

The DESY Local Area Network



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Overview

- The IP Network @ DESY
- Network Technologies
- Telephony @ DESY
- VoIP Installation, Design and Experience

Network Coverage



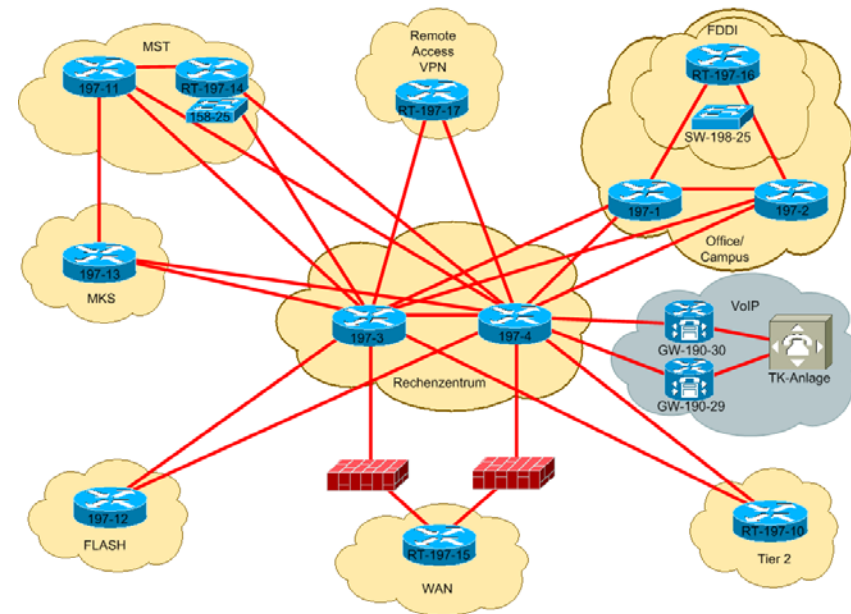
LAN Design



- Requirements:
 - The IP address space is structured into subnets according to the organizational structure of DESY (H1, ZEUS, V1, V2, FLASH, ...)
 - Subnet administration has been delegated to Segmentadministrators within the organizational groups
 - Groups are spread over the entire campus
 - Guests need fast access
 - Lot of movements
- Within the 'Office-Network' MAC addresses have to be registered but devices therefore can move around the entire campus without any reconfiguration
- Network is split into various autonomous areas

Network Layout

- Separated Layer-3-Networks
 - Office
 - Computing Centre
 - Accelerator Control
 - ...
- Connected via OSPF Routing Protocol
- Data rates:
 - CC ~ 100 + 20 TBytes/Tag
 - Backbone ~ 10 TBytes/Tag
 - Campus ~ 5 TBytes/Tag





Facts about the LAN

- OSPF routed 10 GBit/s backbone
- Switched Fast Ethernet (up to 100 MBit/s) available in all offices
- 11 Router, > 100 Switches
 - Homogeneous Cisco-Environment:
 - ~ 11.300 Ports with Fast Ethernet
 - ~ 4.350 Gigabit Ports (~750 Fiber, ~3.600 Copper)
 - ~ 75 10-GE Ports
 - ~ 18.500 DNS entries

LAN Technologies - Power over Ethernet



- PoE standard 802.3af enables power distribution via the Ethernet cable
 - Most interesting for IP Phones, Access Points, Cameras, ...
- Provides a maximum of 15,4 Watts (13 Watt at Powered Device, PD) at 48 Volts
- Power Supplies of the switches are growing (9000 Watt already available)
 - Power efficient Ethernet working group founded
- PoE-Plus standard 802.3at should deliver about 30 Watts

LAN Technologies – Gigabit-Ethernet



- The cabling installation within the newer buildings is capable of running at gigabit speeds
- Gigabit to end devices not (yet) rolled out:
 - Most switch ports are only Fast Ethernet capable
 - Limited backbone capacities as even the buildings are currently only connected via Gigabit
 - One misbehaving system could consume entire build bandwidth
 - no huge demand yet ...
- The data centers are fully gigabit capable
- Costs are ~ 100 € / port (incl PoE, etc.)

