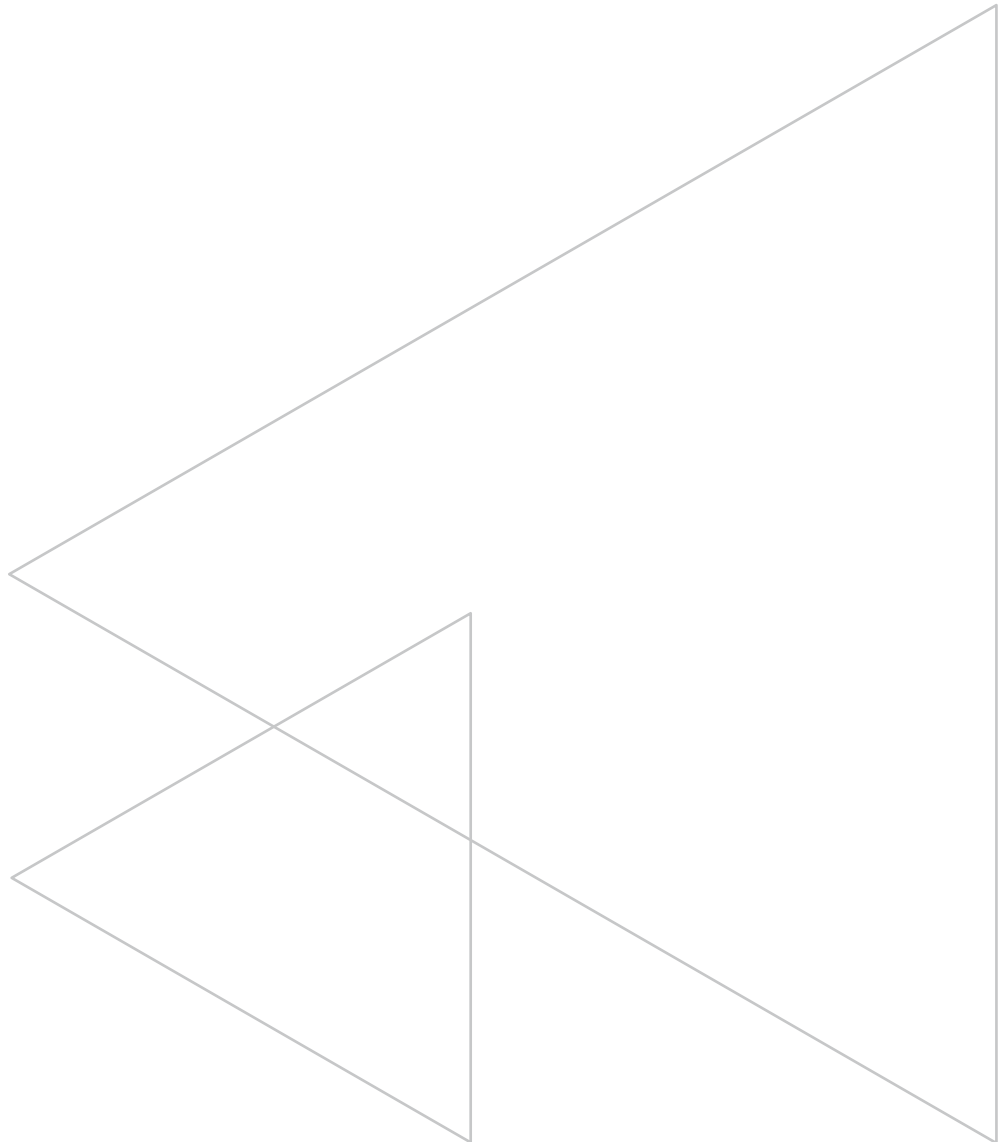
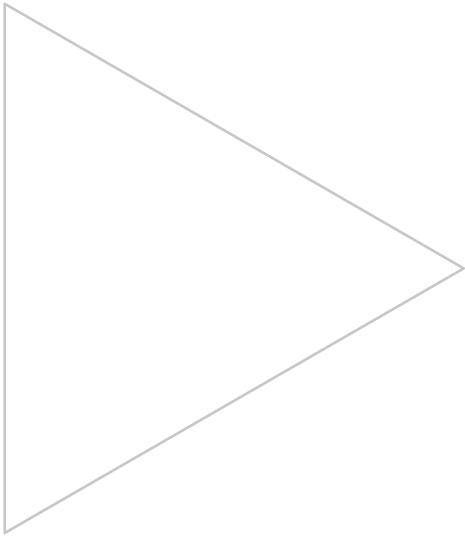


