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In-Premises Optical Fibre Deployment

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Market Survey Objectives

- analysis of installed fibre base to end-2000
- segmentation by type (50MMF, 62MMF, SMF)
- MMF segmentation by modal bandwidth
- installed backbone link length distribution
- installed fibre bundle sizes & overprovision
- Western Europe & United States addressed

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Optical Fibre Types & Trends

- IEC survey MMF usage in 1997 to reduce choice
  - >100 combinations of atten, NA & MB for MMFs
  - wide variation in MB, in particular for 50MMF
  - 62MMF MB essentially 160/500, 200/500 MHz.km
- 62MMF 160/500 dominance due to LAN choice
- ISO 11801 minimum MMF MB = 200/500 MHz.km
  - installed 50MMF far exceeds but MB often not known
  - proposal to separate 50MMF & 62MMF specifications
- TIA to specify MMF with MB of 500/500 MHz.km
- FIA finds 34% UK installed MMF without MB spec
  - high proportion expected to be below 200/500, 500/500

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Survey Methodology

- data extracted from supply industry & end users
- fibre/cable volumes from published market research
  - KMI world-wide optical fibre market 1997 & 1998
  - WIT world-wide & US structured cabling 1995, 1997, 1998
  - BSRIA European structured cabling 1998
- fibre/cable volumes from manufactr/supplier surveys
  - telephone interviews & questionnaires
  - key source of fibre size & MB segmentation
- installation data from installers, users, other surveys
  - telephone interviews & questionnaires
  - key source of installation statistics

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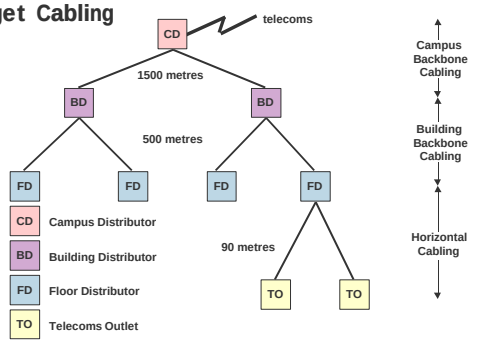
Target Cabling



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Survey Data

- fibre/cable data from major manufacturers/suppliers
- installation data from large end user organisations
- data from ~ 13,000 installed optical backbone links
- data from wide variety of sites, sectors & countries
  - site population 150 to 1,000, with few sites 5,000 to 10,000
  - sites had 150 to 6,000 cabling outlets, few with >10,000 outlets
  - many sole bldgs, many campuses with 1-10 bldgs, some >10
- existing surveys from Nouri, Di Minico & FIA (1996)
- installers generally best source of quantity & quality
- end users generally lacked plans & specifications

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Optical Fibre Market by Type (Western Europe)

- total fibre shipments 1994-2000 from KMI (1997)
- 50/62MMF shipments 1997-2002 from BSRIA (1998)
- 50/62MMF & SMF shipments 1994-2000 from survey
- good correlation of BSRIA & survey MMF data
- amalgamated data extrapolated back to 1990
- good confidence with MMF data
- poor correlation of SMF data, hence low confidence with SMF values and growth estimate

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Optical Fibre Market by Modal Bandwidth (Western Europe)

- shares of main fibre types for 1994-2000 from survey
- good correlation of 62MMF data, with 3 MBs identified
- poor correlation of 50MMF data, with 3 MBs identified and several MB grades omitted due to low presence
- survey data then extrapolated back to 1990
- installed base accumulated from 1990-2000 shipments
- pre-1990 fibre considered replaced or extinct

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Optical Fibre Market by Cabling Hierarchy and Modal Bandwidth (Western Europe)

- 1997 share of fibre in campus backbone, building backbone & horizontal estimated by BSRIA (1998)
- 1997 above share of fibre assumed constant over time
- installed base accumulated from 1990-2000 shipments
- installed base segmented by cabling hierarchy, fibre type and modal bandwidth

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Optical Cable Market by Cabling Hierarchy and Fibre Modal Bandwidth (Western Europe)

- 1997 cable shipments for campus backbone, building backbone & horizontal estimated by BSRIA (1998)
- 1990-2000 cable shipments estimated from fibre CAGR
  (note: this does not allow for increasing core count)
- share of SMF in backbones based on Nouri (1996)
- installed base accumulated from 1990-2000 shipments
- shipments and base segmented by cabling hierarchy, fibre type and modal bandwidth

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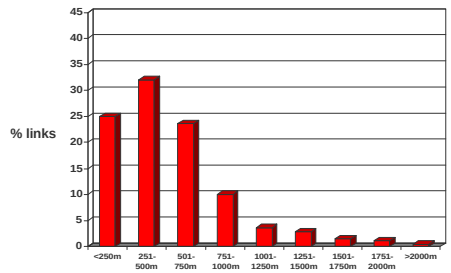
Installed Length Distribution in Campus Backbones (Western Europe)



