WIK-Consult • Inputparameter NGN Modell

Studie für
die Rundfunk und Telekom Regulierungs-GmbH

# Inputparameter des analytischen Kostenmodells für das Breitbandnetz

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# Inputparameter Bottom-up Festnetzmodell

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# 1 Network Planning Module

## 1.1 SERVICE INPUT

In diesem Abschnitt werden für jede Dienstekategorie die Eigenschaften der Dienstekategorie anhand verschiedener Parameter (mittlere Bandbreite, mittlere Paketlänge etc.) definiert.

| Parameter | Type | Description | Base Value | Comments |
|---|---|---|---|---|
| K_total | Int | Number of Services (max. 12) | 11 | |
| | | **Traffic Class (1 to max number of services K_total)** | | |
| Serv_Classk | Int | Mean EndToEnd delay in [ms] (MPoP to core) for traffic class 1 | 37 | Werte nur für einen Zweig des Netzes |
| Serv_Classk | Int | Mean EndToEnd delay in [ms] (MPoP to core) for traffic class 2 | 123 | Werte nur für einen Zweig des Netzes |
| Serv_Classk | Int | Mean EndToEnd delay in [ms] (MPoP to core) for traffic class 3 | 184 | Werte nur für einen Zweig des Netzes |
| Serv_Classk | Int | Mean EndToEnd delay in [ms] (MPoP to core) for traffic class 4 | 307 | Werte nur für einen Zweig des Netzes |

| Serv_Index | Int | Service Index Voice | k=1 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Voice_services** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k (Kbps) | 95,2 | |
| Buk | Double | Mean value of the upstream bandwidth for service k (Kbps) | 95,2 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 238 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 238 | |
| Tk | Double | Mean duration of the service k [min.] | 3 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K_total) | 1 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k (Anteil) | 0,35 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0,42 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0,23 | |
| VoIPICk_in | Double | Incoming traffic distribution to VoIP IC: | | |
| VoIPICk_out | Double | Outgoing traffic distribution to VoIP IC: | | |
| rttrk | Double | Ratio of transit traffic with respect to the total IC traffic: | 0,76 | |
| | | Summe (muss immer 1 abzgl. transit sein) | 1 | |

| Serv_Index | Int | Service Index layer 1 capacity | k=2 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Layer_1_leased_lines** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k (Kbps) | 64 | |
| Buk | Double | Mean value of the upstream bandwidth for service k (Kbps) | 64 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 328 | Parameter nur für Dienste oberhalb Layer 1 relevant. |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 328 | Parameter nur für Dienste oberhalb Layer 1 relevant. |
| Tk | Double | Mean duration of the service k | 60 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 2 | Parameter nur für Dienste oberhalb Layer 1 relevant. |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0,10 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0,12 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0,78 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index (e.g. Premium Business) | k=3 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Premium_Business** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 524,80 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 524,80 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 328 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 328 | |
| Tk | Double | Mean duration of the service k | 60 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 3 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 2 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0,10 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0,12 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0,78 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=4 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Conference_services** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 421,90 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 421,90 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 440 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 440 | |
| Tk | Double | Mean duration of the service k | 30 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 1 | |
| Ndestk | Int | Mean number of destinations for service k | 3 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 2 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0,80 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0,20 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=5 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **VoD** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 2949,30 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 25,60 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 512 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 206 | |
| Tk | Double | Mean duration of the service k | 75 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 1 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 3 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0,6 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0,4 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=6 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Business_Data** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 429,41 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 207,69 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 512 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 256 | |
| Tk | Double | Mean duration of the service k | 1 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 3 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0,2 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0,1 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0,7 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=7 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Best_effort** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 193 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 4 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 512 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 256 | |
| Tk | Double | Mean duration of the service k | 30 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 1 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 4 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0,1 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0,9 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=8 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **PeerToPeer** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 344,4 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 344,4 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 512 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 512 | |
| Tk | Double | Mean duration of the service k | 120 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 4 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 4 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0,25 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0,75 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=9 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **Layer_2_leased_lines** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k | 64 | |
| Buk | Double | Mean value of the upstream bandwidth for service k | 64 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 328 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 328 | |
| Tk | Double | Mean duration of the service k | 60 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 2 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0,1 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0,12 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0,78 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| | | Summe (muss immer 1 sein) | 1 | |

| Serv_Index | Int | Service Index | k=10 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **IPTV** | |
| | Float | Average bandwidth per channel (Mbit/s) | 4.133 | |
| | Int | Maximum number of channels offered | 162 | |
| Bdk | Double | Mean value of the downstream bandwidth for service k (Kbps) | 669600 | Ergibt sich aus Average bandwidth per channel multipliziert mit Maximum number of channels offered |
| Buk | Double | Mean value of the upstream bandwidth for service k (Kbps) | 0,1 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 512 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 50 | |
| Tk | Double | Mean duration of the service k [min.] | 60 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 1 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K) | 3 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k | 0 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| IPTV_servk | Double | Traffic distribution to IP-TV Server for service k | 1 | |

| | | | | |
|---|---|---|---|---|
| | | **Parallel TV channel demand**<br>Describes the probability that many users watch the same TV channels (relevant for dynamic multicast) | | |
| nsteps | Int | Number of steps of the function | 11 | |
| One line for each step: | | | | |
| x | float | user traffic (Erlang) (Aggregated user traffic at a network element) | | |
| y | float | network traffic (Erlang) (Transformation of user traffic to network traffic under consideration that IPTV is a multicast service ) | | |
| x | float | user traffic (Erlang) | 0 | |
| y | float | network traffic (Erlang) | 0 | |
| x | float | user traffic (Erlang) | 100 | |
| y | float | network traffic (Erlang) | 0,04 | |
| x | float | user traffic (Erlang) | 250 | |
| y | float | network traffic (Erlang) | 0,08 | |
| x | float | user traffic (Erlang) | 500 | |
| y | float | network traffic (Erlang) | 0,25 | |
| x | float | user traffic (Erlang) | 1000 | |
| y | float | network traffic (Erlang) | 0,5 | |
| x | float | user traffic (Erlang) | 2500 | |
| y | float | network traffic (Erlang) | 0,75 | |
| x | float | user traffic (Erlang) | 5000 | |
| y | float | network traffic (Erlang) | 0,85 | |
| x | float | user traffic (Erlang) | 10000 | |
| y | float | network traffic (Erlang) | 0,9 | |
| x | float | user traffic (Erlang) | 25000 | |
| y | float | network traffic (Erlang) | 0,94 | |
| x | float | user traffic (Erlang) | 50000 | |
| y | float | network traffic (Erlang) | 0,97 | |
| x | float | user traffic (Erlang) | 100000 | |
| y | float | network traffic (Erlang) | 1 | |

| Serv_Index | Int | Service Index Voice | k=11 | Comments |
|---|---|---|---|---|
| Serv_name | String | Service ID/name | **VoIP** | |
| Bdk | Double | Mean value of the downstream bandwidth for service k (Kbps) | 95,2 | |
| Buk | Double | Mean value of the upstream bandwidth for service k (Kbps) | 95,2 | |
| Ldk | Int | Mean packet length for downstream packets for service k (Byte) | 238 | |
| Luk | Int | Mean packet length for upstream packets for service k (Byte) | 238 | |
| Tk | Double | Mean duration of the service k [min.] | 3 | |
| Dcak | Int | Distribution characteristics (0=PointToPoint/Multipoint; 1=PointToServer | 0 | |
| Ndestk | Int | Mean number of destinations for service k | 1 | |
| Serv_Classk | Int | Traffic Class (1 to max number of services K_total) | 1 | |
| | | **Routing characteristics** | | |
| Euintrac01k | Double | Traffic distribution to e-u intracluster 0-1 for service k | 0 | |
| Euintrac12k | Double | Traffic distribution to e-u intracluster 1-2 for service k | 0 | |
| EutoIPPOPk | Double | Traffic distribution to e-u to IP POP for service k (Anteil) | 0,35 | |
| ON_line_servk | Double | Traffic distribution to ON-line Server for service k | 0 | |
| Video_servk | Double | Traffic distribution to Video Server for service k | 0 | |
| Conf_servk | Double | Traffic distribution to Conference Server for service k | 0 | |
| IPICk | Double | Traffic distribution to IP-IC for service k | 0 | |
| VoiceICk_in | Double | Ingoing Traffic distribution to Voice IC for service k | 0 | |
| VoiceICk_out | Double | Outgoing Traffic distribution to Voice IC for service k | 0 | |
| VoIPICk_in | Double | Incoming traffic distribution to VoIP IC: | 0,42 | |
| VoIPICk_out | Double | Outgoing traffic distribution to VoIP IC: | 0,23 | |
| rttrk | Double | Ratio of transit traffic with respect to the total IC traffic: | 0,76 | |
| | | Summe (muss immer 1 abzgl. transit sein) | 1 | |

## 1.2 TRAFFIC DEMAND

In diesem Abschnitt wird je Produktgruppe der Verkehr den ein Nutzertyp je Dienstekategorie generiert definiert.

| Parameter | Type | Description | Base Value |
|---|---|---|---|
| Data_type | Int | Type of Input Data (0=traffic (in Erlang) 1= call rate) | 0 |
| T | Int | Number of user types (max 6) | 6 |
| K | Int | Number of service types (max 12) | 11 |
| F | Int | Number of access technologies (max 6) | 4 |
| votonetcofa | Float | Voice traffic in voice Busy Hour relative to voice traffic in network traffic Busy Hour | 1,1 |

**Overview:**

6x6 matrix (product groups x user types) = Maximum of 36 access line profiles

each profile with up to 12 service types to be specified by BH Erlang (network traffic), Traffic values are based on network traffic Busy Hour

Erlang value is specified for each service (see below)

| Service Type | Produktgruppe "Voice and Broadband" | | | | | | Comments |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | ISPA PK | SOHO | MLE | ISPA GK | |
| BH Erlang | | | | | | | |
| Voice_services | 0,01 | 0,18 | - | 0,21 | 1,01 | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | 0,01 | 0,08 | 0,01 | |
| Conference_services | - | - | - | 0,00 | 0,00 | 0,00 | |
| VoD | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | |
| Business_data | - | - | - | 0,03 | 0,05 | 0,03 | |
| Best_effort | 0,40 | 0,40 | 0,48 | 0,33 | 0,66 | 0,36 | |
| PeerToPeer | 0,02 | 0,03 | 0,04 | 0,01 | 0,02 | 0,01 | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | 1,25 | 17,10 | - | 20,05 | 96,33 | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | 3,61 | 43,28 | 7,57 | |
| Conference_services | - | - | - | 0,84 | 1,69 | 0,93 | |
| VoD | 14,75 | 22,12 | 40,55 | 30,97 | 30,97 | 30,97 | |
| Business_data | - | - | - | 11,81 | 23,61 | 12,99 | |
| Best_effort | 76,66 | 76,66 | 91,99 | 63,34 | 126,69 | 69,68 | |
| PeerToPeer | 6,94 | 11,00 | 12,31 | 3,27 | 6,54 | 3,60 | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| Summe | 99,60 | 126,87 | 144,86 | 133,89 | 329,11 | 125,73 | |

| **Service Type** | **Produktgruppe "Broadband"** | | | | | | **Comments** |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | ISPA PK | SOHO | MLE | ISPA GK | |
| BH Erlang | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | 0,06 | 0,74 | 0,13 | |
| Conference_services | - | - | - | 0,01 | 0,01 | 0,01 | |
| VoD | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | |
| Business_data | - | - | - | 0,25 | 0,49 | 0,27 | |
| Best_effort | 0,40 | 0,40 | 0,48 | - | - | - | |
| PeerToPeer | 0,02 | 0,03 | 0,04 | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | 32,45 | 389,45 | 68,15 | |
| Conference_services | - | - | - | 2,53 | 5,06 | 2,78 | |
| VoD | 14,75 | 22,12 | 40,55 | 30,97 | 30,97 | 30,97 | |
| Business_data | - | - | - | 106,22 | 212,44 | 116,84 | |
| Best_effort | 76,66 | 76,66 | 91,99 | - | - | - | |
| PeerToPeer | 6,94 | 11,00 | 12,31 | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| Summe | 98,35 | 109,77 | 144,86 | 172,17 | 637,92 | 218,75 | |

| Service Type | Produktgruppe "Voice" | | | | | | Comments |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | L1 LL | SOHO | MLE | L2 LL | |
| BH Erlang | | | | | | | |
| Voice_services | 0,01 | 0,18 | - | 0,21 | 1,01 | - | |
| Layer_1_leased_lines | - | - | 2,00 | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | - | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | 2,00 | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | 1,25 | 17,10 | - | 20,05 | 96,33 | - | |
| Layer_1_leased_lines | - | - | 128,00 | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | 0,00 | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | 128,00 | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| Summe | 1,25 | 17,10 | 128,00 | 20,05 | 96,33 | 128,00 | |

| **Service Type** | | | | | | | **Comments** |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | ISPA PK | SOHO | MLE | ISPA GK | |
| BH Erlang | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | - | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | | | | | | | |
| Layer_1_leased_lines | | | | | | | |
| Premium_business | | | | | | | |
| Conference_services | | | | | | | |
| VoD | | | | | | | |
| Business_data | | | | | | | |
| Best_effort | | | | | | | |
| PeerToPeer | | | | | | | |
| Layer_2_leased_lines | | | | | | | |
| IPTV | | | | | | | |
| VOIP | | | | | | | |
| Summe | | | | | | | |

| **Service Type** | | | | | | | **Comments** |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | ISPA PK | SOHO | MLE | ISPA GK | |
| BH Erlang | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | - | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | | | | | | | |
| Layer_1_leased_lines | | | | | | | |
| Premium_business | | | | | | | |
| Conference_services | | | | | | | |
| VoD | | | | | | | |
| Business_data | | | | | | | |
| Best_effort | | | | | | | |
| PeerToPeer | | | | | | | |
| Layer_2_leased_lines | | | | | | | |
| IPTV | | | | | | | |
| VOIP | | | | | | | |
| Summe | | | | | | | |

| **Service Type** | **IPTV** | | | | | | **Comments** |
|---|---|---|---|---|---|---|---|
| Name | Traditional | Premium | IPTV | SOHO | MLE | IPTV | |
| BH Erlang | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | - | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | 0,05 | - | - | 0,05 | Probability that a user uses the IPTV service in the overall BH |
| VOIP | - | - | - | - | - | - | |
| BH kbit/s downstream | | | | | | | |
| Voice_services | - | - | - | - | - | - | |
| Layer_1_leased_lines | - | - | - | - | - | - | |
| Premium_business | - | - | - | - | - | - | |
| Conference_services | - | - | - | - | - | 0,00 | |
| VoD | - | - | - | - | - | - | |
| Business_data | - | - | - | - | - | - | |
| Best_effort | - | - | - | - | - | - | |
| PeerToPeer | - | - | - | - | - | - | |
| Layer_2_leased_lines | - | - | - | - | - | - | |
| IPTV | - | - | - | - | - | - | IPTV Bandbreiten sind Netzebenen spezifisch und nicht als Werte je Kunde angebbar |
| VOIP | - | - | - | - | - | - | |
| Summe | - | - | - | - | - | 0,00 | |

## 1.3 NETWORK DESIGN

In diesem Abschnitt wird das Netz Design anhand von Parametern festgelegt.

