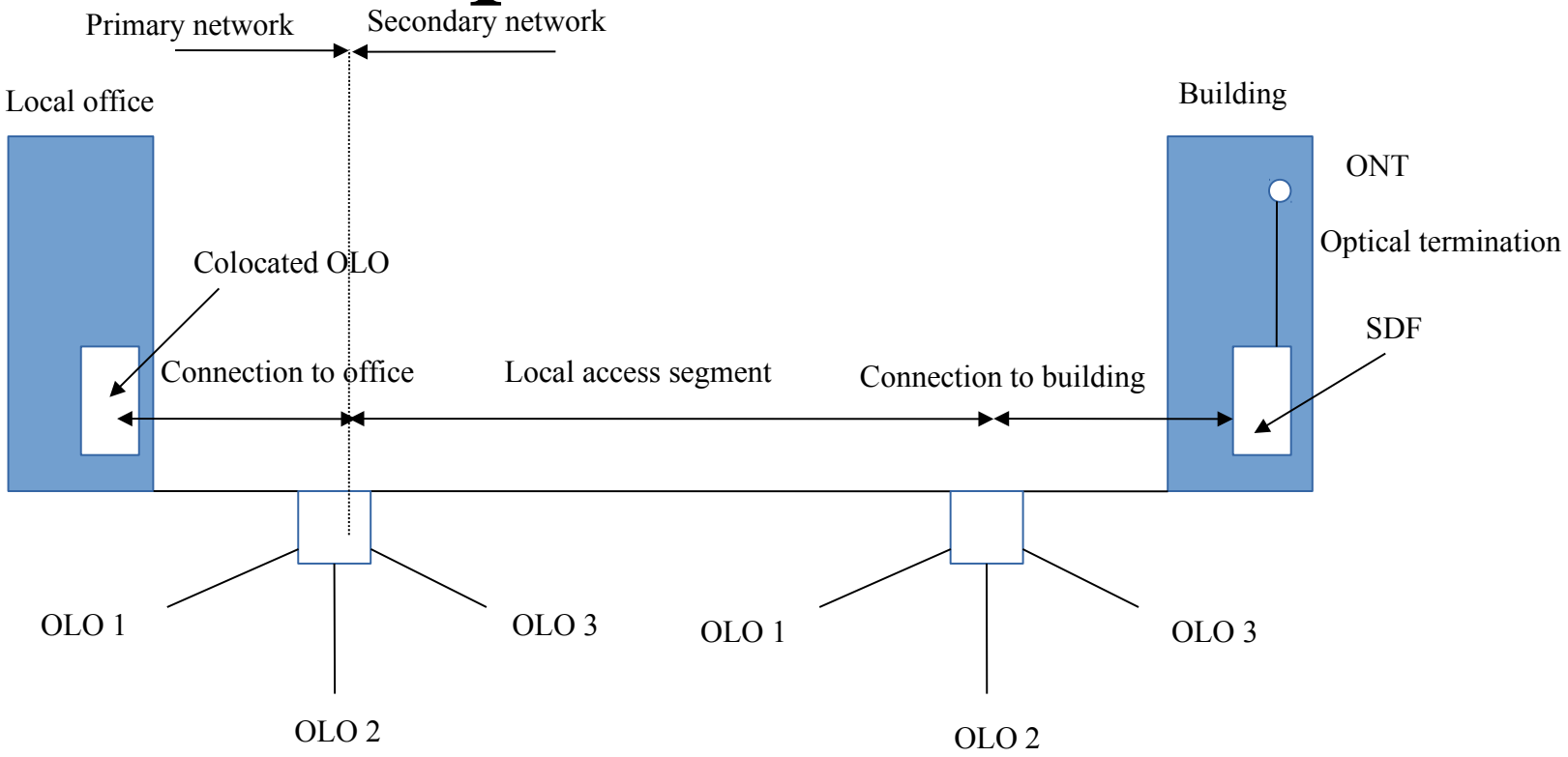
