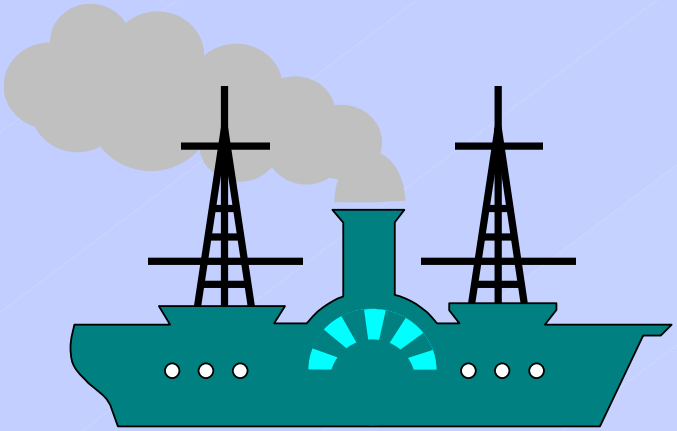

Undersea Cables

Jan 20

IDC Seminar

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Agenda

- **History**
- **Trans-Atlantic and Trans-Pacific cables**
- **Our area – Egypt & Israel**
- **Economics**

History, part 1

- **1840, Samuel Morse, Manhattan with Governor's Island**
- **Press was driving usage**
- **Western Union, AT&T of then, tried to end transatlantic cables**
  - **Had grand plan to go via Alaska and Siberia**

History, part 2

- **By July 1858 cable laid from Ireland to Newfoundland**
- **Aug 27, 1858 first words came across**
  - **25 words in hours**
- **Voltage was 600 volts on cable and press was furious about slow rate**

History, part 3

- **Dr. Whitehouse from UK raised the voltage**
  - **William Thomson had reservations but the chief electrician was given the go ahead**
  - **Voltage raised to 2000 volts, and cable's insulation failed, destroying the cable**
- **1866, first successful trans Atlantic cable**
  - **8 words/minute; $100 for 20 words**
- **1867 - Western Union buys Anglo-American**

History, part 4

- **1874 - Baudot invents TDM for telegraph line (90bps)**
- **1884 - First telephone call over undersea cable**
- **1928 - 21 telegragh trans-Atlantic cables**
  - **2,800 characters/minute**
- **1956 - TAT-1 begins operation**
  - **Sept 25th first call placed via TAT-1**
  - **Capacity – 51 calls**

History, part 5

- **First generation fiber cables carried 280Mb/sec**
  - **TAT-8 – 1988**
- **Second generation carried 560Mb/sec**
- **Third generation carries 2.5-5Gb/sec (1998)**
  - **2.5Gb/sec – STM16**
  - **Really 60,000 circuits x 64kb = 3.84Gb/sec**
  - **1.4Gb/sec used for overhead and error correction**

TransAtlantic cables

- **CANTAT-3** **2.5Gb/sec**
- **TAT-12, TAT-13** **5Gb/sec**
  - **Trans Atlantic Telephone**
  - **100,000km**
- **TAT-14** **16x10Gb/sec**
  - **15,000km, 4/2001**
- **Atlantis-2** **5Gb/sec**
  - **8500km, South America, Europe & Africa**
  - **$231M**
  - **Ready: 6/99**

TAT-14


Blaabjerg,
Norden,
Germany
UK
Bude-Haven
Katwijk,
St. Valery,
France
Italy
United States
Manasquan, NJ
Tuckerton, NJ

TransAtlantic Cables, part 2

- **Gemini** **30Gb/sec**
  - **MFS/Worldcom & CW, $500m, 6000km**
  - **1/2 Ready: 12/97; Completion: 12/98**
- **Columbus III** **10Gb/sec**
  - **US & Southern Europe, Ready: 7/99, 11,000km,$300m**
- **Atlantic Crossing Submarine Cable System (AC-1)** **10Gb/sec**
  - **14,000km, Ready: 3Q98, AT&T lead**