### 1.3.1 Scenario Parameters

| Parameter | Type | Description | Base Value | Comments |
|---|---|---|---|---|
| N_conc_levels | int | Number of Concentration Network Levels (2 or 3) | 3 | |
| N_core_levels | int | Number of Core Network Levels (2 or 3) | 2 | |
| Real_distances | int | 0=Craw flight distance; 1=Street distance | 1 | |
| RingMesh | int | Topology at the top core level (0=Ring; 1=Mesh) see also section 1.3.3 | 1 | |

### 1.3.2 Locations, IC, Design and Protection

| Parameter | Type | Description | Base Value | Comments |
|---|---|---|---|---|
| nonlserv | int | Number of On-line Server locations | 2 | |
| nvserv | int | Number of Video Server locations | 2 | |
| nconfserv | int | Number of Conference Server locations | 2 | |
| nipic | int | Number of IP interconnection point locations | 2 | |
| nvoic | int | Number of voice interconnection point locations | 2 | |
| Pb | float | Blocking probability (of Media Gateway (MGW)) | 0,01 | |
| neth | int | Use predefined network (0=no; 1=yes) | 0 | |
| niptvserv | int | Number of IP TV server locations | 2 | |
| nvoipic | int | Number of VoIP interconnection point locations | 2 | |
| BHvBUF | float | Voice traffic in Voice BH relative to voice traffic in network BH | 1,1 | |
| NopICvoice | int | Average number of operators at voice IC point | 21 | |
| Maxce1 | int | Maximum number of circuits per E1 group (of MGW) | 28 | Bei diesem Parameter wirkt der Global Mark-up Faktor nicht. Der angegebene Wert muss daher Planungsreserven (wochen- und jahreszeitliche Schwankungen, …) berücksichtigen. |
| rlin | float | Ratio of local incoming voice traffic | 1,000 | Summe aus local, single und double ergibt 1. Incoming Local: Verkehrsübergabe an dem B-Teilnehmer nächst gelegenen Interconnectionpunkt. Bei einem flachen Kernnetz wird unterstellt, dass der Verkehr von allen Standorten mit IC Einrichtungen (gewichtet mit dem Sprachverkehr) auf den IP POP des B-Teilnehmers ohne IC-Funktionalität geroutet und beim B-Teilnehmer terminiert wird. |

| | | | | |
|---|---|---|---|---|
| rsin | float | Ratio of single tandem incoming voice traffic | 0,000 | Summe aus local, single und double ergibt 1. Incoming Single: Verkehrsübergabe erfolgt am nächst gelegenen Interconnectionpunkt und vollzieht einen Sprung (Hop) im Kernnetz, bevor der Verkehr den IP-PoP durchläuft. Bei einem flachen Kernnetz oder sofern der IP-PoP des B-Teilnehmers keine IC-Funktionalität aufweist, wird unterstellt, dass der Verkehr von allen Standorten mit IC Einrichtungen (gewichtet mit dem Sprachverkehr) auf den IP POP des B-Teilnehmers geroutet und beim B-Teilnehmer terminiert wird. |
| rdin | float | Ratio of double tandem incoming voice traffic | 0,000 | Summe aus local, single und double ergibt 1. Incoming Double: Verkehrsübergabe an dem B-Teilnehmer nächst gelegenen Interconnectionpunkt wobei der Verkehr zwei Hops im Kernnetz vollzieht. Ist der erste Hop auf der obersten Kernnetzebene, so gilt die Annahme, dass der Verkehr auf allen Level 5 IC-Standorten entsteht (anteilig, nach Verkehrsgewicht über die Standorte verteilt) und zu dem IP-PoP des B-Teilnehmers geroutet und im entsprechenden Konzentrationsnetz terminiert wird. Bei einem flachen Kernnetz ist Double IC Verkehr nicht zu parametrisieren. |
| rlout | float | Ratio of local outgoing voice traffic | 1,000 | Summe aus local, single und double ergibt 1. Local: Verkehrsübergabe am nächst gelegenen Interconnectionpunkt. Bei einem flachen Kernnetz wird der Verkehr an einem IP POP ohne IC-Funktionalität auf alle Standorte mit IC Einrichtungen gewichtet verteilt. |
| rsout | float | Ratio of single tandem outgoing voice traffic | 0,000 | Summe aus local, single und double ergibt 1. Single: Verkehrsübergabe am nächst gelegenen Interconnectionpunkt nach einem Sprung (Hop) im Kernnetz. Bei einem flachen Kernnetz wird der Verkehr an einem IP POP ohne IC-Funktionalität auf alle Standorte mit IC Einrichtungen gewichtet verteilt. |

| | | | | |
|---|---|---|---|---|
| rdout | float | Ratio of double tandem outgoing voice traffic | 0,000 | Summe aus local, single und double ergibt 1. Double: Verkehrsübergabe am nächst gelegenen Interconnectionpunkt nach zwei Hops im Kernnetz. Verkehr auf Level 5 Standorten wird über alle anderen Level 5 Standorte mit IC-Funktionalität gewichtet verteilt. Bei einem flachen Kernnetz ist Double IC Verkehr nicht zu parametrisieren. |
| nbsE0 | int | Number of locations with level 0 bitstream Ethernet interconnection points | 1467 | |
| nbsE1 | int | Number of locations with level 1 bitstream Ethernet interconnection points | 44 | Sofern es auf Level 1 Bitstromzusammenschaltung gibt. Die Anzahl der Zusammenschaltungsstandorte muss programmtechnisch immer gleich der Anzahl der Standorte auf Level 1 sein. |
| nbsE2 | int | Number of locations with level 2 bitstream Ethernet interconnection points | 2 | Sofern es auf Level 2 Bitstromzusammenschaltung gibt. Die Anzahl der Zusammenschaltungsstandorte muss programmtechnisch immer gleich der Anzahl der Standorte auf Level 2 sein. |
| nbsE3 | int | Number of locations with level 3 bitstream IP interconnection points | 2 | Sofern es auf Level 3 Bitstromzusammenschaltung gibt. Die Anzahl der Zusammenschaltungsstandorte muss programmtechnisch immer gleich der Anzahl der Standorte auf Level 3 sein. |
| nbsE4 | int | Number of locations with level 4 bitstream IP interconnection points | 0 | Sofern es auf Level 4 Bitstromzusammenschaltung gibt. Die Anzahl der Zusammenschaltungsstandorte muss programmtechnisch immer gleich der Anzahl der Standorte auf Level 4 sein. |
| nbsE5 | int | Number of locations with level 5 bitstream IP interconnection points | 2 | Sofern es auf Level 4 Bitstromzusammenschaltung gibt. Die Anzahl der Zusammenschaltungsstandorte muss programmtechnisch immer gleich der Anzahl der Standorte auf Level 4 sein. |
| | float | Share of Bitstream traffic handed over at Level 3 | 80% | |
| | float | Share of Bitstream traffic handed over at Level 5 | 20% | |

| | | **Netzebene Level 1 (L1)** | **Base Value** | **Comments** |
|---|---|---|---|---|
| nloc(1) | int | Number of locations at level i = 1 | 44 | |
| dmin(1) | float | Minimum distance between level i locations (km) | 33,8 | |
| maxnod(1) | int | Maximum number of level (i-1) locations assigned to a level i location (per ring) | 18 | |
| gmuf(1) | float | Global mark-up factor (Corresponds to 80% max. utilisation ratio) | 1,25 | |
| dasig(1) | int | Double assignation: [0: level (i-1) locations assigned to one level i location / 1: level (i-1) locations assigned to two level i locations] | 0 | |
| prot(1) | int | Protection (in case of double assignation): [0: 50% protection / 1: 100% protection] | 0 | |
| bwtc(1) | float | Bandwidth threshold for direct links between location of level (i-1) (in Kbit/s) | 10.000.000 | |
| ringprot(1) | int | Ring protection: [0: 50% bandwidth protection / 1: 100% bandwidth protection] | 0 | |
| trenchopt(1) | int | Trench optimisation: [0: not applied / 1: applied] | 1 | |

| | | | | |
|---|---|---|---|---|
| intrath1(1) | float | Intracluster threshold for relative new trench distance | 1,2 | Minimum gain by optimizing trenches (minimum threshold) |
| intrath2(1) | float | Intracluster threshold for relative distance increment | 3 | Maximum length increment caused by combining trenches (upper threshold) |
| interth1(1) | float | Intercluster threshold for relative new trench distance | 1,1 | Minimum gain by optimizing trenches (minimum threshold) |
| interth2(1) | float | Intercluster threshold for relative distance increment | 10 | Maximum length increment caused by combining trenches (upper threshold) |

| **Netzebene Level 2 (L2)** | | | | **Comments** |
|---|---|---|---|---|
| nloc(2) | int | Number of locations at level i | 2 | |
| dmin(2) | float | Minimum distance between level i locations | 35 | |
| maxnod(2) | int | Maximum number of level (i-1) locations assigned to a level i location (per ring) | 16 | |
| gmuf(2) | float | Global mark-up factor (Corresponds to 80% max. utilisation ratio) | 1,25 | |
| dasig(2) | int | Double assignation: [0: level (i-1) locations assigned to one level i location / 1: level (i-1) locations assigned to two level i location] | 1 | |
| prot(2) | int | Protection (in case of double assignation): [0: 50% protection / 1: 100% protection] | 1 | |
| bwtc(2) | float | Bandwidth threshold for direct links between location of level (i-1) (in Kbit/s) | 10.000.000 | |
| ringprot(2) | int | Ring protection: [0: 50% bandwidth protection / 1: 100% bandwidth protection] | 1 | |
| trenchopt(2) | int | Trench optimisation: [0: not applied / 1: applied] | 1 | |
| intrath1(2) | float | Intracluster threshold for relative new trench distance | 1,2 | Minimum gain by optimizing trenches (minimum threshold) |
| intrath2(2) | float | Intracluster threshold for relative distance increment | 3 | Maximum length increment caused by combining trenches (upper threshold) |
| interth1(2) | float | Intercluster threshold for relative new trench distance | 1,1 | Minimum gain by optimizing trenches (minimum threshold) |
| interth2(2) | float | Intercluster threshold for relative distance increment | 10 | Maximum length increment caused by combining trenches (upper threshold) |

| **Netzebene Level 3 (L3)** | | | **Base Value** | **Comments** |
|---|---|---|---|---|
| nloc(3) | int | Number of locations at level i | 2 | |
| dmin(3) | float | Minimum distance between level i locations | 1 | Parameter auf Level 3 nicht relevant |
| maxnod(3) | int | Maximum number of level (i-1) locations assigned to a level i location (per ring) | 1 | Parameter auf Level 3 nicht relevant |
| gmuf(3) | float | Global mark-up factor (Corresponds to 80% max. utilisation ratio) | 1,25 | |
| dasig(3) | int | Double assignation: [0: level (i-1) locations assigned to one level i location / 1: level (i-1) locations assigned to two level i location] | 1 | Parameter auf Level 3 nicht relevant |
| prot(3) | int | Protection (in case of double assignation): [0: 50% protection / 1: 100% protection] | 1 | Parameter auf Level 3 nicht relevant |
| bwtc(3) | float | Bandwidth threshold for direct links between location of level (i-1) (in Kbit/s) | 10.000.000 | Parameter auf Level 3 nicht relevant |
| ringprot(3) | int | Ring protection: [0: 50% bandwidth protection / 1: 100% bandwidth protection] | 0 | |
| trenchopt(3) | int | Trench optimisation: [0: not applied / 1: applied] | 1 | |
| intrath1(3) | float | Intracluster threshold for relative new trench distance | 1,2 | Minimum gain by optimizing trenches (minimum threshold) |

| | | | | |
|---|---|---|---|---|
| intrath2(3) | float | Intracluster threshold for relative distance increment | 3 | Maximum length increment caused by combining trenches (upper threshold) |
| interth1(3) | float | Intercluster threshold for relative new trench distance | 1,1 | Minimum gain by optimizing trenches (minimum threshold) |
| interth2(3) | float | Intercluster threshold for relative distance increment | 10 | Maximum length increment caused by combining trenches (upper threshold) |

| **Netzebene Level 4 (L4)** | | | **Base Value** | **Comments** |
|---|---|---|---|---|
| nloc(4) | int | Number of locations at level i | 0 | |
| dmin(4) | float | Minimum distance between level i locations | 0 | |
| maxnod(4) | int | Maximum number of level (i-1) locations assigned to a level i location (per ring) | 0 | |
| gmuf(4) | float | Global mark-up factor (Corresponds to 80% max. utilisation ratio) | 1,25 | |
| dasig(4) | int | Double assignation: [0: level (i-1) locations assigned to one level i location / 1: level (i-1) locations assigned to two level i location] | 1 | |
| prot(4) | int | Protection (in case of double assignation): [0: 50% protection / 1: 100% protection] | 1 | |
| bwtc(4) | float | Bandwidth threshold for direct links between location of level (i-1) (in Kbit/s) | 0 | Parameter auf Level 4 nicht relevant. Es gibt keine Direct Links zwischen Level 3 Standorten |
| ringprot(4) | int | Ring protection: [0: 50% bandwidth protection / 1: 100% bandwidth protection] | 0 | |
| trenchopt(4) | int | Trench optimisation: [0: not applied / 1: applied] | 1 | |
| intrath1(4) | float | Intracluster threshold for relative new trench distance | 1,2 | Minimum gain by optimizing trenches (minimum threshold) |
| intrath2(4) | float | Intracluster threshold for relative distance increment | 3 | Maximum length increment caused by combining trenches (upper threshold) |
| interth1(4) | float | Intercluster threshold for relative new trench distance | 1,1 | Minimum gain by optimizing trenches (minimum threshold) |
| interth2(4) | float | Intercluster threshold for relative distance increment | 10 | Maximum length increment caused by combining trenches (upper threshold) |