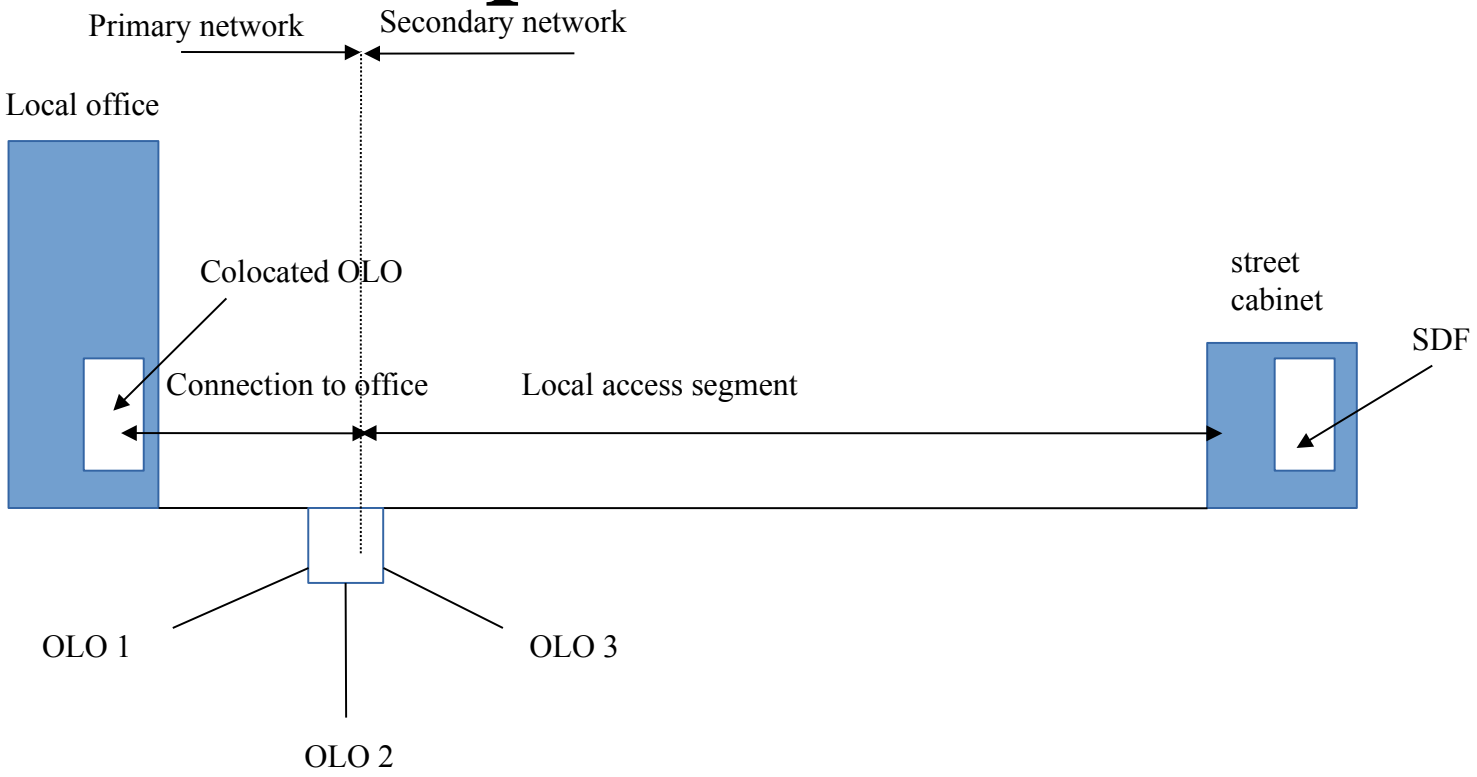
Inter-operator services