LAN Technologies - 10-Gigabit-Ethernet



- As usual the 10-Gigabit-Ethernet has first been implemented on fiber ports
 - Standard 802.3ae defined in July 2002
 - first installation at DESY in December 2003
 - Distances up to 40 km
 - Costs are ~ 7.000 € / port
- Bandwidth demands are still rising, so what will be next?
 - 40 or 100 GBit/s? in 2010 ???
 - At the moment the only solutions is link aggregation (up to 16 physical line form one logical link)

LAN Technologies - 10-Gigabit-Ethernet



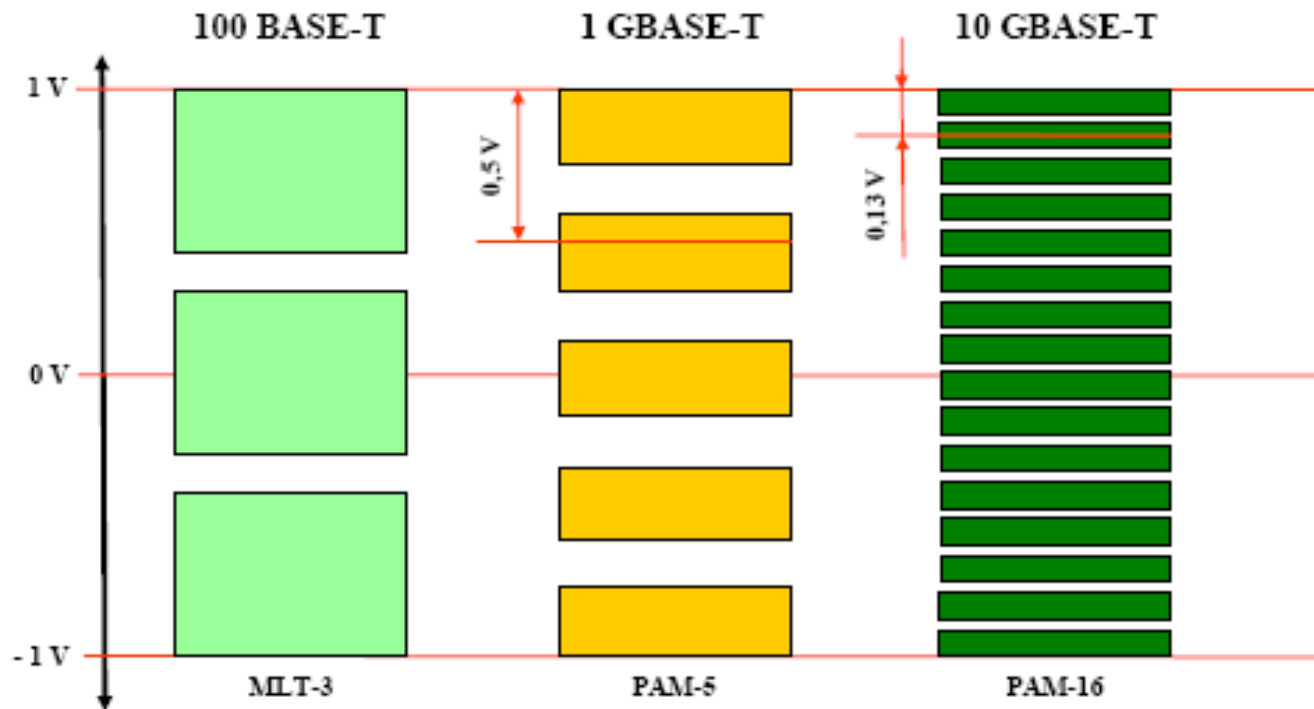
- Copper standard 802.3an (10GBase-T) was finished July 2006, but no components yet
 - heat dissipation (ca. 10 Watt/Port) is huge problem!
 - First components expected not before 2009
- There is one special version (10GBase-CX4) which is already available but requires special cabling and has limited distances (< 15 meter)
 - not used at DESY