**APPENDIX**  
**CARRIER**  
**IP CONNECT**



# Contend

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## 1 INTRODUCTION

The Carrier IP Connect Wholesale service uses IP packets to transfer data between individual locations / locations within a single virtual private network (VPN). The Wholesale service is built in a “full mesh” topology (any-to-any communication) which allows to easily and efficiently interconnect all of branch offices/locations into a single private network followed by the handover of this VPN at NNI (Network-to-Network Interconnection) point. In order to ensure high reliability of the Service, CETIN uses the MPLS protocol operated on fully backed-up systems to build each VPN in its backbone network.

The Service is suitable for the simple interconnection of LANs (local area networks), applications and data centers with a combinations of voice, data and video communications within a single circuit.

The Wholesale Carrier IP Connect service makes use of the most extensive metallic and optical network in the Czech Republic including all qualitative features of its ring-shaped topology.

The Wholesale Carrier IP Connect service is the fully-managed Service that CETIN monitors throughout the entire IP network and along the access line to the Ethernet interface of the Customer premises equipment.

The service allows you to prioritize individual types of traffic such as voice, video, or other applications based optional service Quality of Service (QoS), or to increase service availability with the optional back-up service.

The terms of the Wholesale Carrier IP Connect service stated in this Appendix applies only to Carrier IP Connect service provided in the Czech Republic. The Wholesale Carrier IP Connect service provided outside of the Czech Republic, the service conditions stated in this Appendix also apply, unless otherwise specified in the service order form.

## 2 PARTNER BENEFITS OF THE WHOLESALE CARRIER IP CONNECT

- Full mesh topology (any-to-any communication).
- Wide range of access type technology options (fibre, copper, radio).
- QoS support.
- Cisco CPE delivery including its management.
- Guaranteed SLA starting with 99 level.
- Non-stop monitoring and secured by our Help Desk specialist available 24 hours a day, 7 days a week.
- NNI point and end point of CETIN network back-up options.
- The largest network of own technicians to provide installation in the Czech Republic.
- Quick delivery for own infrastructure.
- Ethernet interface with easy and cheap implementation towards the Partner.

### 3 WHOLESALE SERVICE PARAMETERS

The Wholesale Carrier IP Connect service can be delivered in two options:

- **Carrier internet Basic service** – delivered via copper ADSL, VDSL, SHDSL or unlicensed Point to Point radio. The Service can be provided from asymmetrical speeds 512/128 Kbps to 40/2 Mbps and symmetrical speeds from 2 Mbps to 300 Mbps. The available Service speeds are specified under 5.1 of this Appendix. The contention ratio is not applied. The guaranteed SLA is 99 level.
- **Carrier internet SPECI service** – delivered via fibre, licensed professional point to point radio or SHDSL (dedicated DSLAM) technology. The Service speeds are only symmetrical and can be provided from 2 Mbps to 2 Gbps. The available Service speeds are specified under 5.1 of this Appendix. The guaranteed SLA is 99,5 level.

The overview of Wholesale Carrier IP Connect service and applied CETIN Access technologies:

Product option	ACCESS TECHNOLOGY				
	Copper (DSLAM)	Copper (Bussines SHDSL)	Unlicensed radio	Licensed radio	Optical access
Carrier Internet Basic	Yes	No	Yes	No	No
Carrier Internet Speci	No	Yes	No	Yes	Yes

The Wholesale service Carrier IP Connect includes:

- NNI – Ethernet handoff, NNI-Ethernet service.
- VPN stream (sub-interface).
- Access – transmission capacity between Provider Edge (PE) routers and an end point of CETIN.
- Customer Premises Equipment (CPE).

#### 3.1 NNI – Ethernet Service

The NNI-Ethernet service complies with RFC 10a 4364 (BGP / MPLS IP VPN Virtual Private Networks), also known as VRF-to-VRF connections at the AS border routers.