TransPacific cables

- **TPC-5CN** **5Gb/sec**
  - **25,000km, $1.2b, Japan & USA, 1996**
- **APCN - Asia Pacific Cable Network** **5Gb/sec**
  - **12,000km, $650m, 9 countries, 1997**
- **US/China Fiber Cable** **20Gb/sec**
  - **27,000km, $1.4b, 2001**
- **Tyco Transpacific** **96x10Gb/sec**
  - **2002**

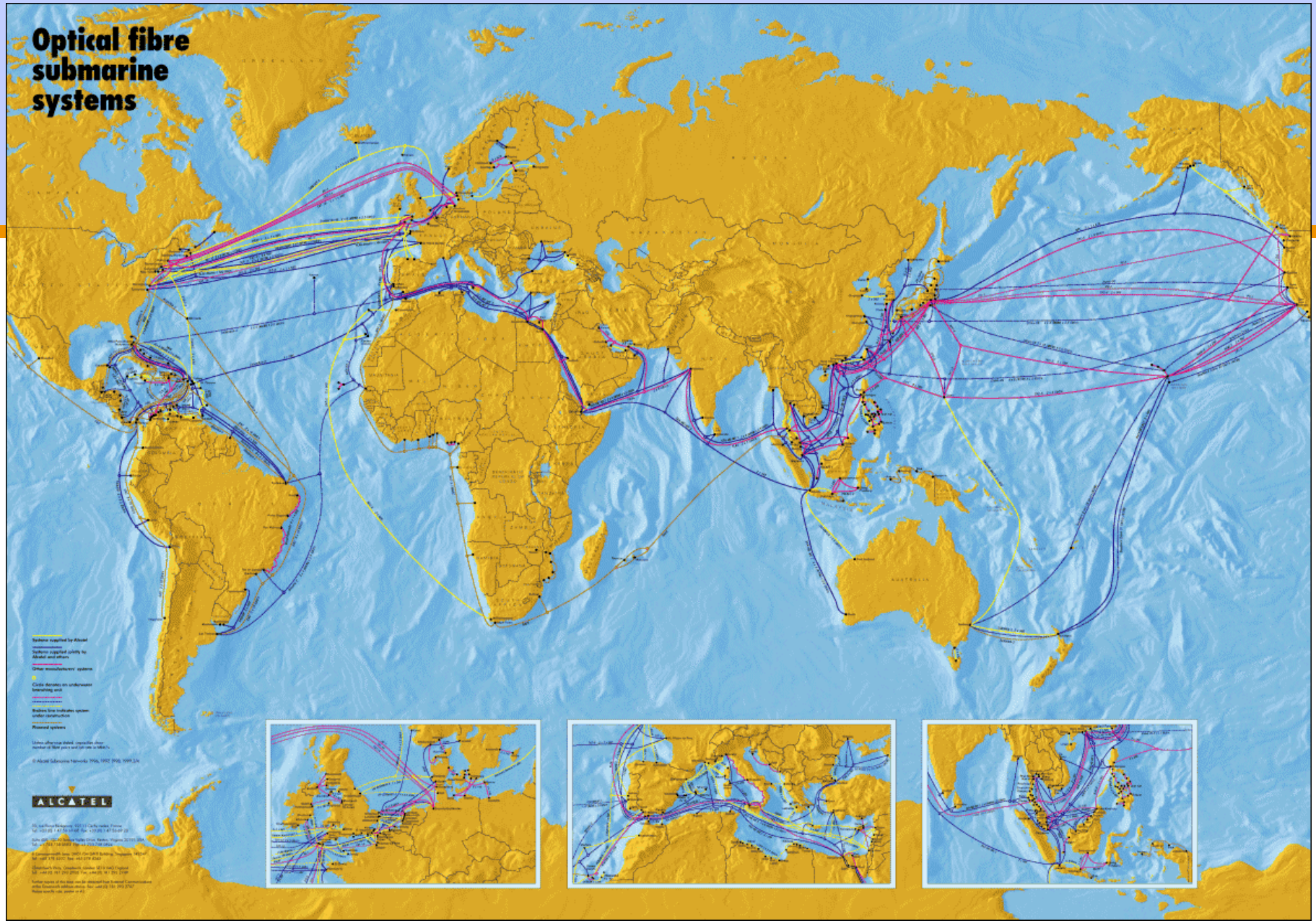
SEA-ME-WE-3

- **South East Asia - Middle East - Western Europe cable**
- **38,000km, in service in 1999 for 33 countries**
- **2.5Gb/sec using WDM to boost capacity to 10Gb/sec**
- **SEA-ME-WE-4 – 21,000km, 14 countries**
  - **80Gbps**
  - **Operational in 2005**

FLAG

- **Fiberoptic Link Around the Globe – 1997**
  - **Install cost - $1.5B**
  - **Bought out by Indian Reliance Telecom (10/2003) for $207M**
- **27,000km, 22 countries, $1.5b, 5Gbp/sec**
- **NOC located in UK and backup in Dubai**
- **UK, Spain, Sicily, Alexandria, Aqaba, Jeddah, Dubai, Mumbai, Thailand, Hong Kong, Shanghai, Korea, Japan**
- **www.flagtelecom.com**


Porthcurno, United Kingdom
Estepona, Spain
Palermo, Italy
Alexandria
Port Said
Suez, Egypt
Fujairah, U.A.E.
Mumbai, India
Satun
Penang, Malaysia
Songkhla, Thailand
Shanghai, China
Keoje Island, Korea
Ninomiya
Miura, Japan
Lantau Island, Hong Kong
LEGEND
Completed