10GBASE-T – the Challenge



Grundlagen 10 GBASE-T

Vergleich Pegel der Ausgangssignale:



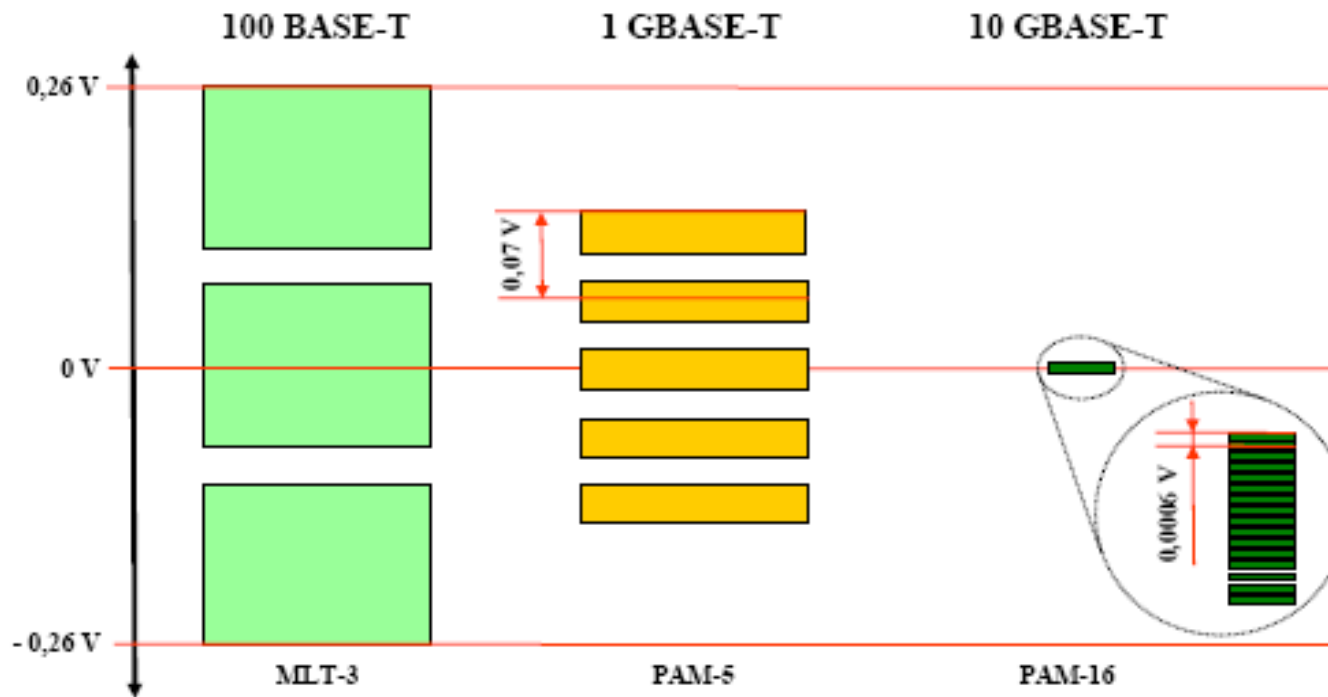
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2nd, 2007

10GBASE-T – the Challenge (2)



Grundlagen 10 GBASE-T

Vergleich Pegel der Eingangssignale:



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Wide Area Networking

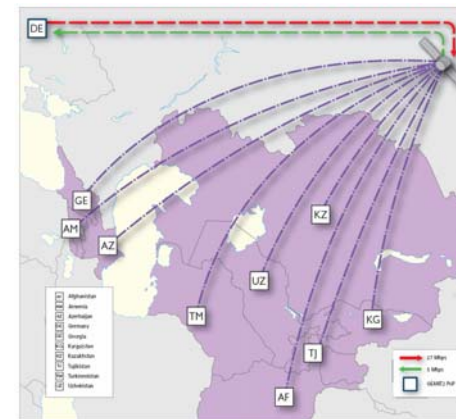


- DESY Hamburg has 2 independent 10 GBit/s lines to the german NREN DFN
 - 10 GBit/s for Tests, 1 GBit/s per contract
 - ~ 60 TBytes/month
- DESY Zeuthen connected with 155 MBit/s to DFN
- Site-to-Site VPN between Hamburg u. Zeuthen
- On July 30th a direct 10 GBit/s line will go into operation between Zeuthen and Hamburg

WAN Projects



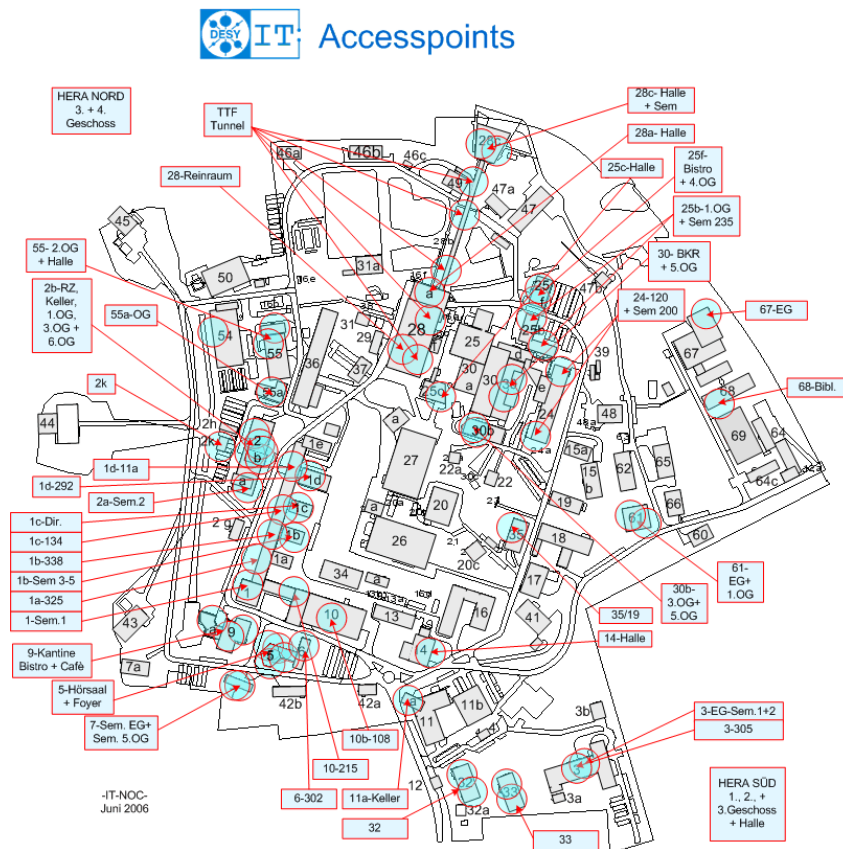
- **SILK**
 - Connecting the Caucasus and Central Asia NRENs to the European research networks
 - Via satellite, ~ 10 MBit/s per country
 - financed by NATO 'Security through Science'
- **OCCASION**
 - SILK Management
 - Enhanced functionalities
 - VoIP, Video Conferencing
 - financed by the EU



Wireless LAN



- ~ 100 access points installed
- 'Hot Spot'-Installation
 - Auditorium, seminar rooms, canteen, bistro, library...
 - New technologies now allow a wider coverage
- 802.11b (11 MBit/s)



WLAN (2)



- Former installation was based on intelligent access points with individual configuration
 - complicated management of frequency and transmit power within overlapping areas
- Installation has been migrated to a controller based solution
 - Central configuration management
 - Dynamic frequency adjustment
 - Dynamic transmit power adjustment
 - Fast Roaming