FTTH: the basic local access service has four segments
- connection to office
- local access segment
- connection to building\
- optical termination segment

Inter-operator services

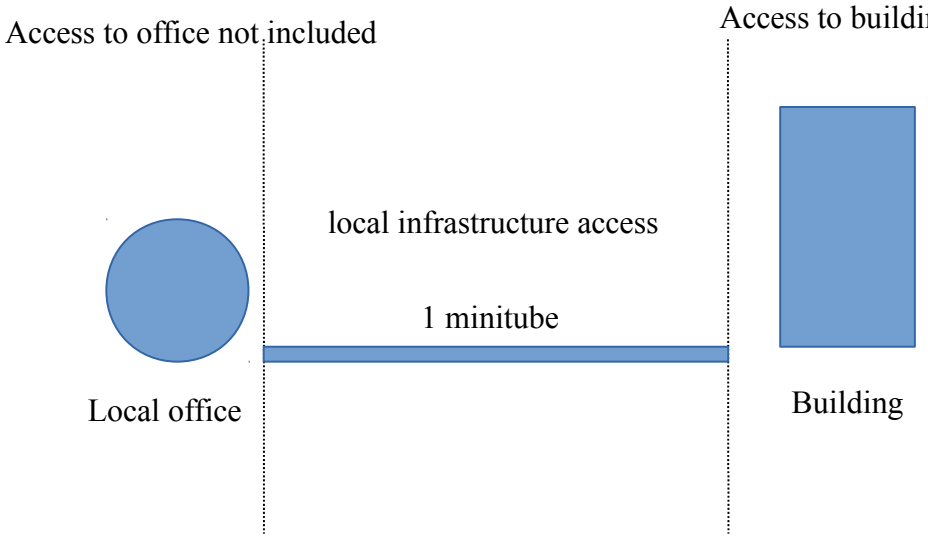


FTTC: the basic local access service has two segments
- connection to office
- local access segment

Inter-operator services

- The basic intermediate service (the *local access segment*) is provided by the incumbent operator who offers access to the optical infrastructure to OLOs
- The access to the local infrastructure service offers to OLOs the IRU (Indefeasible Right of Use) of an infrastructure segment from a local office to the base of a building (the service does not include getting inside the building or inside the local office)
- The elementary service is the IRU related to one minitube
  - Note: optical fibers are hosted in minitubes, and minitubes can be hosted in single tubes of multiple tubes (2 or 3 tubes in a bundle)

Inter-operator services



The service includes ordinary maintenance
Extraordinary maintenance is not included in
The service and is payed for by both the
Incumbent and the OLO

Availability: when the incumbent operaor deploys
new minitubes, it reserves 20% of the minitubes
for requests from OLOs

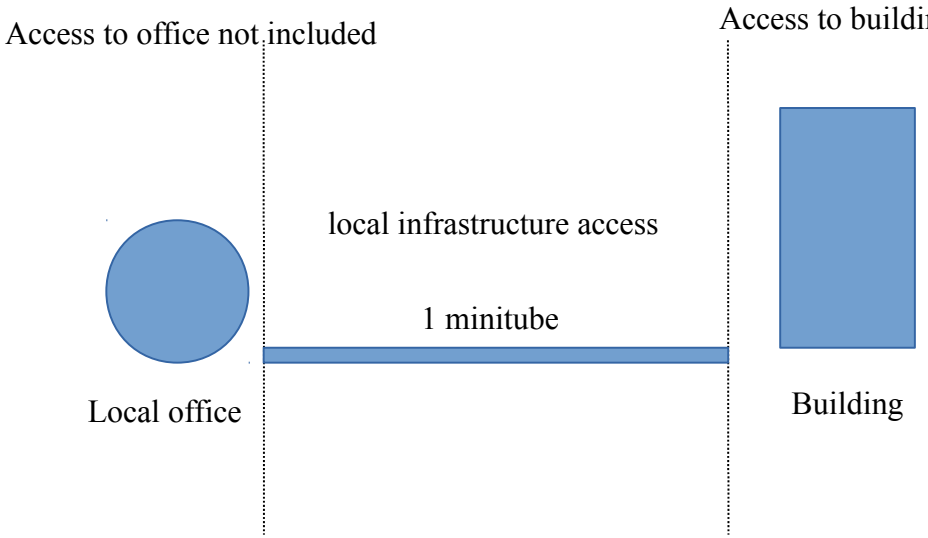
minitube

single
tube

dual
tube

triple
tube

Inter-operator services (local instrastructure access)