| **Netzebene Level 5 (L5)** | | | **Base Value** | **Comments** |
|---|---|---|---|---|
| nloc(5) | int | Number of locations at level i | 2 | |
| dmin(5) | float | Minimum distance between level i locations | 0 | D.h. der Mindestabstand auf Level 5 ist durch den Mindestabstand der darunterliegenden Ebenen bestimmt |
| maxnod(5) | int | Maximum number of level (i-1) locations assigned to a level i location (per ring) | 8 | Im Falle eines 1-Ebenen IP-Kernnetz nicht relevant |
| gmuf(5) | float | Global mark-up factor (Corresponds to 80% max. utilisation ratio) | 1,25 | |
| dasig(5) | int | Double assignation: [0: level (i-1) locations assigned to one level i location / 1: level (i-1) locations assigned to two level i location] | 1 | |
| prot(5) | int | Protection (in case of double assignation): [0: 50% protection / 1: 100% protection] | 1 | |
| bwtc(5) | float | Bandwidth threshold for direct links between location of level (i-1) (in Kbit/s) | 0 | Parameter auf Level 5 nicht relevant. Es gibt keine Direct Links zwischen Level 4 Standorten |
| ringprot(4) | int | Ring protection: [0: 50% bandwidth protection / 1: 100% bandwidth protection] | 0 | Nicht relevant bei Core Optimisation (s. Abschnitt 1.3.3) |

| | | | | |
|---|---|---|---|---|
| trenchopt(5) | int | Trench optimisation: [0: not applied / 1: applied] | 1 | |
| intrath1(5) | float | Intracluster threshold for relative new trench distance | 1,2 | Minimum gain by optimizing trenches (minimum threshold); intra cluster optimisation not relevant at level 5 |
| intrath2(5) | float | Intracluster threshold for relative distance increment | 3 | Maximum length increment caused by combining trenches (upper threshold); intra cluster optimisation not relevant at level 5 |
| interth1(5) | float | Intercluster threshold for relative new trench distance | 1,1 | Minimum gain by optimizing trenches (minimum threshold) |
| interth2(5) | float | Intercluster threshold for relative distance increment | 10 | Maximum length increment caused by combining trenches (upper threshold) |

### 1.3.3 Core Optimisation

| Parameter | Type/Range | Description | Base Value | Comments |
|---|---|---|---|---|
| Protection | int/1-2 | Protection in flat core network (1=50%; 2=100%) | 2 | |
| Optimised | int/0-1 | Meshed network Optimisation (0=full meshed; 1=optimised, optimisation under the restriction of the next four parameters) | 1 | |
| np | int/2-3 | Number of available multipath | 2 | |
| Min_deg | int/>np | Minimum degree (Minimum number of links from or to L5 node) | 3 | |
| Max_diam | int/>2 | Maximum diameter (Maximum number of nodes between two L5 nodes) | 9 | |
| alfa | float/0-1 | Distance/traffic ponderation factor (0 = Elimination of links based on distance / 1 = Elimination based on traffic) | 0 | |

## 1.4 SYSTEM ASSIGNMENT

Abschnitt 1.4 beinhaltet die Parameter mit denen die Netzelemente bzw. Systeme (Carrier Ethernet Switch, Label Edge Router, Label Switch Router etc.), die bei der Bottom-up Modellierung verwendet werden, festgelegt werden. Abschnitt 1.4 beinhaltet Parameter bzgl. Redundanz und Layer 1 Technologie.

### 1.4.1 Redundancy and Layer 1 Technology

| Value | Type | Range | Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Level of equipment (0 to 5): | | | | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Lx_pf | int | 1-2 | Logical protection.Logical network elements (e.g. Ethernet switch, router) are either duplicated (=2) or not (=1). | 1 | 1 | 2 | 2 | 2 | 2 |
| For each Level of rings (0-1 to 5-5): | | | | Level 0-1 | Level 1-2 | Level 3-4 | Level 4-5 | Level 5-5 | |
| Px_pf | int | 1-2 | Physical protection. Physical network element (e.g. OADM) are either duplicated (=2) or not (=1). | 1 | 1 | 2 | 2 | 2 | |
| Tech_xy | int | 0-3 | applied technology physical layer (0= NG SDH (ADM/OADM); 1= NG SDH (OADM); 2=ROADM-OTN; 3=ROADM-ETH (C/DWDM); 4 = Layer 1 elimination common ring option; 5 = Layer 1 elimination individual ring option) | 0 | 0 | 3 | 3 | 3 | |

### 1.4.2 Logical System Assignment

| Parameter | Type | Range | Description | Base Value |
|---|---|---|---|---|
| For each Level of equipment (0 to 5): | | | | |
| Lx | int | 0-5 | Level of the equipment | |
| Rack_PIU_nmax | int | | Maximum number of plug-in units per rack | Siehe Tabelle unten |
| npluginunits | int | | Number of available plug-in units | Siehe Tabelle unten |
| nporttypes | int | | Number of available types of ports | Siehe Tabelle unten |
| For each available Plug-In unit: | | | | |
| Lx_BW_PIU_j | float | | Bandwidth of plug-in unit (e.g. Ethernet-switch) of type j (in Gbps) | Siehe Tabelle unten |
| Lx_PIU_j_nLC | int | | Maximum number of slots for linecards per plug-in unit type j | Siehe Tabelle unten |
| For each available type of port: | | | | |
| Lx_BW_PIU_port_i | float | | Bandwidth in Gbps per port of type i | Siehe Tabelle unten |
| Lx_PIU_port_i_LCnport | int | | Maximum number of ports per linecard i | Siehe Tabelle unten |

### 1.4.2.1 Logical System Assignment - Layer 2 Carrier Ethernet Equipment

In diesem Abschnitt werden die Carier Ethernet Switche, die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Description** | **Plug-in-Unit (PIU)(e.g. Ethernet Switch)** | | | | | |
|---|---|---|---|---|---|---|
| | **PIU-1** | **PIU-1a** | **PIU-2** | **PIU-3** | **PIU-4** | |
| **Plug-in-Unit (PIU)** | | | | | | |
| Bandwidth of plug-in unit (e.g. Ethernet-switch) of type j (in Gbps) | 30 | 90 | 180 | 450 | 1300 | |
| Number of linecard slots | 10 | 10 | 16 | 20 | 20 | |
| **Line Cards** | | | | | | |
| **Port type** | **E/FE** | **E/FE** | **E/FE** | **E/FE** | **E/FE** | |
| Bandwidth port (in Gbps) | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | |
| Number of ports | 4 | 4 | 4 | 4 | 4 | |
| Number of ports | 16 | 16 | 16 | 16 | 16 | |
| Number of ports | 40 | 40 | 40 | 40 | 40 | |
| **Port type** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | **Repeater** |
| Bandwidth port (in Gbps) | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of ports | 2 | 2 | 2 | 2 | 2 | |
| Number of ports | 10 | 10 | 10 | 10 | 10 | |
| Number of ports | 40 | 40 | 40 | 40 | 40 | |
| **Port type** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** | **Repeater** |
| Bandwidth port (in Gbps) | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of ports | 1 | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | 2 | |
| Number of ports | 4 | 4 | 4 | 4 | 4 | |
| Number of ports | 16 | 16 | 16 | 16 | 16 | |
| **Port type** | **40GE** | **40GE** | **40GE** | **40GE** | **40GE** | **Repeater** |
| Bandwidth port (in Gbps) | | | | 40 | 40 | 40 |
| Number of ports | | | | 1 | 1 | |
| **Port type** | **100GE** | **100GE** | **100GE** | **100GE** | **100GE** | **Repeater** |
| Bandwidth port (in Gbps) | | | | | 100 | 100 |
| Number of ports | | | | | 1 | |
| **Rack** | | | | | | |
| Max. number of plug-in units/rack | 3 | 3 | 3 | 2 | 1 | |

### 1.4.2.2 Logical System Assignment - Layer 3 Label Edge Router

In diesem Abschnitt werden die Label Edge Router, die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Description** | **Plug-in-Unit (PIU) bzw. Label Edge Router**<br>**PIU-1** | **PIU-2** |
|---|---|---|
| **Plug-in-Unit (PIU)** | | |
| Bandwidth of the plug-in unit (in Gbps) | 400 | 900 |
| Number of linecard slots | 12 | 12 |
| **Line Cards for optical interfaces for inhouse fibre and Fibre/ C-/DWDM transport layer** | | |
| **Port type** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 |
| Number of ports | 8 | 8 |
| Number of ports | 20 | 20 |
| Number of ports | 48 | 48 |
| **Port type** | **10GE** | **10GE** |
| Bandwidth port (in Gbps) | 10 | 10 |
| Number of ports | 1 | 1 |
| Number of ports | 4 | 4 |
| Number of ports | 10 | 10 |
| **Port type** | **40GE** | **40GE** |
| Bandwidth port (in Gbps) | 40 | 40 |
| Number of ports | 1 | 1 |
| Number of ports | 4 | 4 |
| Number of ports | 8 | 8 |
| **Port type** | **100GE** | **100GE** |
| Bandwidth port (in Gbps) | 100 | 100 |
| Number of ports | 1 | 1 |
| Number of ports | 4 | 4 |
| **Line Cards for optical interfaces for OTN transport layer** | | |
| **Port type** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 |
| Number of ports | 2 | 2 |
| Number of ports | 10 | 10 |
| Number of ports | 40 | 40 |
| **Port type** | **10GE** | **10GE** |
| Bandwidth port (in Gbps) | 10 | 10 |
| Number of ports | 1 | 1 |
| Number of ports | 2 | 2 |
| Number of ports | 4 | 4 |
| **Port type** | **40GE** | **40GE** |
| Bandwidth port (in Gbps) | 40 | 40 |
| Number of ports | 1 | 1 |
| Number of ports | 4 | 4 |
| Number of ports | 8 | 8 |
| **Port type** | **100GE** | **100GE** |
| Bandwidth port (in Gbps) | 100 | 100 |
| Number of ports | 1 | 1 |
| Number of ports | 4 | 4 |
| **Rack** | | |
| Max. number of plug-in units/rack | 2 | 2 |

### 1.4.2.3 Logical System Assignment - Layer 3 Label Switch Router

In diesem Abschnitt werden die Label Switch Router, die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Description** | **Plug-in-Unit (PIU) bzw. Label Edge Router** | | |
|---|---|---|---|
| | **PIU-3** | **PIU-4** | **PIU-5** |
| **Plug-in-Unit (PIU)** | | | |
| Bandwidth of the plug-in unit (in Gbps) | 400 | 650 | 1300 |
| Number of linecard slots | 8 | 16 | 16 |
| **Line Cards for optical interfaces for inhouse fibre and Fibre/ C-/DWDM transport layer** | | | |
| **Port type** | **1GE** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 | 1 |
| Number of ports | 8 | 8 | 8 |
| Number of ports | 20 | 20 | 20 |
| Number of ports | 48 | 48 | 48 |
| **Port type** | **10GE** | **10GE** | **10GE** |
| Bandwidth port (in Gbps) | 10 | 10 | 10 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 4 | 4 | 4 |
| Number of ports | 10 | 10 | 10 |
| **Port type** | **40GE** | **40GE** | **40GE** |
| Bandwidth port (in Gbps) | 40 | 40 | 40 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 4 | 4 | 4 |
| Number of ports | 8 | 8 | 8 |
| **Port type** | **100GE** | **100GE** | **100GE** |
| Bandwidth port (in Gbps) | 100 | 100 | 100 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 4 | 4 | 4 |
| **Line Cards for optical interfaces for OTN transport layer** | | | |
| **Port type** | **1GE** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 | 1 |
| Number of ports | 2 | 2 | 2 |
| Number of ports | 10 | 10 | 10 |
| Number of ports | 40 | 40 | 40 |
| **Port type** | **10GE** | **10GE** | **10GE** |
| Bandwidth port (in Gbps) | 10 | 10 | 10 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 2 | 2 | 2 |
| Number of ports | 4 | 4 | 4 |
| **Port type** | **40GE** | **40GE** | **40GE** |
| Bandwidth port (in Gbps) | 40 | 40 | 40 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 4 | 4 | 4 |
| Number of ports | 8 | 8 | 8 |
| **Port type** | **100GE** | **100GE** | **100GE** |
| Bandwidth port (in Gbps) | 100 | 100 | 100 |
| Number of ports | 1 | 1 | 1 |
| Number of ports | 4 | 4 | 4 |
| **Rack** | | | |
| Max. number of plug-in units/rack | 2 | 2 | 1 |