To be completed
Construction underway
FLAG landing station



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Egypt

- **Satellites can no longer serve as backup - competing cables have to have restoration agreements**
- **FLAG, SEA-ME-WE 1, 2 & 3, AFRICA-1 all converge on one building**
- **Alexandria - center of the fiber world**
- **Single cross-connect for all traffic between Africa, Europe and Asia**

Alexandria

- **Building built in 1933 by British to house PTT**
- **Wrought iron elevator and broken windows**
- **Built on the ruins of the Great Library of Alexandria**
- **Coordinates: 31° 11.738' N, 29° 54.108' E**
  - **Intersection of El Horreya and El Nabi Streets**

Israeli cables

- **EMOS-1: from 1990, 2880km at 280Mb/sec - to Palermo, Italy**
- **CYOS: from 1993, 257km at 565Mb/sec to Ayanapa, Cyprus from Nahariya**
- **LEV: from 1999, 2600km at 2.5Gb/sec - $60-80M**
- **Med-Nautilus: 2001, 7000km**


1996
Cable
1 ADONIS (480ch)
2 ALEXANDRIA-BEIRUT (120ch)
3 ALEXANDROS (624ch)
4 APHRODITE (480ch)
5 APOLLO (1,380ch)
6 ALTEMIS (2,580ch)
7 PALMYRA (480ch)
YUGOSLAVIA
ITALY
ALBANIA
GREECE
TURKEY
Palermo
Lagonissi
Lechaina
Marmaris
Larnaka
CYPRUS
Heraklion
MALTA
LIBYA
EGYPT
Alexandria
Tel
EMOS-1 (280Mbps)
FLAG
SEA-ME-WE-2

