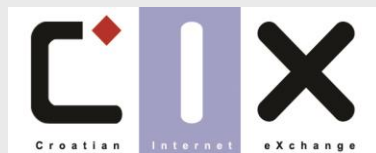


Croatian Internet eXchange and Regional Perspective

4th SEE Telecom Arena

Zagreb, 18. – 19. March 2008

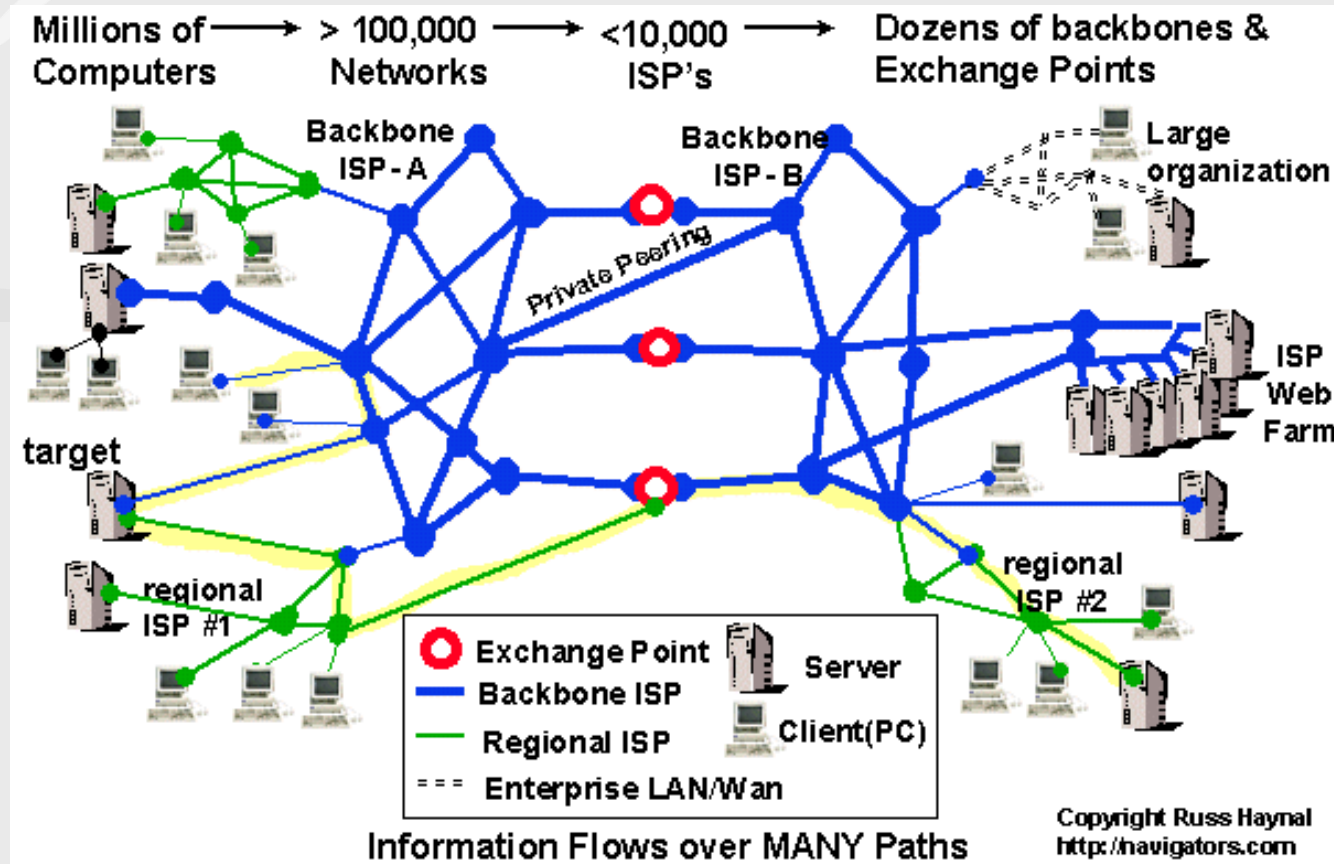


Ivan Marić, Deputy Director / CTO
University Computing Centre - SRCE

Agenda

- ❖ Internet architecture & topology
- ❖ Peering & IXP
- ❖ Croatian Internet eXchange
- ❖ IXP in EU and SEE
- ❖ Directions