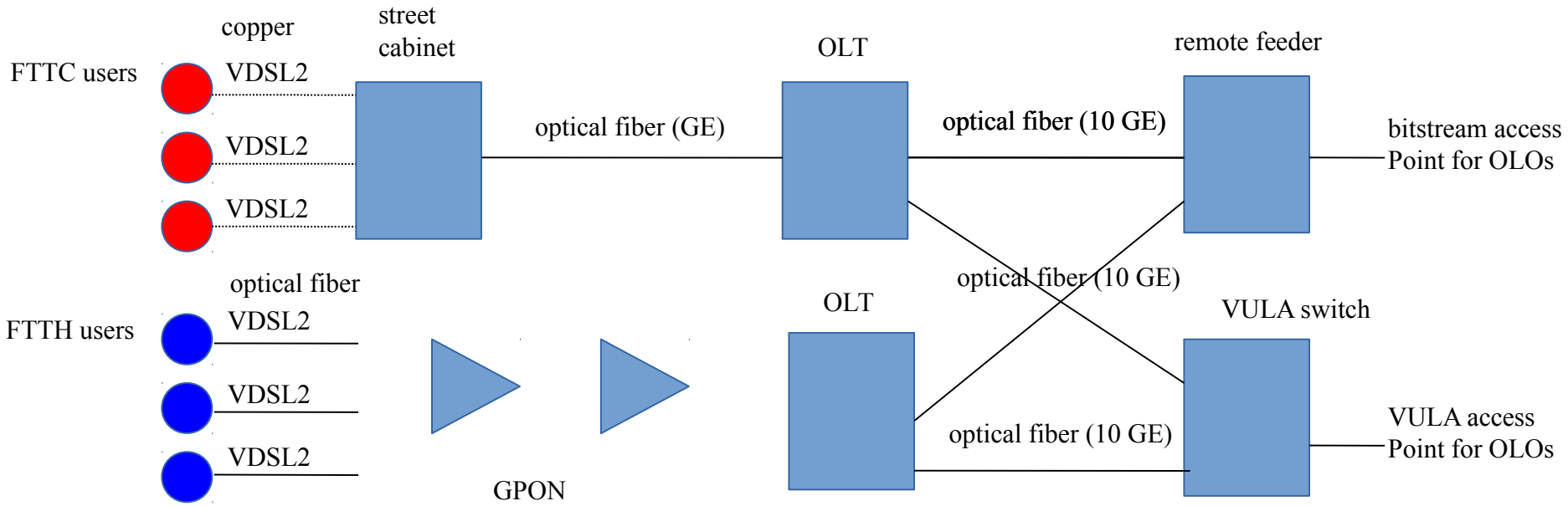


- Access to the office, access to the building, and optical termination are different services that the OLO can request
- Access to the office
  - The incumbent offers to the OLO the segment connecting the minitube to a specific aggregation point inside the office
  - Then the OLO can connect its colocated equipment
- Access to the building
  - The elementary service is 1 minutube (IRU) from the endpoint, outside the building) closest to the building and the incumbent's access point inside the building
- Optical termination
  - The basic service is a single optical fiber to the optical network termination of the individual customer

Wholesale services: bitstream

- From a technical standpoint bitstream services do not place issues: the NGAN can offer customizable high speed access, usually to business users (see the Openreach GEA (Generic Ethernet Access) offer in Great Britain, over FTTC/FTTH)
- Quality of service (QoS), can be differentiated, at least two priority levels can be provided, for example with IEEE 802.1p
- Offering different classes of service through the NGAN allows an effective sharing of the infrastructure among different applications

Bitstream NGA and VULA (Virtual Unbundled Local Access)



Techically, bitstream NGA and VULA are similar services, the basic difference is that VULA is used to implement unbundling in a virtual way