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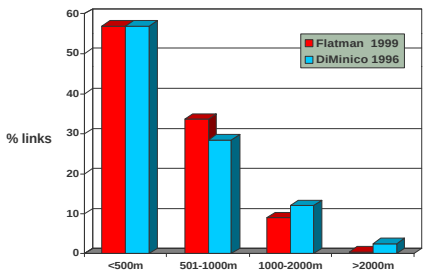

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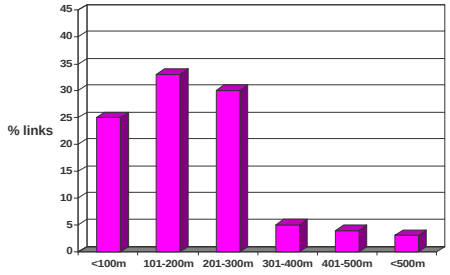
Installed Length Distribution in Building Backbones (Western Europe)



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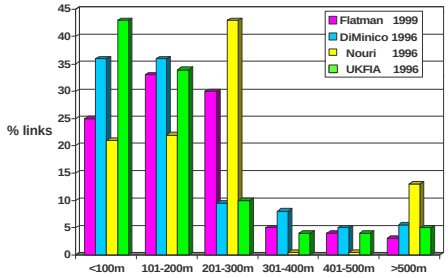

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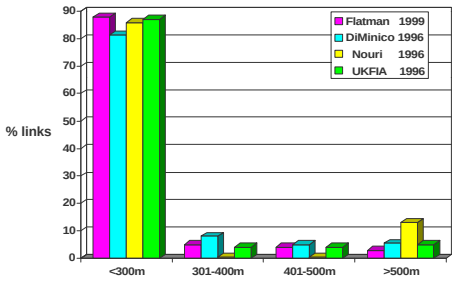

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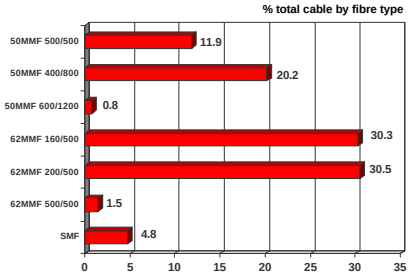
Share of Fibre Types in Campus Backbone end-2000 Installed Base (Western Europe)



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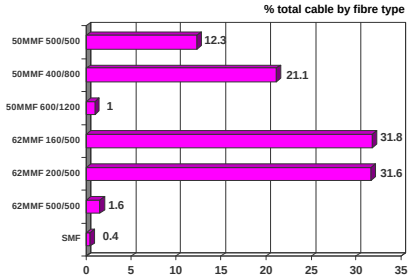

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Fibre-to-the-Desk (Western Europe)

- Euro suppliers suggest FTTD penetration approx 1- 2%
- almost 1% of total outlets shipped a/c to BSRIA (1998)

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Bundle Size & Fibre Overprovision (Western Europe)

- poor correlation in supplier & end user survey data
- no difference seen between 50MMF, 62MMF & SMF
- clear trend identified for increasing cable core count
- 10.5 fibres per backbone cable - BSRIA (1998) average
- 2.7 fibres per horizontal cable - BSRIA (1998) average
- strong regional variation seen:
  - UK favours 8-core, followed by 12-core
  - German standard is 12-core, with some up to 144
  - France has 6, 10 and 12-core

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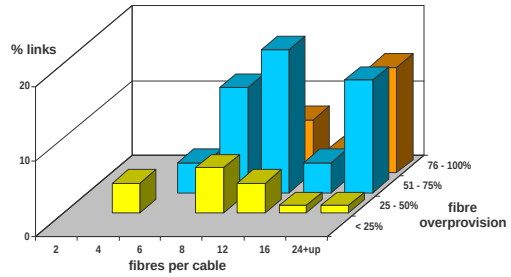
Over-provision of Fibres in Campus Backbone Installed Base (Western Europe)



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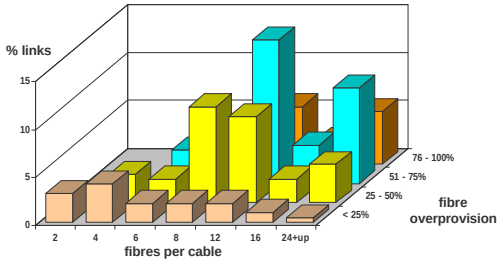

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Regional Variation (Western Europe)

Germany: 50MMF 400/800 popular (DBP spec)
50MMF 600/1200 is emerging
50MMF 600/1000 is also seen

France: 50MMF 400/750 most common grade of 50MMF

Holland: 50MMF 400/800 most common grade of 50MMF

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Optical Fibre Market by Type (United States)