Internet Architecture

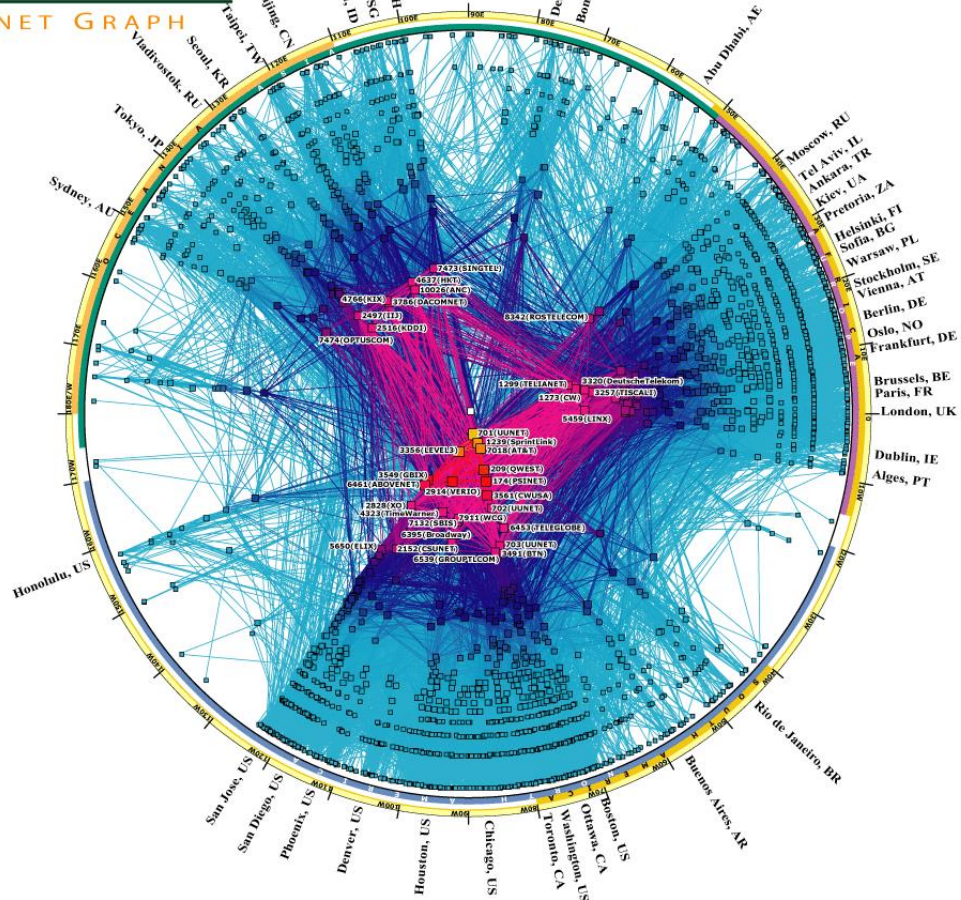
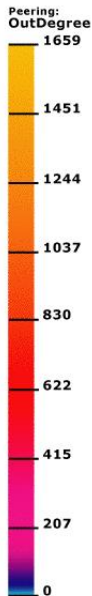