WLAN, the future



- Next standard at DESY is not yet defined, 802.11a/h (54 MBit/s) is preferred
 - 11b/g allows 13 channels in Germany, only 3 non-overlapping
 - 11h has 19 non-overlapping channels
 - 11h is the European version of 11a with TPC (Transmit Power Control) and DFS (Dynamic Frequency Selection)
 - Infrastructure will be planned for b/g and a/h
- Standard for 802.11n is on its way
 - Expected March 2008, official ratification September 2008
 - ~600 MBit/s, 2,4 and 5 GHz-Band, MIMO (Multiple Input Multiple Output)
 - New access points required, 6 antennas, ~ 25 Watts power consumption

Availability



- Stability of network components is very good
 - Average Uptime of components is > 1 year
 - ‚Record‘ is switch within the FLASH network with an uptime von 4 years, 38 weeks !
- Between 2000 and 2006 we have 400 years of operation with ca. 2165 hours downtime
 - ~ 99.94 % availability
 - ~ 10 % Maintenance
 - ~ 90 % Unexpected Outage due to external Events (Power, ...)
 - < 1 % Unplanned Downtime (Crashes, etc.)



Telephony at DESY

- Classical PBX build of
 - 2 Systems from Avaya (former Tenovis)
 - 155 and 1333 (old)
 - ~ 3850 Phone (~650 Digital Phones)
- A lot of long reach connections to analog phones especially within the accelerator tunnels (3-4 km)
- 4 PRI connections to the PSTN (30 channels each)
- Voice-/FAX-/SMS-Server
 - Cycos MRS

VoIP @ DESY



- First Installation of Cisco Callmanager in July 2000
 - Voice quality was bad, but idea was convincing
 - Important step was Version 3 with QSIG-Support (PBX Connection)
 - Still small things missing (leading 0 for external call, Calling Line ID, Call-Back on Busy, Billing of private Calls, etc.), was implemented stepwise
- Since February 2005 a Cisco Callmanager Cluster is in production
- Various phones in use (~ 400 phones)
 - Hardphones (High to Low-End)
 - Softphone released
 - WLAN phones within the next weeks, tests with video phones are underway