IP multimedia services in the NGN

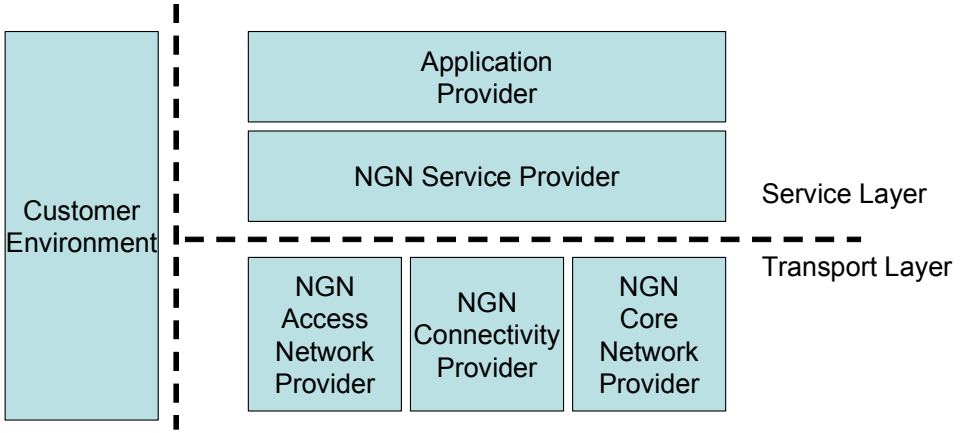
- In the ETSI the working group TISPAN (Telecommunications and Internet converged Services and Protocols for Advanced Networking) has already defined many NGN standards
- A relevant part of these standards covers the interconnection of multiple NGN network, of different operators

IP multimedia services in the NGN

- High-level requirements :
  - QoS must be negotiated both at the connection setup and when the connection is already established
  - QoS negotiation must be enabled also in case of roaming between different operators
  - IP multimedia session must support a wide set of audio/video codecs
  - IP multimedia services must, as much as possible, be provided to a variety of access technologies available to the user UTRAN, WiMAX, ...

Service layer e transport layer

- The Figure shows the logical division among the service layer and the trasnport layer in the NGN:
- **NGN Access Network Provider (NANP)**: concentrates traffic from multiple access lines towards one ore more NGN Connectivity Providers
- **NGN Connectivity Provider (NCP):** provides connectivity to NGN Core Network Provider
- **NGN Core Network Provider (NCNP):** aggregates trafic from edge nodes of multiple access networks towards external networks
- **NGN Service Provider (NSP):** provides services requiring transport onto the NGN. Performs authentication, service control & management, billing. In case of IPTV services performs content ingestion & Digital Rights Management (DRM)



Service requirements

- Two interconnected NGN operators offer end-to-end services
- Quality of Service must be guaranteed in end-to-end fashion through coordination among operators
- Example: carrier-grade VoIP services

VoIP Service requirements

- ETSI TISPAN identifies the emulation/replacement of PSTN/ISDN services as a key issue of the
- With service emulation, a new service is provided through the NGN with identical features of the old service
- Replacement means that some features of the new service may be slightly different

VoIP Service requirements

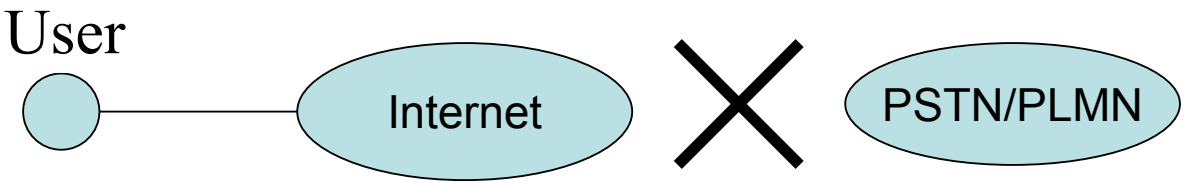
- Basic requirements of the classic PSTN/ISDN service:
  - Numvering plan must be preserved
  - Lawful Interception (LI) must be guaranteed
  - Emergency services must be guaranteed
  - Malicious Call Identification (MCID) service must be guaranteed
  - Anonymous Call Rejection (ACR) service (LI) must be guaranteed
  - Interoperability with the old PSTN/ISDN service must be guaranteed
- Two basic categories of telephone services are devised:
  - **Publicly Available Telephone Service** (PATS);
  - ECS (**Electronic Communication Service**).
- PATS is the service mapping for the classic PSTN/ISDN service and has more tight requirements than ECS