## 1.4.3 Physical System Assignment

| Parameter | Type | Range | Description | Base Value |
|---|---|---|---|---|
| C_ix | Int | | Configuration general index | |
| PIU_ix | Int | | Plug-in unit internal index | |
| PIU_name | String | | Plug-in unit identification name | Siehe Tabelle unten |
| Px_BW_PIU_j | Double | | Bandwidth of plug-in unit (in Gbps) | Siehe Tabelle unten |
| Nfib | Int | | Number of fibres per port | Siehe Tabelle unten |
| Px_PIU_j_nLC_L | Int | | Maximum number of slots for logical equipment sided linecards | Siehe Tabelle unten |
| Lx_BW_PIU_j | float | | Bandwidth of plug-in-unit of type j (in Gbps) | Siehe Tabelle unten |
| Lx_PIU_j_nLC | int | | Maximum number of slots for linecards per plug-in unit type j | Siehe Tabelle unten |
| Lx_BW_PIU_port_i | float | | Bandwidth in Gbps of port of type i | Siehe Tabelle unten |
| Lx_PIU_port_i_LCnport | int | | Maximum number of ports per linecard i | Siehe Tabelle unten |
| port_type | String | | Port type identification name | Siehe Tabelle unten |
| Px_BW_PIU_port_Li | Double | | Bandwidth in Gbps per logical equipment sided port | Siehe Tabelle unten |
| Px_PIU_port_Li_LCnport | Int | | Maximum number of logical equipment sided ports per linecard | Siehe Tabelle unten |
| Px_PIU_j_nLC_R | Int | | Maximum number of slots for ring-sided linecards | Siehe Tabelle unten |
| Px_BW_PIU_port_Ri | Double | | Bandwidth in Gbps per ring-sided port | Siehe Tabelle unten |
| Px_PIU_port_Ri_LCnport | Int | | Maximum number of ring-sided ports per linecard | Siehe Tabelle unten |
| | | | Note.- Usually it is included into the plug-in unit price | |
| Rack_PIU_nmax | Int | | Maximum number of plug-in units per rack | Siehe Tabelle unten |
| Avail_OnL01 | Int | 0-1 | 1= This configuration is available on level 0 - level 1 deployment | Siehe Tabelle unten |
| | | | (and on level 0 - level 2 if level 1 is not available) | |
| Avail_OnL12 | Int | 0-1 | 1= This configuration is available on level 1 - level 2 deployment | Siehe Tabelle unten |
| Avail_OnL34 | Int | 0-1 | 1= This configuration is available on level 3 - level 4 deployment | Siehe Tabelle unten |
| | | | (and on level 3 - level 5 if level 4 is not available) | |
| Avail_OnL45 | Int | 0-1 | 1= This configuration is available on level 4 - level 5 deployment | Siehe Tabelle unten |
| Avail_OnL55 | Int | 0-1 | 1= This configuration is available on level 5 - level 5 deployment | Siehe Tabelle unten |
| Only_ll | Int | 0-1 | 1= Only available for leased lines configurations | Siehe Tabelle unten |
| dbtwrep | float | | Maximum distance between repeaters (in km) | Siehe Tabelle unten |
| dbtwlc | float | | Maximum distance between linecards (in km) | Siehe Tabelle unten |
| N_lambdas | Int | | Number of lambdas | Siehe Tabelle unten |
| Bw_lambda | float | | Bandwidth (in Gbps) per lambda | Siehe Tabelle unten |

### 1.4.3.1 Physical System Assignment - Add Drop Multiplex with electrical and optical Ports

In diesem Abschnitt werden die Add Drop Multiplexer (NG-SDH), die bei der Bottom-up Modellierung verwendet werden, definiert.

| Type | Synchronous Transport Module (STM-n) | | | | | Comments |
|---|---|---|---|---|---|---|
| | STM-1 | STM-4 | STM-16 | STM-64 | STM-256 | |
| **ADM/OADM** | | | | | | |
| Max. ROADM distance without repeater (in km) | 80 | 80 | 80 | 80 | 80 | |
| Number of fibres/ports | 2 | 2 | 2 | 2 | 2 | |
| Number of add drop slots | 6 | 6 | 6 | 6 | 6 | |
| Number of ring slots | 2 | 2 | 2 | 2 | 2 | |
| **Repeater** | | | | | | |
| Repeater length (in km) | 80 | 80 | 80 | 80 | 80 | |
| **Line Cards - Add Drop Ports** | | | | | | |
| **Port type** | **E/FE** | **E/FE** | **E/FE** | **E/FE** | **E/FE** | |
| Bandwidth add drop port1 (in Gbps) | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | |
| Number of ports | 1 | 2 | 6 | -- | -- | |
| Number of ports | -- | 6 | 12 | -- | -- | |
| Number of ports | -- | -- | 25 | -- | -- | |
| **Port type** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | |
| Bandwidth add drop port2 (in Gbps) | 1 | 1 | 1 | 1 | 1 | |
| Number of ports | -- | -- | 1 | 1 | 1 | |
| Number of ports | -- | -- | 2 | 2 | 2 | |
| Number of ports | 0 | 0 | 0 | 10 | 10 | |
| Number of ports | 0 | 0 | 0 | 0 | 20 | |
| **Port type** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** | |
| Bandwidth add drop port3 (in Gbps) | 10 | 10 | 10 | 10 | 10 | |
| Number of ports | -- | -- | -- | 1 | 1 | |
| Number of ports | -- | -- | -- | -- | 4 | |

| **Port type** | **E1** | **E1** | **E1** | **E1** | **E1** | Only applied for plesiosynchronous digital hierarchy leased lines |
|---|---|---|---|---|---|---|
| Bandwidth add drop port4 (in Gbps) | 0,002 | 0,002 | 0,002 | 0,002 | 0,002 | |
| Number of ports | 21 | 21 | -- | -- | -- | |
| **Port type** | **E3** | **E3** | **E3** | **E3** | **E3** | Only applied for plesiosynchronous digital hierarchy leased lines |
| Bandwidth add drop port5 (in Gbps) | 0,034 | 0,034 | 0,034 | 0,034 | 0,034 | |
| Number of ports | 3 | 3 | -- | -- | -- | |
| Number of ports | 0 | 6 | -- | -- | -- | |
| Number of ports | 0 | 12 | -- | -- | -- | |
| **Port type** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | Only applied for synchronous digital hierarchy leased lines |
| Bandwidth add drop port6 (in Gbps) | 0,155 | 0,155 | 0,155 | 0,155 | 0,155 | |
| Number of ports | 1 | 4 | 16 | 32 | -- | |
| **Port type** | **STM-4** | **STM-4** | **STM-4** | **STM-4** | **STM-4** | Only applied for synchronous digital hierarchy leased lines |
| Bandwidth add drop port7 (in Gbps) | 0,662 | 0,662 | 0,662 | 0,662 | 0,662 | |
| Number of ports | -- | 1 | 4 | 16 | -- | |
| **Port type** | **STM-16** | **STM-16** | **STM-16** | **STM-16** | **STM-16** | Only applied for synchronous digital hierarchy leased lines |
| Bandwidth add drop port8 (in Gbps) | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | |
| Number of ports | -- | -- | 1 | 4 | 4 | |
| Number of ports | | | -- | -- | 16 | |

| **Port type** | **STM-64** | **STM-64** | **STM-64** | **STM-64** | **STM-64** | Only applied for synchronous digital hierarchy leased lines |
|---|---|---|---|---|---|---|
| Bandwidth add drop port9 (in Gbps) | 10 | 10 | 10 | 10 | 10 | |
| Number of ports | -- | -- | -- | 1 | 1 | |
| Number of ports | -- | -- | -- | -- | 4 | |
| **Port type** | **STM-256** | **STM-256** | **STM-256** | **STM-256** | **STM-256** | Only applied for synchronous digital hierarchy leased lines |
| Bandwidth add drop port10 (in Gbps) | 40 | 40 | 40 | 40 | 40 | |
| Number of ports | -- | -- | -- | -- | 1 | |
| **Rack** | | | | | | |
| Max. number of plug-in units/rack | 8 | 4 | 4 | 2 | 2 | |

### 1.4.3.2 Physical System Assignment - ROADM-C/DWDM

In diesem Abschnitt werden die ROADM (C/DWDM), die bei der Bottom-up Modellierung verwendet werden, definiert.

| Type | Coarse Wavelength Division Multiplex | | Reconfigurable optical add-drop multiplexer Dense Wavelength Division Multiplex | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ROADM/CWDM1 | ROADM/CWDM2 | ROADM/DWDM1 | ROADM/DWDM2 | ROADM/DWDM3 | ROADM/DWDM4 | ROADM/DWDM5 | ROADM/DWDM6 |
| **ROADM** | | | | | | | | |
| Gbps/lambda | 10 | 10 | 10 | 10 | 10 | 100 | 100 | 100 |
| Number of lambdas | 9 | 18 | 40 | 80 | 160 | 40 | 80 | 160 |
| Max. distance between ROADM (in km) | 80 | 80 | 150 | 150 | 150 | 150 | 150 | 150 |
| Number of fibres/port | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of add drop slots | 3 | 3 | 4 | 8 | 16 | 4 | 8 | 16 |
| Number of ring slots | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Repeater** | | | | | | | | |
| Repeater legnth (in km) | 80 | 80 | 150 | 150 | 150 | 150 | 150 | 150 |
| **Line Cards - Add Drop Ports** | | | | | | | | |
| **Port type 1** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** |
| Bandwidth add drop port1 (in Gbps) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of ports | 3 | 3 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of ports | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Port type 2** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** | **10GE** |
| Bandwidth add drop port2 (in Gbps) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of ports | 3 | 3 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of ports | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Port type 3** | **100GE** | **100GE** | **100GE** | **100GE** | **100GE** | **100GE** | **100GE** | **100GE** |
| Bandwidth add drop port3 (in Gbps) | | | | | | 100 | 100 | 100 |
| Number of ports | | | | | | 10 | 10 | 10 |
| **Rack** | | | | | | | | |
| Max. number of plug-in units/rack | 4 | 4 | 4 | 3 | 2 | 4 | 3 | 2 |

### 1.4.3.3 Physical System Assignment - ROADM-OTN

In diesem Abschnitt werden die OTN-ROADM, die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Type** | | | | | **Comments** |
|---|---|---|---|---|---|
| | **Optical transport network - Reconfigurable optical add-drop multiplexer** | | | | |
| | **OTN/ROADM1** | **OTN/ROADM2** | **OTN/ROADM4** | **OTN/ROADM8** | |
| **ROADM** | | | | | |
| Gbps/lambda | 100 | 100 | 100 | 100 | |
| Number of lambdas | 40 | 80 | 80 | 80 | |
| Max. distance between ROADM (in km) | 150 | 150 | 150 | 150 | |
| Number of fibres/port | 1 | 1 | 1 | 1 | |
| Maximum number of slots for logical equipment-sided linecards | 10 | 20 | 40 | 80 | |
| Number of ring slots | 2 | 2 | 2 | 2 | |
| **Repeater** | | | | | |
| Repeater length (in km) | 150 | 150 | 150 | 150 | |
| **Line Cards - Logical Equipment-sided Ports, or customer sided ports (e.g. leased lines)** | | | | | |
| **Port type** | **1GE** | **1GE** | **1GE** | **1GE** | |
| Bandwidth OTN port (in Gbps) | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| Number of ports | 10 | 10 | 10 | 10 | |
| Number of ports | 20 | 20 | 20 | 20 | |
| **Port type** | **10GE** | **10GE** | **10GE** | **10GE** | |
| Bandwidth OTN port (in Gbps) | 10 | 10 | 10 | 10 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 10 | 10 | 10 | 10 | |
| **Port type** | **40GE** | **40GE** | **40GE** | **40GE** | |
| Bandwidth OTN port (in Gbps) | 40 | 40 | 40 | 40 | |
| Number of ports | | 1 | 1 | 1 | |
| Number of ports | | -- | 2 | 2 | |
| **Port type** | **100GE** | **100GE** | **100GE** | **100GE** | |
| Bandwidth OTN port (in Gbps) | 100 | 100 | 100 | 100 | |
| Number of ports | 1 | 1 | 1 | 1 | |

| **Port type** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | Only for synchronous digital hierarchy leased lines |
|---|---|---|---|---|---|
| Bandwidth OTN port (in Gbps) | 0,155 | 0,155 | 0,155 | 0,155 | |
| Number of ports | 16 | 16 | 16 | 16 | |
| **Port type** | **STM-4** | **STM-4** | **STM-4** | **STM-4** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 0,662 | 0,662 | 0,662 | 0,662 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 16 | 16 | 16 | 16 | |
| **Port type** | **STM-16** | **STM-16** | **STM-16** | **STM-16** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 2,5 | 2,5 | 2,5 | 2,5 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 8 | 8 | 8 | 8 | |
| Number of ports | 16 | 16 | 16 | 16 | |
| **Port type** | **STM-64** | **STM-64** | **STM-64** | **STM-64** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 10 | 10 | 10 | 10 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 10 | 10 | 10 | 10 | |
| **Port type** | **STM-256** | **STM-256** | **STM-256** | **STM-256** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 40 | 40 | 40 | 40 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| **Repeater** | | | | | |
| Max. number of plug-in units/rack | 3 | 2 | 1 | 1 | |