Internet Topology Map

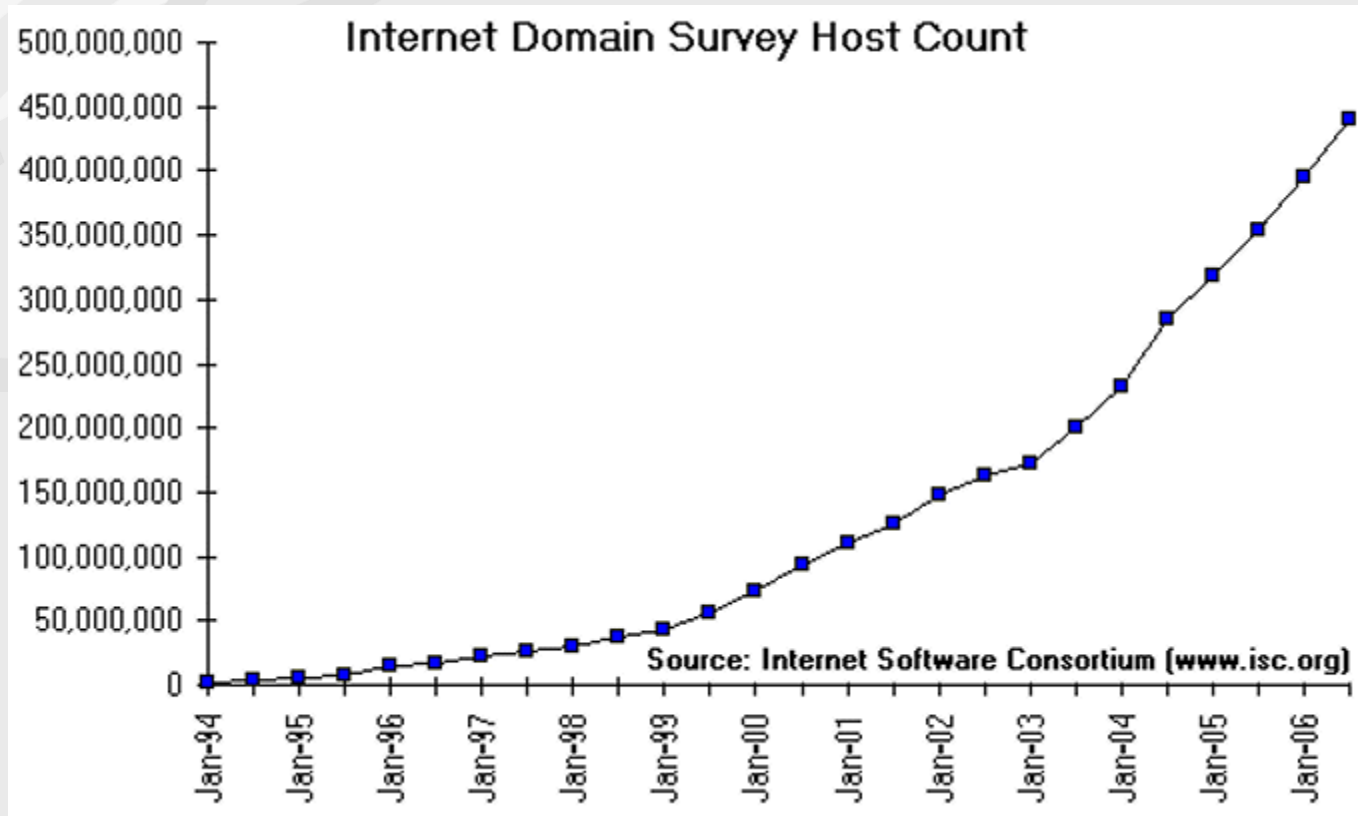
IP v4 INTERNET TOPOLOGY MAP

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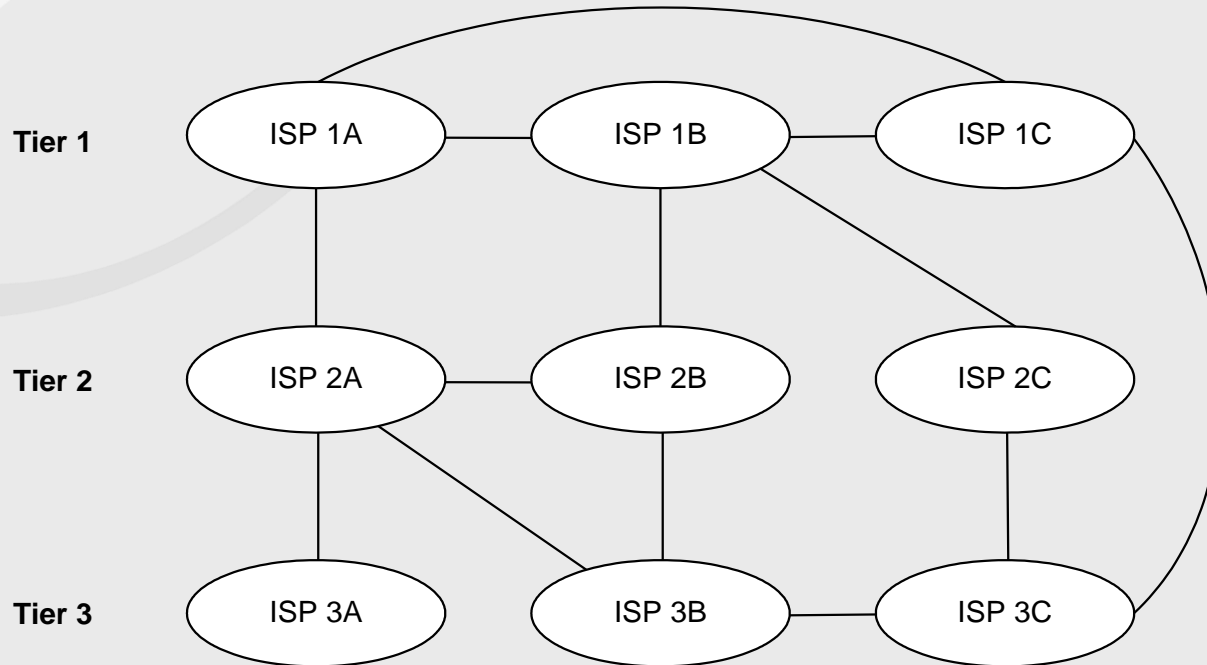
AS-level INTERNET GRAPH