The NNI-Ethernet service is provided on the following interfaces:

Interface type	Speed	Connectors
Ethernet 1000 Base – Tx/LX	1000 Mbps	RF-45F, SC/PC/LC/PC
Ethernet 10G – LR	10 000 Mbps	SC/PC/LC/PC

In the case of a Partner request, the redundancy of NNI - Ethernet service can be provided individually. If the NNI - Ethernet service is used only for termination of Carrier IP Connect Wholesale services, the back-up of primary NNI point is solved by using the BGP protocol.

If a "hybrid" NNI is used which means that the NNI - Ethernet service is used to terminate Carrier Ethernet Multi service and Carrier IP Connect service, the redundancy is solved by using MC-LAG, available only in the POPs (Point of Presence) in the Czech Republic and Bratislava.

The BGP prefix limit at NNI per Partner's VPN is 1500. Any higher route limit number is the subject to commercial agreements.

The planning of capacity utilisation of the NNI-Ethernet service is fully responsibility of the Partner. The overbooking of NNI-Ethernet service capacities allowed but CETIN is not guarantying any technical and operation parameters of the Individual Access service.

### 3.2 VPN STREAM

The VPN stream service addresses how to forward each VPN within the NNI-Ethernet service. This Service is established as a virtual channel that uses physical NNI-Ethernet Service and it is defined as VLAN on NNI point. The VPN stream is handovered only as 802.1Q and the VLAN value must be stated on service order of Individual service.

The Partner shall provide IP address to each VPN stream.

### 3.3 Access

The Service speed rate is limited by the throughput in SDH/WDM/IP backbone, which is set up according to the Service order form.

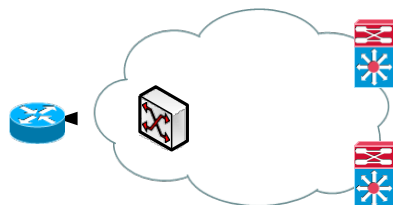
The end point of Partner or Partner's Subscriber location is Ethernet 10/100/1000BASE-Tx/LX and 10G BASE-LR.

The individual Access services are provided through various technologies in the CETIN network depending on local conditions and required capacity.

#### Diagram of the use of various CETIN Network technologies for Access purposes

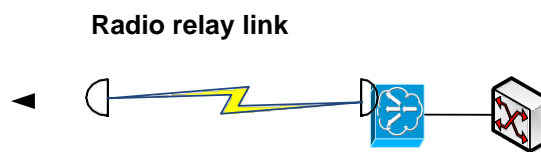
Optical infrastructure:

- MPLS MBH (Mobile Back Haul), NG-SDH or NG-DWDM technology.
- Available only for product variant: **Carrier IP Connect Speci.**



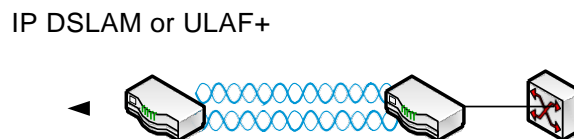
#### Professional radio infrastructure:

- Availability from CETIN mobile base stations or fixed network aggregation sites.
- Connecting directly on optical ring based topology.
- Qualitative parameters are identical with optical connection.
- Service variants:
  - **Carrier Internet Basic** – unlicensed radio (non-coordinated frequencies 10,5 GHz, 17 GHz and 24 GHz).
  - **Carrier Internet Speci** – licensed radio (coordinated frequencies 7-42 GHz or 80 GHz).



#### Copper infrastructure:

- ADSL/VDSL/SHDSL using up to 4 copper pairs.
- Service variants:
  - **Carrier IP Connect Basic** – ADSL/VDSL, SHDSL (DSLAM) – asymmetrical speeds up to 40/4 Mbps and symmetrical speeds up to 20Mbps.
  - **Carrier IP Connect Speci** – SHDSL (Business SHDSL) – symmetrical speeds 2 - 20 Mbps.



### 3.4 Customer Premises equipment (hereinafter CPE)

CETIN can provide Cisco CPE as a part of the Wholesale Services. In the case of asymmetric access the CPE is an integral part of the Individual Access services. In other cases providing CPE is optional.