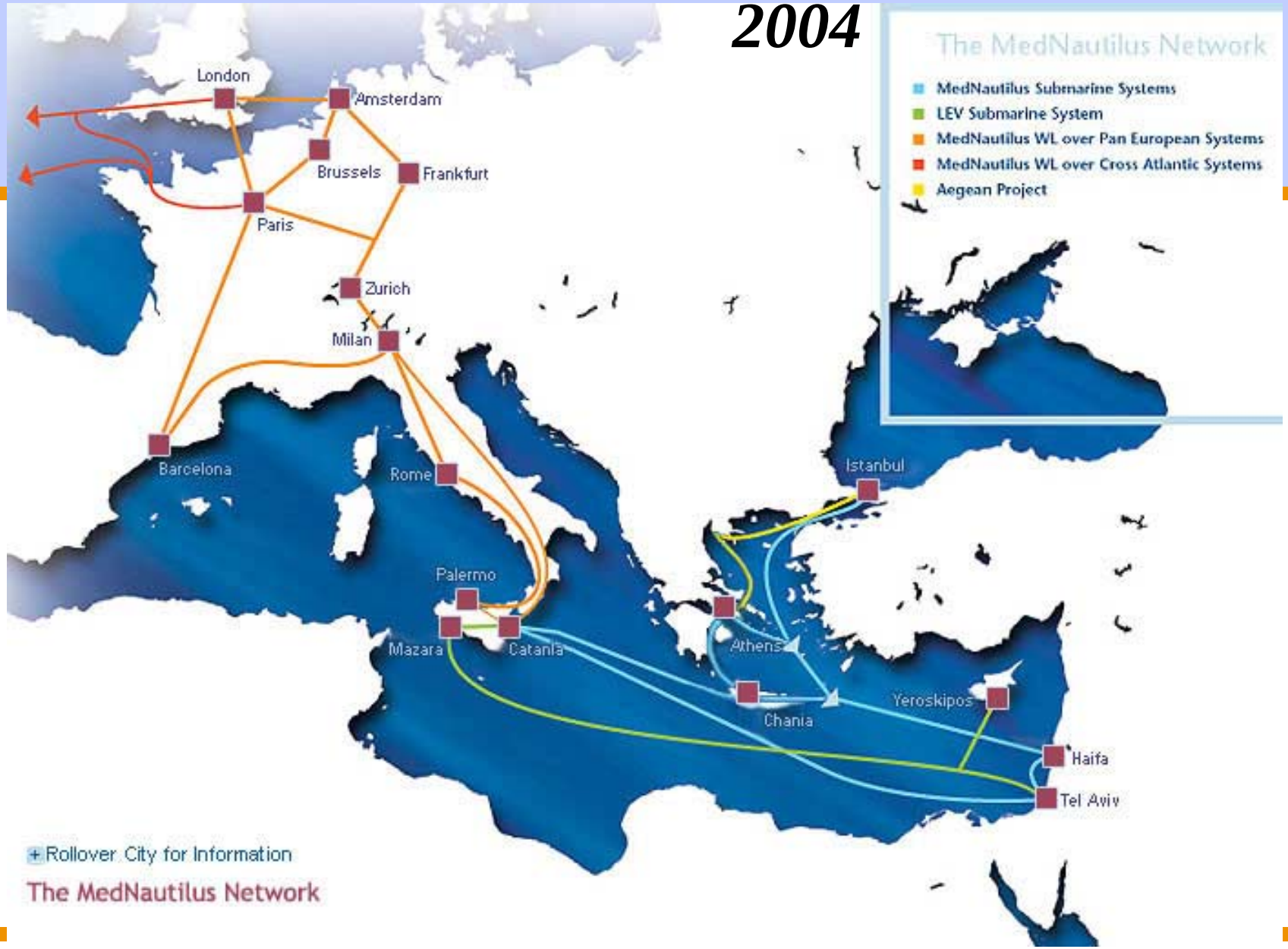
LEV

- **In-service 3Q98**
- **Initially owned by: Bezek (21.25%), Telecom Italia (18.25%), Clalcom (18.25%), KAMA (9.25%), Telrad (9.25%), AUREC (8.25%), Globescom (8.25%), Cyprus Telecom Authority (7.25%)**
  - **Now called Med-Nautilus and majority owned by Telecom Italia (51%) with Globescom, Clalcom, KAMA and AUREC**
  - **Med-1 valued at $240M**
- **Landing on Rechov HaYarkon**

Med-1

- **7000km, 92 repeaters, 6 fiber pairs, 10Gb/sec for each fiber pair**
- **Landing in Petach Tikve and Tirat HaCarmel**
- **Operational December 2001**
- **Part left in ocean (Egypt)**