IP Phones



Video Telephony

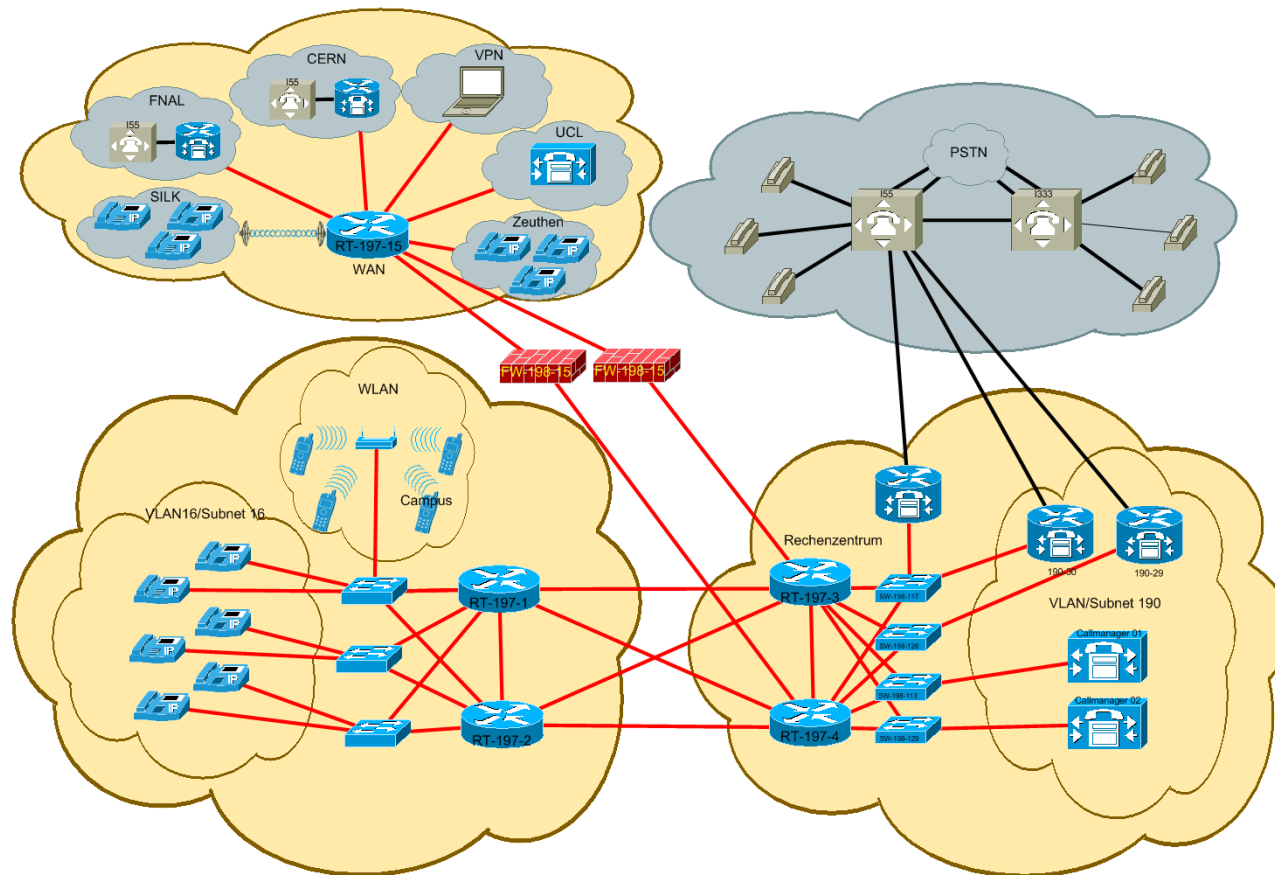




The VoIP Network

- 2 dedicated VLANs (Phones, Server)
 - both VLANs protected by firewalls
 - Phone VLAN provided via 'Auxiliary VLAN Functionality', thus PC can be used 'behind' the phone
- Integration between IPT installation and PBX
 - Two gateways, each with one PRI interface
 - External Calls still via PBX -> Billing!
- Nearly all phones operated via PoE and PoE installation is being extended
- No QoS configuration yet

VoIP Network Design



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Goals of the Migration



- Soft migration, no fork list installation at day X
- Integration into DESYs dialing plan
 - enables exchange of classic phones with IP phone without changing the phone number
- New PBX (I55) will still be operated for the next years (redundancy)
- Exchanging the old analog phone with IP phones (ca. 1900 devices)
 - New functionalities like Calling Line, Missed Calls, etc.
- The aim is to switch of the old I333
- No more investment into PBX

IPT experience



- No unexpected outage yet
 - ~ 2000 placed calls per day, ~ 1300 completed calls per day
 - ~ 4000 call minutes per day
- Current Callmanger is based on Windows 2003 Server
 - Patches required, works without interruption but maintenance window required
 - Callmanger 5.x will be Linux based appliance
- Excellent 'Hand-free-Operation' of IP-Phones
- Remote installations easy and fast
 - Zeuthen
 - Laptops
 - ...

Future of the IP Telephony



- Switch of old PBX (I333)
- Transparent integration of video conference systems und E.164 dial plan (H.323)
- Soft- und Video-Phones
- SIP-Support with Callmanager 5.x
 - Connecting any SIP capable Hard-/Software
- More Site-to-Site VoIP-Peering (Zeuthen, CERN, ...)
- WLAN phones und Dual Mode Mobiles
 - Dual Mode mobiles use WLAN if available
 - Allows Callmanger integration

Q + A