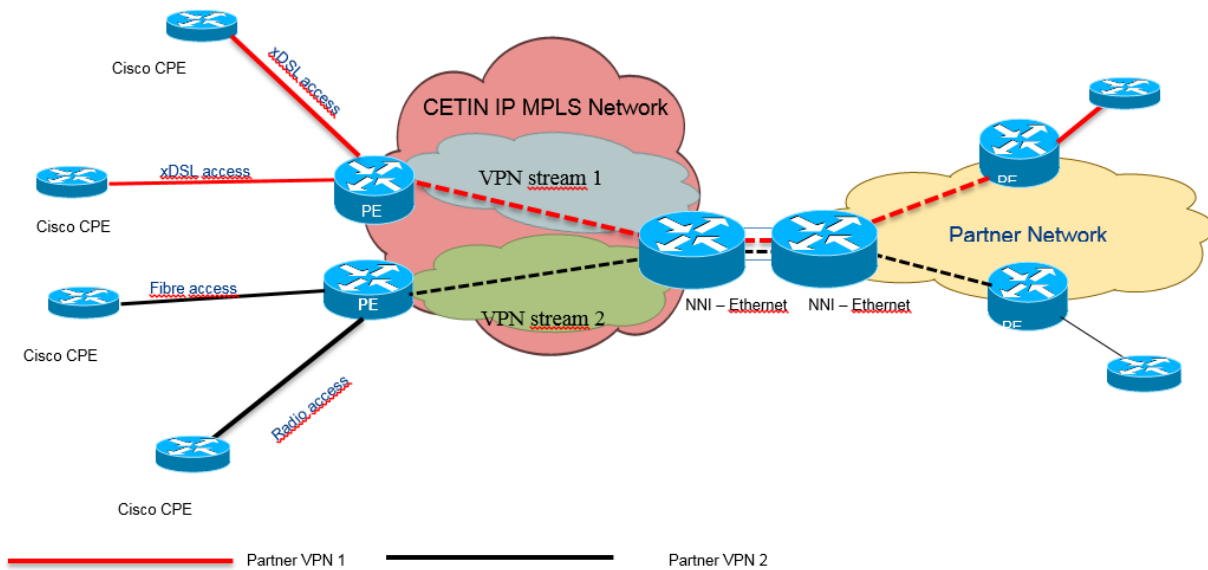
CETIN offers following CPE management options for Carrier IP Connect service:

- a) **No CPE** – own Partner or Partner's Subscriber equipment – can be provided only in case of symmetrical access. The WAN interface of the Individual service is always Ethernet.

- b) **Managed CPE** – the CPE is under CETIN management and the demarcation point is LAN Ethernet port of the CPE. The CPE is selected by the Partner from the list of the supported CPEs.
- c) **Unmanaged CPE with hardware maintenance** - the CPE is delivered and installed at the End point of CETIN network with a first basic configuration by CETIN. The CPE type is selected by the Partner from the list of the supported CPEs. The hardware maintenance is the responsibility of CETIN. The management of the CPE is responsibility of the Partner. When the failure is not hardware issue but it is wrong configuration caused by Partner then Partner is billed for Baseless service maintenance departure.

CETIN provides / 32 IP addresses for IP loopback exclusively for Managed CPE options In case of other variants the Partner shall provide WAN and loopback IP addresses.

#### 4 WHOLESALE CARRIER IP CONNECT SCHEME



#### 5 OPTIONAL SERVICES

- Back-up
- Quality of Service (QoS)
- Mutli-VRF

## 5.1 Back-up

The availability of Carrier IP Connect Wholesale service can be increased by a backup service – symmetrical or asymmetrical access line. The CPE is adjusted by CETIN within this optional service with an additional interface and configured to automatically establish a backup connection in even of a primary circuit failure. The Partner is responsible for back-up configuration in case of unmanaged or no CPE option.

## 5.2 Quality of Service (QoS)

The optional service QoS can be ordered with the Wholesale Carrier IP Connect service which enables Partner to define the usage of the capacity of the Individual Access service into individual service classes that is Class of Service. Each service class ensures the prioritization of the individual applications such as VoIP, SAP, email, Internet, etc.) in the Access and CETIN core network.