Host Count



Hierarchical ISP model



Peering

- ❖ One of the most important and effective ways for ISPs to improve the efficiency of operation
- ❖ *Interconnection bussines arrangement whereby each ISP directly exchanges traffic to and from each other's customers.*

Peering Decision Tree

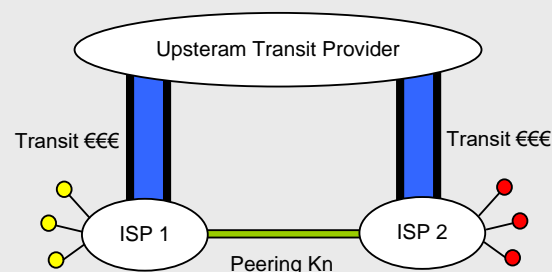
❖ Identification of Potential Peer

◆ Why Peer?

- Lower Transit Costs
- Lower Latency

◆ With Whom to Peer?

- Quantities of traffic
- Peering policies

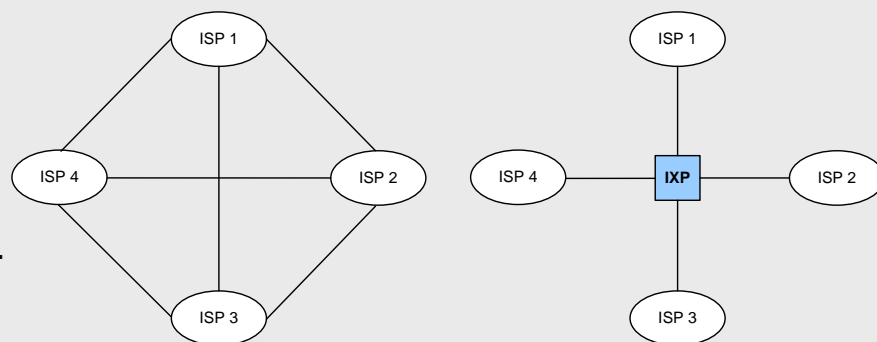


❖ Initial Contact and Qualification

❖ Implementation Discussions

◆ How to interconnect?

- Direct Circuit-based Interconnection vs.
- Exchange-Based Interconnection



Exchange Selection Criteria

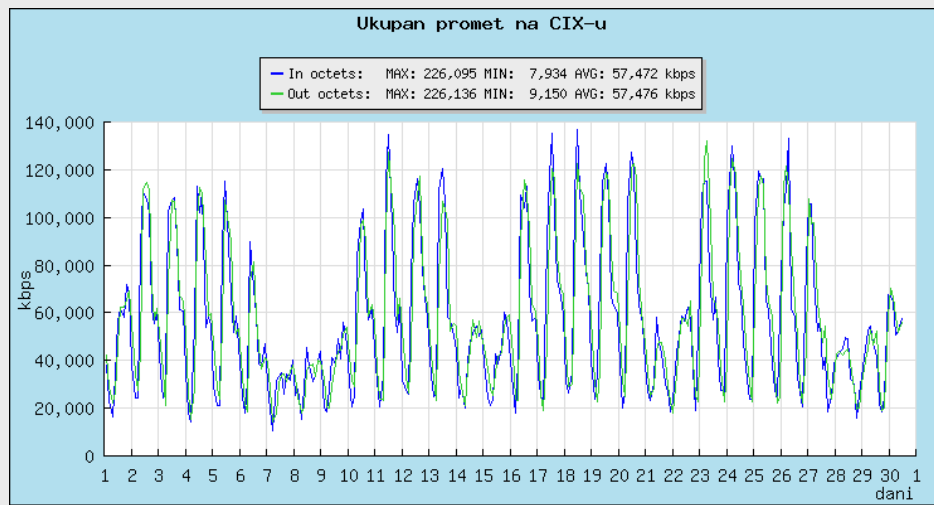
- ❖ Telecommunication Access Issues
- ❖ Deployment Issues (getting in&up)
- ❖ ISP Current Presences (there yet?)
- ❖ Operational Issues (restrictions?)
- ❖ Business Issue (neutrality/alignment)
- ❖ Cost Issues (€€)
- ❖ Credibility Issues (backing, attraction)
- ❖ Exchange Population Issues (side effect)
- ❖ Existing Exchange vs. New Exchange?