### 1.4.3.4 Physical System Assignment - OTN Line Terminals (OTN-LT)

In diesem Abschnitt werden die OTN Line Terminals, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Type | Optical transport network (OTN) | | | | Comments |
|---|---|---|---|---|---|
| | OTN1 | OTN2 | OTN4 | OTN8 | |
| **OTN Line Termial** | | | | | |
| Gbps/lambda | 100 | 100 | 100 | 100 | |
| Number of lambdas | 40 | 80 | 80 | 80 | |
| Max. distance between OTN-LT (in km) | 150 | 150 | 150 | 150 | |
| Number of fibres/port | 1 | 1 | 1 | 1 | |
| Maximum number of slots for logical equipment-sided linecards | 10 | 20 | 40 | 80 | |
| Number of trunk slots | 1 | 1 | 1 | 1 | |
| **Repeater** | | | | | |
| Repeater legnth (in km) | 150 | 150 | 150 | 150 | |
| **Line Cards - Logical Equipment-sided Ports** | | | | | |
| **Port type** | **1GE** | **1GE** | **1GE** | **1GE** | |
| Bandwidth OTN port (in Gbps) | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| Number of ports | 10 | 10 | 10 | 10 | |
| Number of ports | 20 | 20 | 20 | 20 | |
| **Port type** | **10GE** | **10GE** | **10GE** | **10GE** | |
| Bandwidth OTN port (in Gbps) | 10 | 10 | 10 | 10 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 10 | 10 | 10 | 10 | |

| **Port type** | **40GE** | **40GE** | **40GE** | **40GE** | |
|---|---|---|---|---|---|
| Bandwidth OTN port (in Gbps) | 40 | 40 | 40 | 40 | |
| Number of ports | | 1 | 1 | 1 | |
| Number of ports | | -- | 2 | 2 | |
| **Port type** | **100GE** | **100GE** | **100GE** | **100GE** | |
| Bandwidth OTN port (in Gbps) | 100 | 100 | 100 | 100 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| **Port type** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 0,155 | 0,155 | 0,155 | 0,155 | |
| Number of ports | 16 | 16 | 16 | 16 | |
| **Port type** | **STM-4** | **STM-4** | **STM-4** | **STM-4** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 0,662 | 0,662 | 0,662 | 0,662 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 16 | 16 | 16 | 16 | |
| **Port type** | **STM-16** | **STM-16** | **STM-16** | **STM-16** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 2,5 | 2,5 | 2,5 | 2,5 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 8 | 8 | 8 | 8 | |
| Number of ports | 16 | 16 | 16 | 16 | |

| **Port type** | **STM-64** | **STM-64** | **STM-64** | **STM-64** | Only for synchronous digital hierarchy leased lines |
|---|---|---|---|---|---|
| Bandwidth OTN port (in Gbps) | 10 | 10 | 10 | 10 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 4 | 4 | 4 | 4 | |
| Number of ports | 10 | 10 | 10 | 10 | |
| **Port type** | **STM-256** | **STM-256** | **STM-256** | **STM-256** | Only for synchronous digital hierarchy leased lines |
| Bandwidth OTN port (in Gbps) | 40 | 40 | 40 | 40 | |
| Number of ports | 1 | 1 | 1 | 1 | |
| Number of ports | 2 | 2 | 2 | 2 | |
| **Rack** | | | | | |
| Max. number of plug-in units/rack | 3 | 2 | 1 | 0,5 | |

### 1.4.3.5 Physical System Assignment - Optical Cross Connector

In diesem Abschnitt werden die Optical Cross Connector (OXC), die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Type** | **Optical transport network - Reconfigurable optical add-drop multiplexer** | | | | |
|---|---|---|---|---|---|
| | **OXC1** | **OXC2** | **OXC3** | **OXC4** | **OXC5** |
| **OXC** | | | | | |
| Bandwidth/lamda | 10 | 10 | 10 | 100 | 100 |
| Number of linecards | 8 | 8 | 4 | 8 | 8 |
| **Line Card** | | | | | |
| Number of lamda/Linecard | 40 | 80 | 160 | 40 | 80 |
| **Rack** | | | | | |
| Max. number of plug-in units/rack | 1 | 1 | 1 | 1 | 1 |

## 1.4.4 Media Gateway

In diesem Abschnitt werden die Media Gateway (MGW), die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Type | Range | Description | Base Value |
|---|---|---|---|---|
| Ix_PIU | int | | Plug-in unit index | |
| Cix_PIU | String | | Plug-in unit identifier | |
| BW_PIU_max | int | | Maximum bandwidth (in Gbps) | Siehe Tabelle unten |
| N_avail_voice_LC | int | | Number of available voice linecards | Siehe Tabelle unten |
| N_avail_ngn_LC | int | | Number of available next generation network linecards | Siehe Tabelle unten |
| N_slots_voice_LC | int | | Number of slots for voice linecards | Siehe Tabelle unten |
| N_slots_ngn_LC | int | | Number of slots for next generation network linecards | Siehe Tabelle unten |
| N_PIU_rack | int | | Number of plug-in units per rack | Siehe Tabelle unten |
| For each available voice LC (j =1 to N_avail_voice_LC): | | | | |
| Ix_voice_j_LC | int | | Voice linecard index | |
| CIx_voice_j_LC | String | | Voice linecard identifier | |
| Lx_BW_voice_j | float | | Mean bandwidth per port (in Gbps) | Siehe Tabelle unten |
| Lx_voice_j_nLC | int | | Maximum number of ports per linecard | Siehe Tabelle unten |
| For each available NGN LC (j =1 to N_avail_ngn_LC): | | | | |
| Ix_ngn_j_LC | int | | Next generation network linecard index | Siehe Tabelle unten |
| CIx_ngn_j_LC | String | | Next generation network linecard identifier | Siehe Tabelle unten |
| Lx_BW_ngn_j | float | | Mean bandwidth per port (in Gbps) | Siehe Tabelle unten |
| Lx_ngn_j_nLC | int | | Maximum number of ports per linecard | Siehe Tabelle unten |

| Type | Media Gateway bzw. Plug-in-Unit (PIU) | | | | | |
|---|---|---|---|---|---|---|
| | PIU-1 | PIU-2 (50%) | PIU-3 (25%) | PIU-4 (12,5%) | PIU-5 (6,25%) | PIU-6 (6,25%) |
| **Media Gateway (PIU)** | | | | | | |
| Bandwidth of the Plug-in unit (in Gbps) | 4 | 2 | 1 | 0,5 | 0,25 | 0,25 |
| Number of linecard slots (external) | 16 | 8 | 4 | 2 | 1 | 3 |
| Number of slots per plug-in unit (internal) | 2 | 2 | 2 | 2 | 2 | 2 |
| **Line Cards for connection to the interconnection network (external)** | | | | | | |
| **Port type** | **E1** | **E1** | **E1** | **E1** | **E1** | **E1** |
| Bandwidth port (in Gbps) | 0,002 | 0,002 | 0,002 | 0,002 | 0,002 | 0,002 |
| Number of ports | 21 | 21 | 21 | 21 | 21 | 21 |
| **Port type** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | **STM-1** | **STM-1** |
| Bandwidth port (in Gbps) | 0,155 | 0,155 | 0,155 | 0,155 | 0,155 | 0,155 |
| Number of ports | 1 | 1 | 1 | 1 | 1 | - |
| Number of E1/port | 63 | 63 | 63 | 63 | 63 | - |
| **Line Cards for network-sided ports (internal)** | | | | | | |
| **Port type** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of ports | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of ports | - | 1 | 1 | 1 | 1 | 1 |
| **Rack** | | | | | | |
| Max. number of plug-in units/rack | 2 | 3 | 4 | 6 | 6 | 6 |

## 1.4.5 DSLAM Parameter

In diesem Abschnitt werden die DSLAM, die bei der Bottom-up Modellierung verwendet werden, definiert.

| **Description** | **Plug-in-Unit (PIU)** | |
|---|---|---|
| | **DSLAM-1** | **DSLAM-2** |
| **Plug-in-Unit (PIU)** | | |
| Max number of users per DSLAM | 864 | 2592 |
| Number of slots for network sided linecards | 1 | 1 |
| **Line Cards** | | |
| **Port type** | **1GE** | **1GE** |
| Bandwidth port (in Gbps) | 1 | 1 |
| Number of ports | 2 | 2 |
| **Rack** | | |
| Max. number of plug-in units/rack | 3 | 1 |

## 1.4.5 Layer 0 (Cables and Infrastructure)

In diesem Abschnitt werden die Kabel und Infrastrukturparameter, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Type | Range | Description | Base Value |
|---|---|---|---|---|
| For each cable configuration: | | | | |
| Index cable | int | | Configuration index | |
| Type_cable | String | | Configuration identifier | |
| n_fibre_per_cable | int | | Number of fibres per cable | Siehe Tabelle unten |
| Global_reserve | Float | | Global reserve of fibres per cable (in %) | Siehe Tabelle unten |
| Indiv_rsv_l_0-1 | Float | | Individual reserve of fibre for level 0-1 infrastructure (in %) | Siehe Tabelle unten |
| Indiv_rsv_l_1-2 | Float | | Individual reserve of fibre for level 1-2 infrastructure (in %) | Siehe Tabelle unten |
| Indiv_rsv_l_3-4 | Float | | Individual reserve of fibre for level 3-4 infrastructure (in %) | Siehe Tabelle unten |
| Indiv_rsv_l_4-5 | Float | | Individual reserve of fibre for level 4-5 infrastructure (in %) | Siehe Tabelle unten |
| Indiv_rsv_l_5-5 | Float | | Individual reserve of fibre for level 5-5 infrastructure (in %) | Siehe Tabelle unten |

| Description | Cables and Infrastructure | | | | | |
|---|---|---|---|---|---|---|
| | Typ 1 | Typ 2 | Typ 3 | Typ 4 | Typ 5 | Typ 6 |
| Number of fibres | 48 | 96 | 144 | 288 | 516 | 596 |

| Description | Base Value<br>Cables and Infrastructure | | | | | |
|---|---|---|---|---|---|---|
| | Typ 1 | Typ 2 | Typ 3 | Typ 4 | Typ 5 | Typ 6 |
| Number of fibres | 48 | 96 | 144 | 288 | 516 | 596 |
| Global reserve [%] | 17% | 10% | 8% | 6% | 4% | 3% |
| Individual reserve per network level [%] | | | | | | |
| 0-1 | 0% | 0% | 0% | 0% | 0% | 0% |
| 1-2 | 4% | 3% | 3% | 2% | 2% | 1% |
| 3-4 | 4% | 3% | 3% | 2% | 2% | 1% |
| 4-5 | 8% | 5% | 4% | 2% | 2% | 2% |
| 5-5 | 13% | 7% | 6% | 3% | 3% | 2% |

## 1.5 MPOP-LIST

| Name | Type | Description |
|---|---|---|
| **First line** | | |
| N_POPS | Int | Total number of MPOP nodes |
| N_Tech | Int | Number of considered Access Technologies |
| N_TUsers | Int | Number of considered User's types |
| GeoRefT | Int | Geographical reference system (0=UTM xy; |
| For each MPOP | | |
| **First line** | | |
| MPOP | String | MPOP ID/Name |
| Mpop_code | String | MPOP Code |
| Mpop_lan | Double | Geographical Latitude (X UTM) |
| Mpop_lon | Double | Geographical Longitude (Y UTM) |
| Tot_users | Int | Total Number of users |
| Remote_Location | Int | Node is a remote location (0=NO; 1=YES) |
| **Next lines, one for each Access Technology** | | |
| Usr1_PN | Int | PN Users of type 1 |
| Usr2_PN | Int | PN Users of type 2 |
| Usr3_PN | Int | PN Users of type 3 |
| Usr4_PN | Int | PN Users of type 4 |
| Usr5_PN | Int | PN Users of type 5 |
| Usr6_PN | Int | PN Users of type 6 |
| Usr1_EB0 | Int | Bitstream Ethernet Level 0 Users of type 1 |
| Usr2_EB0 | Int | Bitstream Ethernet Level 0 Users of type 2 |
| Usr3_EB0 | Int | Bitstream Ethernet Level 0 Users of type 3 |
| Usr4_EB0 | Int | Bitstream Ethernet Level 0 Users of type 4 |
| Usr5_EB0 | Int | Bitstream Ethernet Level 0 Users of type 5 |
| Usr6_EB0 | Int | Bitstream Ethernet Level 0 Users of type 6 |
| Usr1_EB1 | Int | Bitstream Ethernet Level 1 Users of type 1 |
| Usr2_EB1 | Int | Bitstream Ethernet Level 1 Users of type 2 |
| Usr3_EB1 | Int | Bitstream Ethernet Level 1 Users of type 3 |
| Usr4_EB1 | Int | Bitstream Ethernet Level 1 Users of type 4 |
| Usr5_EB1 | Int | Bitstream Ethernet Level 1 Users of type 5 |
| Usr6_EB1 | Int | Bitstream Ethernet Level 1 Users of type 6 |

| | | |
|---|---|---|
| Usr1_EB2 | Int | Bitstream Ethernet Level 2 Users of type 1 |
| Usr2_EB2 | Int | Bitstream Ethernet Level 2 Users of type 2 |
| Usr3_EB2 | Int | Bitstream Ethernet Level 2 Users of type 3 |
| Usr4_EB2 | Int | Bitstream Ethernet Level 2 Users of type 4 |
| Usr5_EB2 | Int | Bitstream Ethernet Level 2 Users of type 5 |
| Usr6_EB2 | Int | Bitstream Ethernet Level 2 Users of type 6 |
| Usr1_IPB3 | Int | Bitstream IP Level 3 Users of type 1 |
| Usr2_IPB3 | Int | Bitstream IP Level 3 Users of type 2 |
| Usr3_IPB3 | Int | Bitstream IP Level 3 Users of type 3 |
| Usr4_IPB3 | Int | Bitstream IP Level 3 Users of type 4 |
| Usr5_IPB3 | Int | Bitstream IP Level 3 Users of type 5 |
| Usr6_IPB3 | Int | Bitstream IP Level 3 Users of type 6 |
| Usr1_IPB4 | Int | Bitstream IP Level 4 Users of type 1 |
| Usr2_IPB4 | Int | Bitstream IP Level 4 Users of type 2 |
| Usr3_IPB4 | Int | Bitstream IP Level 4 Users of type 3 |
| Usr4_IPB4 | Int | Bitstream IP Level 4 Users of type 4 |
| Usr5_IPB4 | Int | Bitstream IP Level 4 Users of type 5 |
| Usr6_IPB4 | Int | Bitstream IP Level 4 Users of type 6 |
| Usr1_IPB5 | Int | Bitstream IP Level 5 Users of type 1 |
| Usr2_IPB5 | Int | Bitstream IP Level 5 Users of type 2 |
| Usr3_IPB5 | Int | Bitstream IP Level 5 Users of type 3 |
| Usr4_IPB5 | Int | Bitstream IP Level 5 Users of type 4 |
| Usr5_IPB5 | Int | Bitstream IP Level 5 Users of type 5 |
| Usr6_IPB5 | Int | Bitstream IP Level 5 Users of type 6 |

### 1.5.1 Structure of the MPoP-List

see also section 1.2

| | user type 1 | user type 2 | user type 3 | user type 4 | user type 5 | user type 6 |
|---|---|---|---|---|---|---|
| Product group 1 | | | | | | |
| Product group 2 | | | | | | |
| Product group 3 | | | | | | |
| Product group 4 | | | | | | |
| Product group 5 | | | | | | |
| Product group 6 | | | | | | |