CETIN provides following 6 distinct Class of Service:

Class	IP Prec	DSCP values	Queuing	Policy
Network Control	6,7	CS6,7 (48-63)	LLQ	max 5%
Voice	5	EF,CS5 (40-47)	LLQ	max 50%
Platinum	4	AF4x,CS0 (32-39)	CBWFQ/W	
Gold	3	AF3x,CS3 (24-31)	CBWFQ/W	20%/100%
Silver	2	AF2x,CS2 (16-23)	CBWFQ/W	20%/100%
Best effort	0	0 (CS0; 0-7)	CBWFQ/W	10%/100%

Bandwidth setting rules for each CoS class:

- Capacity for each class must be entered in % the circuit capacity.
- Minimum capacity of each class is 5% of the circuit capacity.
- The maximum Voice CoS allocation is 50%.
- The maximum capacity for all classes is 95% (5% of circuit capacity is allocated for CETIN control operation).

Different QoS model can be provided individually.

## 5.3 Multi-VRF

The optional service Multi-VRF can be ordered with the Carrier IP Connect SPECI service which enables Partner to create multiple separate VPNs within one circuit which terminated at the Partner or Partner's Subscriber locality. The terms of this optional service are derived from the use of the CETIN Network access technology.



## 6 OPERATING PARAMETERS

### 6.1 Service speeds and recommended values of CPE configuration:

The service speeds up to 100 Mbps are defined in link layer (L2) and service speeds from 100 Mbps are defined on physical layer (L1). The L2 service speeds includes The Layer 2 speeds include the whole Ethernet frame including FCS without preamble and IFG. The layer 2 speeds are related to 1522B frame size, where  $L1=L2*(1542/1522)$ .

#### 6.1.1 Service speeds to 100 Mbps are defined on Link Layer (Layer 2):

Product speed	L2 speed	Product speed	L2 speed
512/128 Kbps*	320/160 Kbps 640/160 Kbps	10 Mbps	10240 Kbps
2048/256 Kbps*	1280/320 Kbps 2560/320 Kbps 3840/320 Kbps	12 Mbps	12288 Kbps
4096/512 Kbps*	5120/640 Kbps	14 Mbps	14336 Kbps
8192/512 Kbps*	10240/640 Kbps	16 Mbps	16384 Kbps
16/1 Mbps*	12/1 Mbps 14/1 Mbps 16/1 Mbps 18/1 Mbps	18 Mbps	18432 Kbps
24/2 Mbps*	20/2 Mbps 22/2 Mbps 24/2 Mbps 27/2 Mbps	20 Mbps	20480 Kbps
40/4 Mbps	40/4 Mbps	30 Mbps	30720 Kbps
2 Mbps	2048 Kbps	40 Mbps	40000 Kbps
4 Mbps	4096 Kbps	50 Mbps	48128 Kbps
6 Mbps	6144 Kbps	100 Mbps	96256 Kbps
8 Mbps	8192 Kbps		

\*the nominal Layer 2 speeds depends on copper cable attenuation

#### 6.1.2 Service speeds from 100 Mbps are defined on physical layer (Layer 1) and product speed corresponds to parameters of the physical layer:

Service speed	Speed L2
150 Mbps	148 Mbps
200 Mbps	197 Mbps
300 Mbps	296 Mbps
400 Mbps	395 Mbps
450 Mbps	445 Mbps
500 Mbps	493 Mbps
600 Mbps	593 Mbps
1 Gbps	987 Mbps
2 Gbps*	1973 Mbps

\*service speed 2 Gbps can be provided only 10GBASE-xx interfaces

## 6.2 Routing protocols

CETIN supports following routing protocols between PE and CPE:

- BGP
- Static

## 6.3 Other Service parameters

Other guaranteed parameters of Carrier IP Connect Service:

- The Packet loss  $\leq 0,01\%$  for the optical access and radio access and 0,1% for copper access.
- The Jitter = 5 ms (99% packets).
- The Round Trip Delay (RTD)  $< 20$  ms in case the End point of CETIN Network is located in the Czech Republic.
- Minimum guaranteed packet size is 64B, guaranteed maximum size is 1500B.

## 7 CHARGES

For the provision or modification of the Wholesale Carrier IP connect service Partner pays non recurring charge. For providing the Individual services the Partner pays recurring monthly charge. These charges are mandatory part of the Wholesale service order