2004



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MED-1 – MedNet Map

Price comparison over time

Cable	Bandwidth	Length/ km	Date	Cost	Cost/km	Cost/Gbps /km
TAT-9	565Mb	9310	1992	$450M	$48355	$85548
TPC-4	560Mb	9860	1992	$373M	$37830	$67553
CIOS	622Mb	261	1993	$10M	$38314	$61598
TPC-5	5Gb	25000	1996	$1.12B	$44800	$8960
FLAG	10Gb	27000	1997	$1.5B	$56000	$5600
Columbus-III	10Gb	11000	1999	$300M	$27000	$2700

Cables vs satellite costs

- **LEO (Low Earth Orbit)**
  - **Globestar, 48 satellites, $2.6b (max 7.2k/sec) - nope**
  - **Iridium, 66 satellites, $5b (max 2.4k/sec) - nope**
  - **Skybridge, 80 satellites, $3.5b - nope**
  - **Teledesic, 288 satellites (1999), $9b (max 64Mb/sec)**
    - **Signed contracts in 2002 to build 2 satellites**
    - **Revised design to be 30 satellites**

Cable vs Satellite costs

- **GEO: Geostationary Earth Orbit**
  - **Hughes Expressway, 14 sats, $3.85b - nope**
  - **Hughes Spaceway, 8 sats, $3b (max 6Mb/sec) - nope**
  - **Cyberstar, 3 satellites, $1.6b (max 30Mb/sec) - nope**
  - **PanAmSat, 23 satellites, $6b**
- **Celestri, 63 GEO & LEO satellites, $12.9b**
  - **max thruput - 155Mb/sec - nope**

Satellite vs Fiber

- **1999 costs from Western Europe to USA**
  - **Satellite – Mbps/sec - $3000**
  - **Fiber – Mbps/sec - $4100**
- **2004 costs from Western Europe to USA**
  - **Satellite – Mbps/month - $1200**
  - **Fiber – Mbps/month - $140**

Ramifications

- **Fiber became cheaper than satellite around 2000**
- **Fiber prices stable at $0.06/meter to fabricate**
  - **Submarine cables go for $20/meter**
  - **Pre-1997 has 2 fibers be cable – now 4 fibers**
- **1996 - 30 million kilometer of fiber sold - led by Siemens, Lucent, Pirelli, and Alcatel**
- **Carriers have moved to undersea cable**
  - **no problems with right-of-way**
  - **major urban centers are near the sea**
  - **no backhoe problems**

T3 (45Mb/sec) Economics

- **11,000km cable - $300M**
- **10 year lifetime**
- **10Gb is really 7.68Gb = 170 T3 lines**
- **50% sold over lifetime of cable**
- **T3 line = $75K/yr x 10 = $750K**
- **$750K x 170 x 50% = $64M**
- **Carriers losing money on every circuit due to glut of undersea cables currently on market**

Per minute Economics

- **Today: $.20 (direct dial); $.04 (VoIP)**
- **$.02/minute - avg over next 10 years**
- **64kb line can carry 8 voice circuits with excellent clarity (8kb/sec per circuit)**
- **525,600 minutes/year x $.02 = $10K/yr/voice circuit**
- **10Gb/sec can carry 9,600,000 voice circuits**
- **9.6M voice circuits could generate $96M/yr x 10 years = $960M**

Economics of 10Gb/sec cable

- **Cost - $300M**
- **Revenue via T3 lines over 10 years - $64M**
- **Revenue via VoIP circuits over 10 years - $960M**
- **Which would you be selling?**

Conclusion

- **Internet telephony will radically change phone tariffs (as if we didn't know that)**
  - **Telephone monopolies are running scared**
- **Investments in undersea cables used to be a good investment for venture capitalists until the market became saturated around 2000**
- **Israel used to lag far behind in undersea cable infrastructure until Med-1 came along**