### 1.5.2 Example of assignment of access line types (and according traffic demand) in the MPoP-List

| | Traditional | Premium | ISPA PK | SOHO | MLE | ISPA GK |
|---|---|---|---|---|---|---|
| Produktgruppe "Voice and Broadband" | Voice und BB | Voice und BB | ISPA mit VoB | Voice und BB | Voice und BB | ISPA mit VoB |
| Produktgruppe "Broadband" | BB SA | BB SA | ISPA mit Voice Inc. | BB SA | BB SA | ISPA mit Voice Inc. |
| Produktgruppe "Voice" | Voice SA / BSA Voice | Voice SA / BSA Voice | Layer 1 Mietleitungen | Voice SA / BSA Voice | Voice SA / BSA Voice | Layer 2 Mietleitungen |
| D | | | | | | |
| E | | | | | | |
| IPTV | | | IPTV | | | IPTV |

# 2 COST MODULE

## 2.1 Sites

In diesem Abschnitt werden Investitionen (z.B. Ausbau- und Unterbringungsinvestitionen, Gebäude, Grundstück), die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value |
|---|---|---|---|
| **Level 0** | | | |
| p_L0_accomm_log_eq | >=0 | Investment for accommodation assets per site for Layer 2/3 equipment at Level 0 | 150.000 |
| p_L0_accomm_phys_eq | >=0 | Investment for accommodation assets per site for Layer 1/0 equipment at Level 0 | 50.000 |
| p_L0_build | >=0 | Investment for buildings per site at Level 0 | 161.000 |
| p_L0_land | >=0 | Investment for land per site at Level 0 | 69.000 |
| **Level 1** | | | |
| p_L1_accomm_log_eq | >=0 | Additional investment for accommodation assets per site for Layer 2/3 equipment at Level 1 | 30.000 |
| p_L1_accomm_phys_eq | >=0 | Additional investment for accommodation assets per site for Layer 1/0 equipment at Level 1 | 50.000 |
| p_L1_build | >=0 | Investment for buildings per site at Level 1 | 227.500 |
| p_L1_land | >=0 | Investment for land per site at Level 1 | 122.500 |
| **Level 2** | | | |
| p_L2_accomm_log_eq | >=0 | Additional investment for accommodation assets per site for Layer 2/3 equipment at Level 2 | 50.000 |
| p_L2_accomm_phys_eq | >=0 | Additional investment for accommodation assets per site for Layer 1/0 equipment at Level 2 | no L1/0 eq |
| p_L2_build | >=0 | Investment for buildings per site at Level 2 | 300.000 |
| p_L2_land | >=0 | Investment for land per site at Level 2 | 300.000 |
| **Level 3** | | | |
| p_L3_accomm_log_eq | >=0 | Additional investment for accommodation assets per site for Layer 2/3 equipment at Level 3 | 50.000 |
| p_L3_accomm_phys_eq | >=0 | Additional investment for accommodation assets per site for Layer 1/0 equipment at Level 3 | 50.000 |
| p_L3_build | >=0 | Investment for buildings per site at Level 3 | 75.000 |
| p_L3_land | >=0 | Investment for land per site at Level 3 | 75.000 |
| **Level 4** | | | |
| p_L4_accomm_log_eq | >=0 | Additional investment for accommodation assets per site for Layer 2/3 equipment at Level 4 | 100.000 |
| p_L4_accomm_phys_eq | >=0 | Additional investment for accommodation assets per site for Layer 1/0 equipment at Level 4 | 50.000 |
| p_L4_build | >=0 | Investment for buildings per site at Level 4 | 500.000 |
| p_L4_land | >=0 | Investment for land per site at Level 4 | 500.000 |
| **Level 5** | | | |
| p_L5_accomm_log_eq | >=0 | Additional investment for accommodation assets per site for Layer 2/3 equipment at Level 5 | 500.000 |
| p_L5_accomm_phys_eq | >=0 | Additional investment for accommodation assets per site for Layer 1/0 equipment at Level 5 | 50.000 |
| p_L5_build | >=0 | Investment for buildings per site at Level 5 | 750.000 |
| p_L5_land | >=0 | Investment for land per site at Level 5 | 750.000 |

## 2.2 Control Layer

In diesem Abschnitt werden die Netzelemente der Dienstebene (z.B. BRAS, DNS, Softswitch), die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value |
|---|---|---|---|
| **Broadband Remote Access Server** | | | € / % |
| BRAS_cap_1 | >=0 | Capacity per unit (Type 1) | 32.000 parallel sessions |
| BRAS_cap_2 | >=0 | Capacity per unit (Type 2) | 128.000 parallel session |
| BRAS_cap_3 | >=0 | Capacity per unit (Type 3) | 512.000 parallel sessions |
| nt_CLB | >=0 | Number of locations with BRAS | At all L3 nodes |
| ur_BRAS_1 | [0,1] | Maximum utilization ratio (Type 1) | 80% |
| ur_BRAS_2 | [0,1] | Maximum utilization ratio (Type 2) | 80% |
| ur_BRAS_3 | [0,1] | Maximum utilization ratio (Type 3) | 80% |
| n_BRAS_red_1 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 1) | 1 |
| n_BRAS_red_2 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 2) | 1 |
| n_BRAS_red_3 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 3) | 1 |
| share_red_tr_BRAS_1 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 1) | 100% |
| share_red_tr_BRAS_2 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 2) | 100% |
| share_red_tr_BRAS_3 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 3) | 100% |
| **Remote Authentication Dial-In-User Service server** | | | |
| RADIUS_cap | >=0 | Capacity per unit | Already included in BRAS |
| p_radius | >=0 | Investment per Remote Authentication Dial-In-User Service server | Already included in BRAS |
| nt_CLR | >=0 | Number of locations with RADIUS | Already included in BRAS |
| ur_RADIUS | [0,1] | Maximum utilization ratio | Already included in BRAS |
| n_RADIUS_red | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) | Already included in BRAS |
| share_red_tr_RADIUS | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) | Already included in BRAS |
| **Domain name server** | | | |
| DNS_cap_1 | >=0 | Capacity per unit (Type 1) | 30.000 DNS connection call attempts |
| DNS_cap_2 | >=0 | Capacity per unit (Type 2) | 240.000 DNS connection call attempts |
| DNS_cap_3 | >=0 | Capacity per unit (Type 3) | 960.000 DNS connection call attempts |
| nt_CLD | >=0 | Number of locations with DNS | 2 |
| ur_DNS_1 | [0,1] | Maximum utilization ratio (Type 1) | 80% |
| ur_DNS_2 | [0,1] | Maximum utilization ratio (Type 2) | 80% |
| ur_DNS_3 | [0,1] | Maximum utilization ratio (Type 3) | 80% |
| n_DNS_red_1 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 1) | 1 |
| n_DNS_red_2 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 2) | 1 |
| n_DNS_red_3 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 3) | 1 |
| share_red_tr_DNS_1 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 1) | 100% |
| share_red_tr_DNS_2 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 2) | 100% |
| share_red_tr_DNS_3 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 3) | 100% |

| **Softswitch** | | | |
|---|---|---|---|
| SSW_cap_1 | >=0 | Capacity per unit (Type 1) | 215.625 BHCA |
| SSW_cap_2 | >=0 | Capacity per unit (Type 2) | 862.500 BHCA |
| SSW_cap_3 | >=0 | Capacity per unit (Type 3) | 1.725.000 BHCA |
| nt_CLS | >=0 | Number of locations with SSW | 2 |
| ur_SSW_1 | [0,1] | Maximum utilization ratio (Type 1) | 80% |
| ur_SSW_2 | [0,1] | Maximum utilization ratio (Type 2) | 80% |
| ur_SSW_3 | [0,1] | Maximum utilization ratio (Type 3) | 80% |
| n_SSW_red_1 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 1) | 1 |
| n_SSW_red_2 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 2) | 1 |
| n_SSW_red_3 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 3) | 1 |
| share_red_tr_SSW_1 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 1) | 100% |
| share_red_tr_SSW_2 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 2) | 100% |
| share_red_tr_SSW_3 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 3) | 100% |
| **Media Gateway Controller** | | | |
| MGC_cap_1 | >=0 | Capacity per unit (Type 1) | 125.000 BHCA (voice TDM IC calls) |
| MGC_cap_2 | >=0 | Capacity per unit (Type 2) | 500.000BHCA (voice TDM IC calls) |
| MGC_cap_3 | >=0 | Capacity per unit (Type 3) | 1.000.000 BHCA (voice TDM IC calls) |
| nt_CLM | >=0 | Number of locations with MGC | 2 |
| ur_MGC_1 | [0,1] | Maximum utilization ratio (Type 1) | 80% |
| ur_MGC_2 | [0,1] | Maximum utilization ratio (Type 2) | 80% |
| ur_MGC_3 | [0,1] | Maximum utilization ratio (Type 3) | 80% |
| n_MGC_red_1 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 1) | 1 |
| n_MGC_red_2 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 2) | 1 |
| n_MGC_red_3 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 3) | 1 |
| share_red_tr_MGC_1 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 1) | 100% |
| share_red_tr_MGC_2 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 2) | 100% |
| share_red_tr_MGC_3 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 3) | 100% |
| **SBC** | | | |
| SBC_cap_1 | >=0 | Capacity per unit (Type 1) | 32.000 (VoIP-IC calls) |
| SBC_cap_2 | >=0 | Capacity per unit (Type 2) | 128.000 (VoIP-IC calls) |
| SBC_cap_3 | >=0 | Capacity per unit (Type 3) | 512.000 (VoIP-IC calls) |
| nt_CLC | >=0 | Number of locations with SBC | 2 (At all Voice IP IC locations) |
| ur_SBC_1 | [0,1] | Maximum utilization ratio (Type 1) | 80% |
| ur_SBC_2 | [0,1] | Maximum utilization ratio (Type 2) | 80% |
| ur_SBC_3 | [0,1] | Maximum utilization ratio (Type 3) | 80% |
| n_SBC_red_1 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 1) | 1 |
| n_SBC_red_2 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 2) | 1 |
| n_SBC_red_3 | >=0 | Number of units which capacity has to be replaced by the others in case of failure (redundancy) (Type 3) | 1 |
| share_red_tr_SBC_1 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 1) | 100% |
| share_red_tr_SBC_2 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 2) | 100% |
| share_red_tr_SBC_3 | [0,1] | % from original traffic per unit to be managed by the others in case of failure (redundancy) (Type 3) | 100% |

## 2.3 Traffic Parameters

In diesem Abschnitt werden verschiedene Traffic Parameter, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| ndays | >0 | Number of days for the conversion of day traffic to annual traffic | 250 | |
| pbhd | [0,1] | Percentage of busy hour voice traffic in relation to total voice day traffic | 11,1% | |
| unb_min | [0,1] | Share of unbilled voice traffic | 10,0% | |
| share_sessions_BH | [0,1] | Parallel sessions in BH as a percentage of total user lines | 70% | Anzahl der von den BRAS abgewickelten Sessions in der Busy Hour angegeben als Prozentsatz der Anschlussleitungen aller Teilnehmer. |

## 2.4 Common cost and WACC

In diesem Abschnitt werden verschiedene Kostenparameter, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| WACC | [0,1] | Weighted Average Cost of Capital | 10,53% | |
| coco | [0,1] | Mark-up for common cost (in per cent), not considered for Pure LRIC calculation (but for LRIC+(in general) that may be applied for voice origination costs) | 0,00% | |
| coco_fix | >=0 | (Additional) common cost as a fixed annual amount [€] | 0 | |

## 2.5 Mark-ups for network support investment

In diesem Abschnitt werden Mark-ups für Network Support (z.B. Fuhrpark, Bürogebäude) Investitionen, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value |
|---|---|---|---|
| **Ethernet Switch** | | | |
| iif_mv_ESW | [0,1] | Investment for motor vehicles (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 3% |
| iif_of_ESW | [0,1] | Investment for office equipment (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 0,5% |
| iif_wo_ESW | [0,1] | Investment for workshop equipment (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 1% |
| iif_it_ESW | [0,1] | Investment for IT network support equipment (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 2% |
| iif_nm_ESW | [0,1] | Investment for network management equipment (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 2% |
| iif_lb_ESW | [0,1] | Investment for land and buildings equipment (allocated to Ethernet Switch) as a percentage of direct investment in Ethernet Switch | 1% |
| **SDH equipment** | | | |
| iif_mv_SDH | [0,1] | Investment for motor vehicles (allocated to SDH equipment) as a percentage of direct investment in SDH equipment | 3% |
| iif_of_SDH | [0,1] | Investment for office equipment (allocated to SDH) as a percentage of direct investment in SDH | 0,5% |
| iif_wo_SDH | [0,1] | Investment for workshop equipment (allocated to SDH) as a percentage of direct investment in SDH | 1% |
| iif_it_SDH | [0,1] | Investment for IT network support equipment (allocated to SDH) as a percentage of direct investment in SDH | 2% |
| iif_nm_SDH | [0,1] | Investment for network management equipment (allocated to SDH) as a percentage of direct investment in SDH | 2% |
| iif_lb_SDH | [0,1] | Investment for land and buildings equipment (allocated to SDH) as a percentage of direct investment in SDH | 1% |
| **DWDM equipment** | | | |
| iif_mv_DWDM | [0,1] | Investment for motor vehicles (allocated to DWDM equipment) as a percentage of direct investment in DWDM equipment | 3% |
| iif_of_DWDM | [0,1] | Investment for office equipment (allocated to DWDM) as a percentage of direct investment in DWDM | 0,5% |
| iif_wo_DWDM | [0,1] | Investment for workshop equipment (allocated to DWDM) as a percentage of direct investment in DWDM | 1% |
| iif_it_DWDM | [0,1] | Investment for IT network support equipment (allocated to DWDM) as a percentage of direct investment in DWDM | 2% |
| iif_nm_DWDM | [0,1] | Investment for network management equipment (allocated to DWDM) as a percentage of direct investment in DWDM | 2% |
| iif_lb_DWDM | [0,1] | Investment for land and buildings equipment (allocated to DWDM) as a percentage of direct investment in DWDM | 1% |
| **OTN equipment** | | | |
| iif_mv_OTN | [0,1] | Investment for motor vehicles (allocated to OTN equipment) as a percentage of direct investment in OTN equipment | 2% |
| iif_of_OTN | [0,1] | Investment for office equipment (allocated to OTN) as a percentage of direct investment in OTN | 0,4% |
| iif_wo_OTN | [0,1] | Investment for workshop equipment (allocated to OTN) as a percentage of direct investment in OTN | 1% |
| iif_it_OTN | [0,1] | Investment for IT network support equipment (allocated to OTN) as a percentage of direct investment in OTN | 2% |
| iif_nm_OTN | [0,1] | Investment for network management equipment (allocated to OTN) as a percentage of direct investment in OTN | 2% |
| iif_lb_OTN | [0,1] | Investment for land and buildings equipment (allocated to OTN) as a percentage of direct investment in OTN | 1% |
| **Layer 0 equipment** | | | |
| iif_mv_layer_0 | [0,1] | Investment for motor vehicles (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 3% |
| iif_of_layer_0 | [0,1] | Investment for office equipment (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 0,5% |
| iif_wo_layer_0 | [0,1] | Investment for workshop equipment (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 1% |
| iif_it_layer_0 | [0,1] | Investment for IT network support equipment (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 2% |
| iif_nm_layer_0 | [0,1] | Investment for network management equipment (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 2% |
| iif_lb_layer_0 | [0,1] | Investment for land and buildings equipment (allocated to Layer 0 equipment) as a percentage of direct investment in Layer 0 equipment | 1% |