- total fibre shipments 1994-2000 from KMI (1997)
- MMF shares based on Nouri (1996), DiMinico (1996)
  - 50MMF ~ 10%
  - 62MMF ~ 90%
- SMF share based on WIT (1998) ~ 3% total in 1997
- data extrapolated back to 1990 using KMI growth
- wide range of 50MMF share forecasts for US
  - some estimate 50MMF to be only 1% of installed base
  - TIA FOLS members estimate 50MMF base ~5% in 1996
  - 50MMF may be growing more strongly than 62MMF

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Optical Fibre Market by Modal Bandwidth (United States)

- small sample base of data provided by suppliers
- but many global fibre makers are US-based hence shares of main grades are based on Euro survey
- volume shipments calculated for each identified MB
- installed base accumulated from 1990-2000 shipments

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Optical Cable Market by Cabling Hierarchy and Fibre Modal Bandwidth (United States)

- total cable shipments 1995-2000 from WIT (1997)
- 1997 cable shipments for campus backbone, building backbone & horizontal estimated by WIT (1997):

  campus backbone = 8.4% (Europe = 24.5%)
  building backbone = 29.0% (Europe = 43.0%)
  horizontal cabling = 62.6% (Europe = 32.5%)

- WIT (1998) cable growth ~ KMI (1998) fibre growth
- data extrapolated back to 1990 using 22.5% CAGR
- installed base accumulated from 1990-2000 shipments
- shipments and base segmented by cabling hierarchy, fibre type and modal bandwidth

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Optical Fibre Market by Cabling Hierarchy and Modal Bandwidth (United States)

- fibre shipments are calculated from cable using core average counts estimated by WIT (1997):

  18 fibres per campus backbone cable
  12 fibres per building backbone cable
  2 fibres per horizontal cable

- share of SMF in backbones based on Nouri (1996)
- installed base accumulated from 1990-2000 shipments
- shipments and base segmented by cabling hierarchy, fibre type and modal bandwidth

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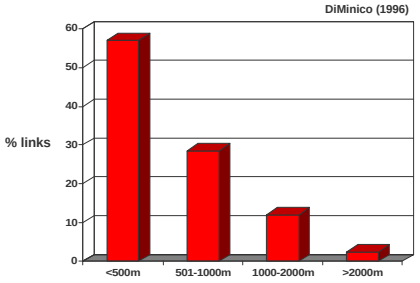
Installed Length Distribution in Campus Backbones (United States)



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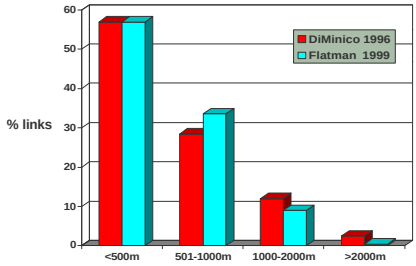

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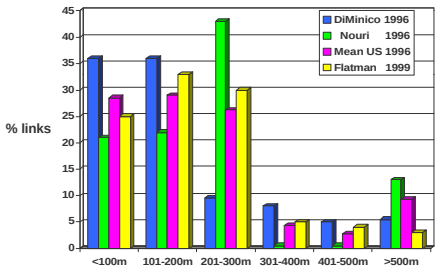

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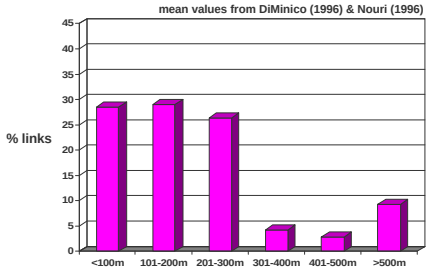

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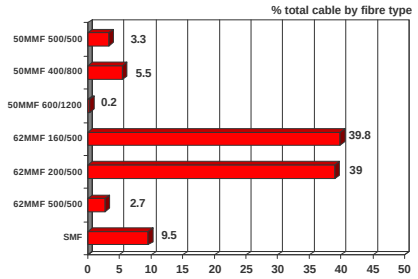

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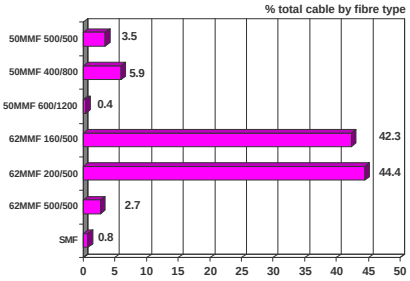

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Fibre-to-the-Desk (United States)

- US suppliers suggest FTTD penetration approx 2- 3%
- 3.3% FTTD penetration in US end 1997 a/c to WIT (1998)
- Frost & Sullivan recently estimated FTTD as 2.5% in US

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Bundle Size & Fibre Overprovision (United States)

- 18 fibres / campus backbone cable - WIT (1997) average
- 12 fibres / building backbone cable - WIT (1997) average
- 2 fibres / horizontal cable - WIT (1997) average
- strong trend indicated for increasing cable core count
- similar to European backbone cable trends
- no US data on fibre overprovision trends