VoIP Service requirements

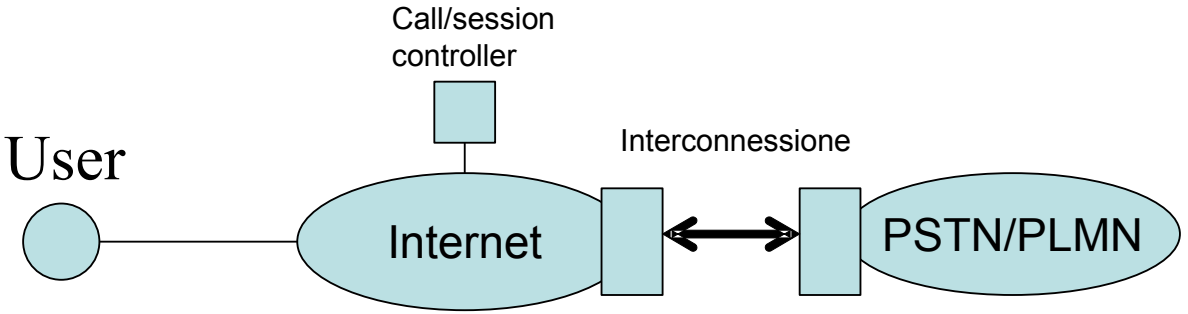
- The emulation of the classic PSTN/ISDN service is usually referred to as ToIP (Telephony over IP), to distinguish it from ECS services, such as VoIN (Voice over Internet)
- In the VoIN service network operatori usually do not control the service and do not guarantee qos
- Typical VoIN services are p2p telephony such as Skype, among others
- The VoIN In&Out service allows users to interconnect through external networks such as PSTN/PLMN