| | | | |
|---|---|---|---|
| **Label Edge Router** | | | |
| iif_mv_LER | [0,1] | Investment for motor vehicles (allocated to LER) as a percentage of direct investment in LER | 3% |
| iif_of_LER | [0,1] | Investment for office equipment (allocated to LER) as a percentage of direct investment in LER | 0,5% |
| iif_wo_LER | [0,1] | Investment for workshop equipment (allocated to LER) as a percentage of direct investment in LER | 1% |
| iif_it_LER | [0,1] | Investment for IT network support equipment (allocated to LER) as a percentage of direct investment in LER | 2% |
| iif_nm_LER | [0,1] | Investment for network management equipment (allocated to LER) as a percentage of direct investment in LER | 2% |
| iif_lb_LER | [0,1] | Investment for land and buildings equipment (allocated to LER) as a percentage of direct investment in LER | 1% |
| **Label Switch Router** | | | |
| iif_mv_LSR | [0,1] | Investment for motor vehicles (allocated to LSR) as a percentage of direct investment in LSR | 3% |
| iif_of_LSR | [0,1] | Investment for office equipment (allocated to LSR) as a percentage of direct investment in LSR | 0,5% |
| iif_wo_LSR | [0,1] | Investment for workshop equipment (allocated to LSR) as a percentage of direct investment in LSR | 1% |
| iif_it_LSR | [0,1] | Investment for IT network support equipment (allocated to LSR) as a percentage of direct investment in LSR | 2% |
| iif_nm_LSR | [0,1] | Investment for network management equipment (allocated to LSR) as a percentage of direct investment in LSR | 2% |
| iif_lb_LSR | [0,1] | Investment for land and buildings equipment (allocated to LSR) as a percentage of direct investment in LSR | 1% |
| **Media Gateway** | | | |
| iif_mv_MGW | [0,1] | Investment for motor vehicles (allocated to MGW) as a percentage of direct investment in MGW | 3% |
| iif_of_MGW | [0,1] | Investment for office equipment (allocated to MGW) as a percentage of direct investment in MGW | 0,5% |
| iif_wo_MGW | [0,1] | Investment for workshop equipment (allocated to MGW) as a percentage of direct investment in MGW | 1% |
| iif_it_MGW | [0,1] | Investment for IT network support equipment (allocated to MGW) as a percentage of direct investment in MGW | 2% |
| iif_nm_MGW | [0,1] | Investment for network management equipment (allocated to MGW) as a percentage of direct investment in MGW | 2% |
| iif_lb_MGW | [0,1] | Investment for land and buildings equipment (allocated to MGW) as a percentage of direct investment in MGW | 1% |
| **Sites** | | | |
| iif_mv_sites | [0,1] | Investment for motor vehicles (allocated to sites) as a percentage of direct investment in sites | 3% |
| iif_of_sites | [0,1] | Investment for office equipment (allocated to sites) as a percentage of direct investment in sites | 0,5% |
| iif_wo_sites | [0,1] | Investment for workshop equipment (allocated to sites) as a percentage of direct investment in sites | 1% |
| iif_it_sites | [0,1] | Investment for IT network support equipment (allocated to sites) as a percentage of direct investment in sites | 2% |
| iif_nm_sites | [0,1] | Investment for network management equipment (allocated to sites) as a percentage of direct investment in sites | 2% |
| iif_lb_sites | [0,1] | Investment for land and buildings equipment (allocated to sites) as a percentage of direct investment in sites | 1% |
| **Racks** | | | |
| iif_mv_racks | [0,1] | Investment for motor vehicles (allocated to racks) as a percentage of direct investment in racks | 3% |
| iif_of_racks | [0,1] | Investment for office equipment (allocated to racks) as a percentage of direct investment in racks | 0,5% |
| iif_wo_racks | [0,1] | Investment for workshop equipment (allocated to racks) as a percentage of direct investment in racks | 1% |
| iif_it_racks | [0,1] | Investment for IT network support equipment (allocated to racks) as a percentage of direct investment in racks | 2% |
| iif_nm_racks | [0,1] | Investment for network management equipment (allocated to racks) as a percentage of direct investment in racks | 2% |
| iif_lb_racks | [0,1] | Investment for land and buildings equipment (allocated to racks) as a percentage of direct investment in racks | 1% |
| **BRAS** | | | |
| iif_mv_BRAS | [0,1] | Investment for motor vehicles (allocated to BRAS) as a percentage of direct investment in BRAS | 3% |
| iif_of_BRAS | [0,1] | Investment for office equipment (allocated to BRAS) as a percentage of direct investment in BRAS | 0,5% |
| iif_wo_BRAS | [0,1] | Investment for workshop equipment (allocated to BRAS) as a percentage of direct investment in BRAS | 1% |
| iif_it_BRAS | [0,1] | Investment for IT network support equipment (allocated to BRAS) as a percentage of direct investment in BRAS | 2% |
| iif_nm_BRAS | [0,1] | Investment for network management equipment (allocated to BRAS) as a percentage of direct investment in BRAS | 2% |
| iif_lb_BRAS | [0,1] | Investment for land and buildings equipment (allocated to BRAS) as a percentage of direct investment in BRAS | 1% |

| | | | |
|---|---|---|---|
| **RADIUS** | | | |
| iif_mv_RADIUS | [0,1] | Investment for motor vehicles (allocated to RADIUS) as a percentage of direct investment in RADIUS | 3% |
| iif_of_RADIUS | [0,1] | Investment for office equipment (allocated to RADIUS) as a percentage of direct investment in RADIUS | 0,5% |
| iif_wo_RADIUS | [0,1] | Investment for workshop equipment (allocated to RADIUS) as a percentage of direct investment in RADIUS | 1% |
| iif_it_RADIUS | [0,1] | Investment for IT network support equipment (allocated to RADIUS) as a percentage of direct investment in RADIUS | 2% |
| iif_nm_RADIUS | [0,1] | Investment for network management equipment (allocated to RADIUS) as a percentage of direct investment in RADIUS | 2% |
| iif_lb_RADIUS | [0,1] | Investment for land and buildings equipment (allocated to RADIUS) as a percentage of direct investment in RADIUS | 1% |
| **DNS** | | | |
| iif_mv_DNS | [0,1] | Investment for motor vehicles (allocated to DNS) as a percentage of direct investment in DNS | 3% |
| iif_of_DNS | [0,1] | Investment for office equipment (allocated to DNS) as a percentage of direct investment in DNS | 0,5% |
| iif_wo_DNS | [0,1] | Investment for workshop equipment (allocated to DNS) as a percentage of direct investment in DNS | 1% |
| iif_it_DNS | [0,1] | Investment for IT network support equipment (allocated to DNS) as a percentage of direct investment in DNS | 2% |
| iif_nm_DNS | [0,1] | Investment for network management equipment (allocated to DNS) as a percentage of direct investment in DNS | 2% |
| iif_lb_DNS | [0,1] | Investment for land and buildings equipment (allocated to DNS) as a percentage of direct investment in DNS | 1% |
| **Softswitch** | | | |
| iif_mv_SSW | [0,1] | Investment for motor vehicles (allocated to Softswitch) as a percentage of direct investment in Softswitch | 3% |
| iif_of_SSW | [0,1] | Investment for office equipment (allocated to Softswitch) as a percentage of direct investment in Softswitch | 0,5% |
| iif_wo_SSW | [0,1] | Investment for workshop equipment (allocated to Softswitch) as a percentage of direct investment in Softswitch | 1% |
| iif_it_SSW | [0,1] | Investment for IT network support equipment (allocated to Softswitch) as a percentage of direct investment in Softswitch | 2% |
| iif_nm_SSW | [0,1] | Investment for network management equipment (allocated to Softswitch) as a percentage of direct investment in Softswitch | 2% |
| iif_lb_SSW | [0,1] | Investment for land and buildings equipment (allocated to Softswitch) as a percentage of direct investment in Softswitch | 1% |
| **Media Gateway Controler** | | | |
| iif_mv_MGC | [0,1] | Investment for motor vehicles (allocated to MGC) as a percentage of direct investment in MGC | 3% |
| iif_of_MGC | [0,1] | Investment for office equipment (allocated to MGC) as a percentage of direct investment in MGC | 0,5% |
| iif_wo_MGC | [0,1] | Investment for workshop equipment (allocated to MGC) as a percentage of direct investment in MGC | 1% |
| iif_it_MGC | [0,1] | Investment for IT network support equipment (allocated to MGC) as a percentage of direct investment in MGC | 2% |
| iif_nm_MGC | [0,1] | Investment for network management equipment (allocated to MGC) as a percentage of direct investment in MGC | 2% |
| iif_lb_MGC | [0,1] | Investment for land and buildings equipment (allocated to MGC) as a percentage of direct investment in MGC | 1% |
| **Session Border Controler** | | | |
| iif_mv_SBC | [0,1] | Investment for motor vehicles (allocated to SBC) as a percentage of direct investment in SBC | 3% |
| iif_of_SBC | [0,1] | Investment for office equipment (allocated to SBC) as a percentage of direct investment in SBC | 0,5% |
| iif_wo_SBC | [0,1] | Investment for workshop equipment (allocated to SBC) as a percentage of direct investment in SBC | 1% |
| iif_it_SBC | [0,1] | Investment for IT network support equipment (allocated to SBC) as a percentage of direct investment in SBC | 2% |
| iif_nm_SBC | [0,1] | Investment for network management equipment (allocated to SBC) as a percentage of direct investment in SBC | 2% |
| iif_lb_SBC | [0,1] | Investment for land and buildings equipment (allocated to SBC) as a percentage of direct investment in SBC | 1% |

## 2.6 Economic lifetime

In diesem Abschnitt wird die ökonomische Lebensdauer je Netzelementtyp und anderer Betriebsmittel, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value [Jahre] | Comments |
|---|---|---|---|---|
| el_ESW | >0 | Economic lifetime for Ethernet switch unit | 8 | |
| el_ESW_ports | >0 | Economic lifetime for ESW ports | 8 | |
| el_MGW | >0 | Economic lifetime for Media Gateway | 8 | |
| el_LER | >0 | Economic lifetime for LER | 8 | |
| el_LER_ports | >0 | Economic lifetime for LER ports | 8 | |
| el_LSR | >0 | Economic lifetime for LSR | 8 | |
| el_LSR_ports | >0 | Economic lifetime for LSR ports | 8 | |
| el_SDH | >0 | Economic lifetime for SDH Multiplexer | 8 | |
| el_SDH_ports | >0 | Economic lifetime for SDH Multiplexer ports | 8 | |
| el_DWDM | >0 | Economic lifetime for DWDM unit | 8 | |
| el_DWDM_ports | >0 | Economic lifetime for DWDM ports | 8 | |
| el_OTN | >0 | Economic lifetime for OTN unit | 8 | |
| el_OTN_ports | >0 | Economic lifetime for OTN ports | 8 | |
| el_SDH_reg | >0 | Economic lifetime for SDH repeater | 8 | |
| el_DWDM_reg | >0 | Economic lifetime for DWDM repeater | 8 | |
| el_OTN_reg | >0 | Economic lifetime for OTN repeater | 8 | |
| el_DWDM_OXC | >0 | Economic lifetime for DWDM OXC unit | 8 | |
| el_DWDM_OXC_ports | >0 | Economic lifetime for DWDM OXC ports | 8 | |
| el_OTN_OXC | >0 | Economic lifetime for OTN OXC unit | 8 | |
| el_OTN_OXC_ports | >0 | Economic lifetime for OTN OXC ports | 8 | |
| el_DSLAM | >0 | Economic lifetime for DSLAM | 8 | |
| el_cable | >0 | Economic lifetime for cables | 20 | |
| el_infra | >0 | Economic lifetime for trenches (incl. empty ducts) | 35 | |
| el_accomm_log_eq | >0 | Economic lifetime for Accommodation assets Layer 2/3 equipment | 10 | |
| el_accomm_phys_eq | >0 | Economic lifetime for Accommodation assets Layer 1/0 equipment | 10 | |
| el_build | >0 | Economic lifetime for buildings | 50 | |
| el_land | >0 | Economic lifetime for land | 100 | |
| el_racks | >0 | Economic lifetime for racks | 20 | |
| el_BRAS | >0 | Economic lifetime for BRAS | 8 | |
| el_RADIUS | >0 | Economic lifetime for RADIUS | 8 | |
| el_DNS | >0 | Economic lifetime for DNS | 8 | |
| el_SSW | >0 | Economic lifetime for Softswitch | 5 | |
| el_MGC | >0 | Economic lifetime for Media Gateway Controller | 8 | |
| el_SBC | >0 | Economic lifetime for SBC | 8 | |
| el_mv | >0 | Economic lifetime for motor vehicles | 5 | |
| el_of | >0 | Economic lifetime for office equipment | 6 | |
| el_wo | >0 | Economic lifetime for workshop equipment | 5 | |
| el_it | >0 | Economic lifetime for IT network support equipment | 5 | |
| el_nm | >0 | Economic lifetime for network management equipment | 6 | |
| el_lb | >0 | Economic lifetime for land and buildings | 28 | |

## 2.7 Expected annual rate of price change

In diesem Abschnitt wird die erwartete durchschnittliche prozentuelle Preisänderung je Jahr, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| dp_ESW | [0,1] | Expected price change for Ethernet switch unit | -4% | |
| dp_ESW_ports | [0,1] | Expected price change for ESW ports | -4% | |
| dp_MGW | [0,1] | Expected price change for Media Gateway | -6% | |
| dp_LER | [0,1] | Expected price change for LER | -5% | |
| dp_LER_ports | [0,1] | Expected price change for LER ports | -5% | |
| dp_LSR | [0,1] | Expected price change for LSR | -5% | |
| dp_LSR_ports | [0,1] | Expected price change for LSR ports | -5% | |
| dp_SDH | [0,1] | Expected price change for SDH Multiplexer | -3% | |
| dp_SDH_ports | [0,1] | Expected price change for SDH Multiplexer ports | -3% | |
| dp_DWDM | [0,1] | Expected price change for DWDM unit | -5% | |
| dp_DWDM_ports | [0,1] | Expected price change for DWDM ports | -5% | |
| dp_OTN | [0,1] | Expected price change for OTN unit | -8% | |
| dp_OTN_ports | [0,1] | Expected price change for OTN ports | -8% | |
| dp_SDH_reg | [0,1] | Expected price change for SDH repeater | -3% | |
| dp_DWDM_reg | [0,1] | Expected price change for DWDM repeater | -5% | |
| dp_OTN_reg | [0,1] | Expected price change for OTN repeater | -8% | |
| dp_DWDM_OXC | [0,1] | Expected price change for DWDM OXC unit | -5% | |
| dp_DWDM_OXC_ports | [0,1] | Expected price change for DWDM OXC ports | -5% | |
| dp_OTN_OXC | [0,1] | Expected price change for OTN OXC unit | -8% | |
| dp_OTN_OXC_ports | [0,1] | Expected price change for OTN OXC ports | -8% | |
| dp_DSLAM | [0,1] | Expected price change for DSLAM | -9% | |
| dp_cable | [0,1] | Expected price change for cables | -3% | |
| dp_infra | [0,1] | Expected price change for trenches (incl. empty ducts) | 1% | |
| dp_accomm_log_eq | [0,1] | Expected price change for Accommodation assets Layer 2/3 equipment | 2% | |
| dp_accomm_phys_eq | [0,1] | Expected price change for Accommodation assets Layer 1/0 equipment | -2% | |
| dp_build | [0,1] | Expected price change for buildings | 2% | |
| dp_land | [0,1] | Expected price change for land | 2% | |
| dp_racks | [0,1] | Expected price change for racks | -2% | |
| dp_BRAS | [0,1] | Expected price change for BRAS | -5% | |
| dp_RADIUS | [0,1] | Expected price change for RADIUS | -5% | |
| dp_DNS | [0,1] | Expected price change for DNS | -5% | |
| dp_SSW | [0,1] | Expected price change for Softswitch | -5% | |
| dp_MGC | [0,1] | Expected price change for Media Gateway Controller | -2% | |
| dp_SBC | [0,1] | Expected price change for SBC | -2% | |
| dp_mv | [0,1] | Expected price change for motor vehicles | 2% | |
| dp_of | [0,1] | Expected price change for office equipment | 2% | |
| dp_wo | [0,1] | Expected price change for workshop equipment | 2% | |
| dp_it | [0,1] | Expected price change for IT network support equipment | -5% | |
| dp_nm | [0,1] | Expected price change for network management equipment | 2% | |
| dp_lb | [0,1] | Expected price change for land and buildings | 1% | |

## 2.8 Growth rate

In diesem Abschnitt wird die prognostizierte durchschnittliche Änderungsrate der Auslastung je Netzelementtyp, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| g_ESW | [0,1] | Expected growth rate for Ethernet switch unit | 0% | |
| g_ESW_ports | [0,1] | Expected growth rate for ESW ports | 0% | |
| g_MGW | [0,1] | Expected growth rate for Media Gateway | -17% | |
| g_LER | [0,1] | Expected growth rate for LER | 0% | |
| g_LER_ports | [0,1] | Expected growth rate for LER ports | 0% | |
| g_LSR | [0,1] | Expected growth rate for LSR | 0% | |
| g_LSR_ports | [0,1] | Expected growth rate for LSR ports | 0% | |
| g_SDH | [0,1] | Expected growth rate for SDH Multiplexer | 0% | |
| g_SDH_ports | [0,1] | Expected growth rate for SDH Multiplexer ports | 0% | |
| g_DWDM | [0,1] | Expected growth rate for DWDM unit | 0% | |
| g_DWDM_ports | [0,1] | Expected growth rate for DWDM ports | 0% | |
| g_OTN | [0,1] | Expected growth rate for OTN unit | 0% | |
| g_OTN_ports | [0,1] | Expected growth rate for OTN ports | 0% | |
| g_SDH_reg | [0,1] | Expected growth rate for SDH repeater | 0% | |
| g_DWDM_reg | [0,1] | Expected growth rate for DWDM repeater | 0% | |
| g_OTN_reg | [0,1] | Expected growth rate for OTN repeater | 0% | |
| g_DWDM_OXC | [0,1] | Expected growth rate for DWDM OXC unit | 0% | |
| g_DWDM_OXC_ports | [0,1] | Expected growth rate for DWDM OXC ports | 0% | |
| g_OTN_OXC | [0,1] | Expected growth rate for OTN OXC unit | 0% | |
| g_OTN_OXC_ports | [0,1] | Expected growth rate for OTN OXC ports | 0% | |
| g_DSLAM | [0,1] | Expected growth rate for DSLAM | 0% | |
| g_cable | [0,1] | Expected growth rate for cables | 12% | |
| g_infra | [0,1] | Expected growth rate for trenches (incl. empty ducts) | 12% | |
| g_accomm_log_eq | [0,1] | Expected growth rate for Accommodation assets Layer 2/3 equipment | 24% | |
| g_accomm_phys_eq | [0,1] | Expected growth rate for Accommodation assets Layer 1/0 equipment | 24% | |
| g_build | [0,1] | Expected growth rate for buildings | 12% | |
| g_land | [0,1] | Expected growth rate for land | 12% | |
| g_racks | [0,1] | Expected growth rate for racks | 0% | |
| g_BRAS | [0,1] | Expected growth rate for BRAS | 0% | |
| g_RADIUS | [0,1] | Expected growth rate for RADIUS | 0% | |
| g_DNS | [0,1] | Expected growth rate for DNS | -17% | |
| g_SSW | [0,1] | Expected growth rate for Softswitch | -17% | |
| g_MGC | [0,1] | Expected growth rate for Media Gateway Controller | -17% | |
| g_SBC | [0,1] | Expected growth rate for SBC | -17% | |
| g_mv | [0,1] | Expected growth rate for motor vehicles | 0% | |
| g_of | [0,1] | Expected growth rate for office equipment | 0% | |
| g_wo | [0,1] | Expected growth rate for workshop equipment | 0% | |
| g_it | [0,1] | Expected growth rate for IT network support equipment | 0% | |
| g_nm | [0,1] | Expected growth rate for network management equipment | 0% | |
| g_lb | [0,1] | Expected growth rate for land and buildings | 0% | |

## 2.9 OPEX mark-ups

In diesem Abschnitt werden die jährlichen Betriebskosten als Prozentsatz der Investitionen, die bei der Bottom-up Modellierung verwendet werden, definiert.

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| ocf_ESW | [0,1] | Annual OPEX for Ethernet switch and ports as a percentage of direct investment | 11% | |
| ocf_SDH | [0,1] | Annual OPEX for SDH equipment as a percentage of direct investment | 8% | |
| ocf_DWDM | [0,1] | Annual OPEX for DWDM equipment as a percentage of direct investment | 8% | |
| ocf_OTN | [0,1] | Annual OPEX for OTN equipment as a percentage of direct investment | 8% | |
| ocf_layer_0 | [0,1] | Annual OPEX for Layer 0 equipment as a percentage of direct investment | 1% | |
| ocf_LER | [0,1] | Annual OPEX for LER and ports as a percentage of direct investment | 12% | |
| ocf_LSR | [0,1] | Annual OPEX for LSR and ports as a percentage of direct investment | 12% | |
| ocf_DWDM | [0,1] | Annual OPEX for DWDM equipment as a percentage of direct investment | 8% | |
| ocf_OTN | [0,1] | Annual OPEX for OTN equipment as a percentage of direct investment | 8% | |
| ocf_DSLAM | [0,1] | Annual OPEX for DSLAM equipment as a percentage of direct investment | 8% | |
| ocf_layer_0 | [0,1] | Annual OPEX for Layer 0 equipment as a percentage of direct investment | 1% | |
| ocf_MGW | [0,1] | Annual OPEX for Media Gateway as a percentage of direct investment | 12% | |
| ocf_sites | [0,1] | Annual OPEX for sites as a percentage of direct investment | 7% | |
| ocf_racks | [0,1] | Annual OPEX for racks as a percentage of direct investment | 1% | |
| ocf_BRAS | [0,1] | Annual OPEX for BRAS as a percentage of direct investment | 11% | |
| ocf_RADIUS | [0,1] | Annual OPEX for RADIUS as a percentage of direct investment | 11% | |
| ocf_DNS | [0,1] | Annual OPEX for DNS as a percentage of direct investment | 11% | |
| ocf_SSW | [0,1] | Annual OPEX for Softswitch as a percentage of direct investment | 11% | |
| ocf_MGC | [0,1] | Annual OPEX for Media Gateway Controller as a percentage of direct investment | 11% | |
| ocf_SBC | [0,1] | Annual OPEX for SBC as a percentage of direct investment | 11% | |
| ocf_mv | [0,1] | Annual OPEX for motor vehicles as a percentage of direct investment | 11% | |
| ocf_of | [0,1] | Annual OPEX for office equipment as a percentage of direct investment | 11% | |
| ocf_wo | [0,1] | Annual OPEX for workshop equipment as a percentage of direct investment | 11% | |
| ocf_it | [0,1] | Annual OPEX for IT network support equipment as a percentage of direct investment | 11% | |
| ocf_nm | [0,1] | Annual OPEX for network management equipment as a percentage of direct investment | 30% | |
| ocf_lb | [0,1] | Annual OPEX for land and buildings as a percentage of direct investment | 5% | |

## 2.10 Other parameters

In diesem Abschnitt werden weitere Parameter bzgl. IPTV und gemeinsamer Durchführung von Grabungsarbeiten, die bei der Bottom-up Modellierung verwendet werden, definiert

| Parameter | Range | Description | Base Value | Comments |
|---|---|---|---|---|
| | | | | |
| IPTV | Yes/No | Consideration of IPTV outband for cost calculation | *No* | Die nachfolgenden Parameter share_IPTV_Li sind nur bei IPTV outband relevant. |
| share_IPTV_Li | [0,1] | Share of rings with IPTV traffic per transmission level 0-1 | *100%* | Beschreibt den Anteil der Ringe zwischen diesen Ebenen, über die IPTV Signale in separater Faser geführt werden. Wenn keine Knoten der unteren Ebene IPTV benötigen (keine Nachfrage von Kunden), dann muss ein Ring nicht mit IPTV beschaltet werden. |
| share_IPTV_Li | [0,1] | Share of rings with IPTV traffic per transmission level 1-2 | *100%* | Beschreibt den Anteil der Ringe zwischen diesen Ebenen, über die IPTV Signale in separater Faser geführt werden. Wenn keine Knoten der unteren Ebene IPTV benötigen (keine Nachfrage von Kunden), dann muss ein Ring nicht mit IPTV beschaltet werden. |
| share_IPTV_Li | [0,1] | Share of rings with IPTV traffic per transmission level 3-4 | *100%* | Beschreibt den Anteil der Ringe zwischen diesen Ebenen, über die IPTV Signale in separater Faser geführt werden. Wenn keine Knoten der unteren Ebene IPTV benötigen (keine Nachfrage von Kunden), dann muss ein Ring nicht mit IPTV beschaltet werden. |
| share_IPTV_Li | [0,1] | Share of rings with IPTV traffic per transmission level 4-5 | *100%* | Beschreibt den Anteil der Ringe zwischen diesen Ebenen, über die IPTV Signale in separater Faser geführt werden. Wenn keine Knoten der unteren Ebene IPTV benötigen (keine Nachfrage von Kunden), dann muss ein Ring nicht mit IPTV beschaltet werden. |
| share_IPTV_Li | [0,1] | Share of rings with IPTV traffic per transmission level 5-5 | *100%* | Beschreibt den Anteil der Ringe auf dieser Ebene, über die IPTV Signale in separater Faser geführt werden. Wenn keine Knoten der unteren Ebenen IPTV benötigen (keine Nachfrage von Kunden), dann muss ein Ring nicht mit IPTV beschaltet werden. Auf oberster Kernnetzebene kann das nur vorkommen, wenn nur in einem sehr begrenzten Gebiet IPTV angeboten wird. |
| share_trench_sharing | [0,1] | Share of trenches used by other utilities | *0%* | Der Faktor gibt an, inwieweit Trenches auch mit Gas, Wasser oder Strom, Straßenbeleuchtung, Ampelsteurungen etc. gemeinsam gebaut werden (Längenanteil), |
| n_shared_uses | >=0 | Number of shared uses | *2* | Im Falle dass Trenches auch mit Gas, Wasser oder Strom, Straßenbeleuchtung, Ampelsteurungen etc. gemeinsam gebaut werden, die Anzahl der anderen Unternehmungenn, die beteiligt sind. |
| add_dig_inv | [0,1] | Additional digging investment for second and more utilities | *30%* | In case of ducts with more than one utility being deployed , absolute duct investment will increase (share of investment per utility may however decrease) |
| share_TDM_IC_red | [0,1] | % from TDM voice IC traffic per location to be managed by others in case of failure (redundancy) | *100%* | |