VoIP Service requirements

a) VoIN Peer-to-Peer



b) VoIN In&Out

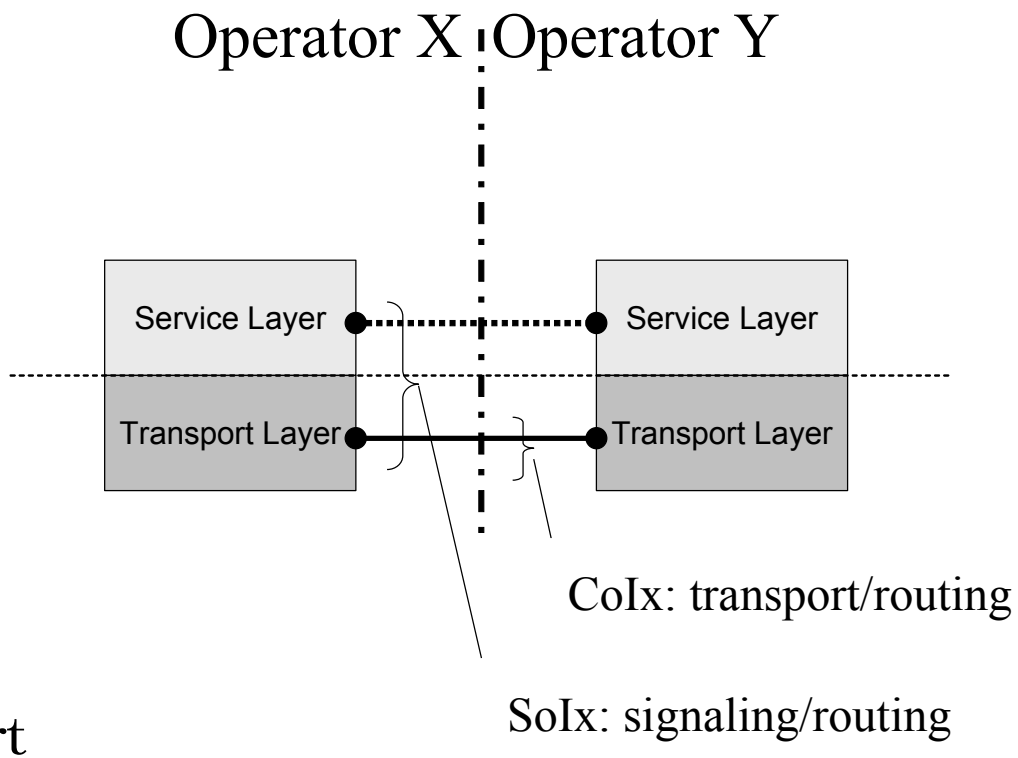


VoIP Service requirements

	Calls to PSTN & PLMN	**Additional services (emergency calls, number portability, telepowering, special number, connection through other networks)**		
VoIN Peer-to-Peer	NO	**NO**		
VoIN IN&OUT	YES	YES (no emergency calls, number portability, telepowering, special number)		
ToIP	YES	YS (no telepowering)		

NGN Interconnection

- NGN interconenction is standardized by ETSI/TISPAN
- In ETSI standards, interconnection can be performed in two ways::
  - Service-oriented Interconnection (SoIx);
  - Connectivity-oriented Interconnection (CoIx).
- SoIx operates at the service layer, CoIx operates at the transport layer

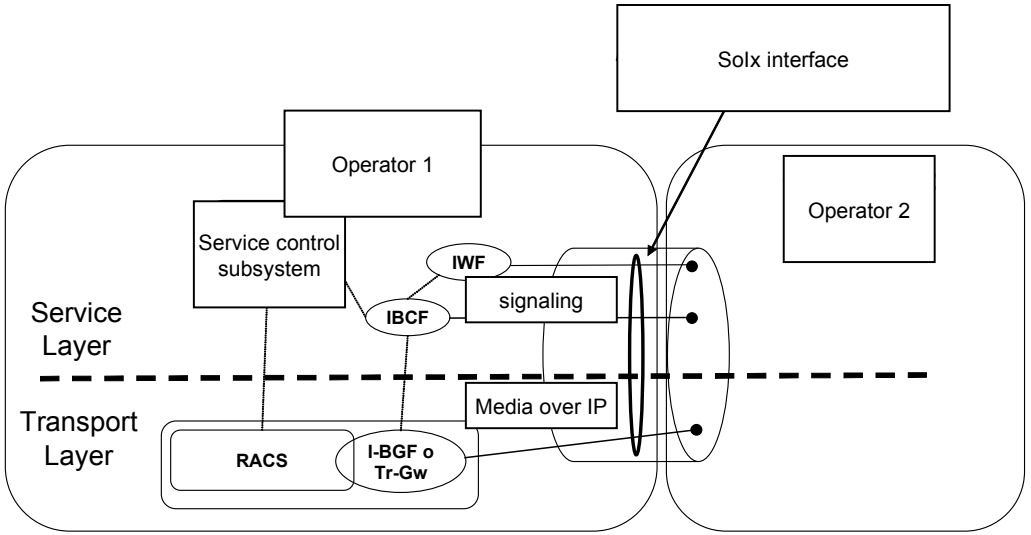


NGN Interconnection

- SoIx interconnection is the physical and logical interconnection between two administrative domains of different NGN operators. It allows operators to offers a complete service with QoS requirement in end-to-end fashion
- The CoIx interconnection operates basically at the IP layer, without considering service-level QoS requirements
- The CoIx interconnection may operate guaranteeing IP-layer service requirements

NGN Interconnection

- With reference to the interconnection for the delivery of ToIP services, the InterWorking Function (IWF) enables interworking of different signaling protocolssuch as SIP (Session Initiation Protocol) and ISUP (Integrated Services User Part)
- The Border Gateway Function (BGF) separates the two interconnected administrative domains, supporting security, QoS, call tracing, traffic logs
- The RACS (Resource and Admission Control Subsystem) function controls the usage of resources at the IP layer and it is responsible of QoS at the IP layer



Legenda
IBCF: Interconnection Border Control Function
I-BGF: Interconnection Border Gateway Function
Tr-GW: Transition GateWay in 3GPP
IWF: Interworking Function
RACS: Resource and Admission Control Subsystem

NGN Interconnection

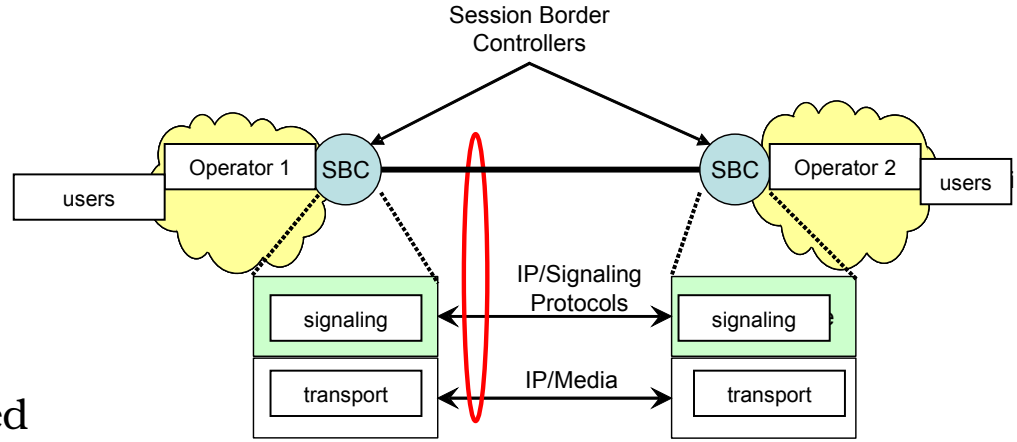
- The CoIx interconnection provides the connectivity allowing operators to let their customers reach external networks
- A typical example of CoIx interconnection is the peering IP service

NGN Interconnection

Interconnection service	Definizione	Esempi di applicazione	
		SoIx	CoIx
termination	Service requests are originated at the OLO/SP side and terminated onto customers of the interconnected operator	Telephone termination e videotelephony Termination of video-streaming session based Messaging (SMS, MMS...)	N.A.
collection	Service requestsof customers are forwarded to OLO/SP	Communication to non-geographic numbers Carrier Selection & Carrier Pre-selection Internet Dial-up	N.A.
transit	Service requests of OLO/SP transit through the interconnected operator	Transit of telephony & video telephony	N.A.
IP transit	IP traffic of OLO/SP transit through the interconnected operator	N.A.	IP transit to Peering domains
access	IP traffic of customers are forwarded to OLO/SP	N.A.	Bitstream Leased Lines (Terminating)
IP transport	IP traffic of OLO/SP between two remote points transits through the interconnected operator	N.A.	Leased Lines (trunk) VPN interconnection

SoIx requirements

- Signaling requirements:
  - Interoperability of signaling and service identification
- Requirements on codecs:
  - A set of codecs must be supported: at least G.711 bur are recommended Adaptive Multirate (AMR), G.729A and Enhanced Variable Rate Code (EVCR)
- Authomatic selection of codecs must be supported, the system must be able to scale down to the lowest quality codec involved in the session. Audio transcoding must be supported.
- Video codecs: at least H.263 and H.264



SoIx requirements

- routing:
  - Service-based routing must be supported
- security
  - Lawful interception, authorization, authentication, access control, data integrity, privacy
- Billing and accounting
  - Logs, traffic reports, billing generation, Charging Data Record (CDR).
- QoS & SLA
  - Resource reservation for QoS-aware sessions
- Connection Admission Control