CIX Definition

- ❖ CIX has accepted industry definition of an IXP:
 - ♦ *A physical network infrastructure operated by a single entity with the purpose to facilitate the exchange of Internet traffic between Internet Service Providers. The number of Internet Service Providers connected should at least be three and there must be a clear and open policy for others to join.*
- ❖ Croatian Internet eXchange is a service provided by University Computing Centre - Srce, to Croatian Internet Service Providers, non-commercial and private networks for the purpose of exchanging Internet traffic on the national level.
- ❖ CIX is not-for-profit Exchange Point

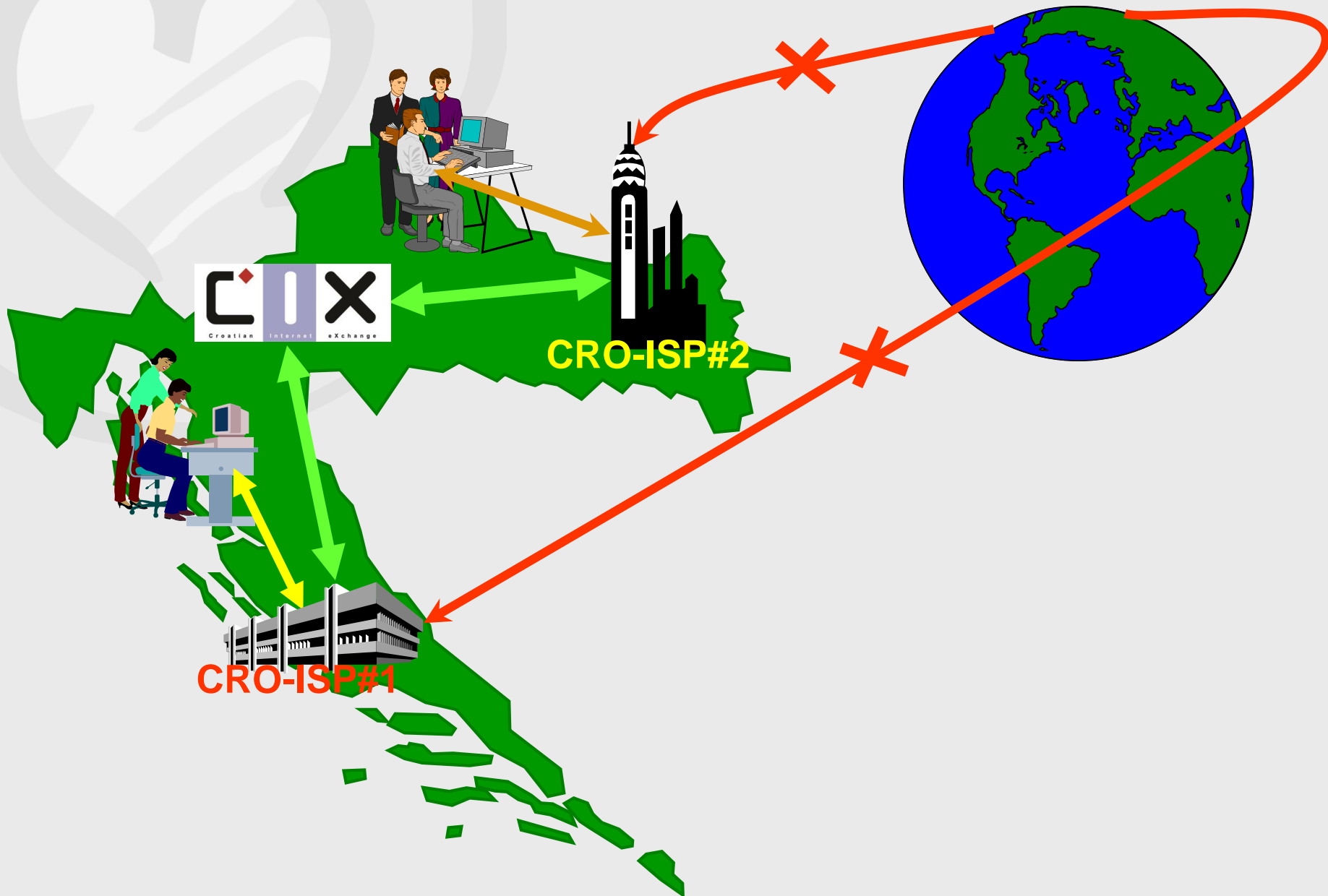
CIX Status

- ❖ CIX location – SRCE building, Zagreb
- ❖ CIX was established in 2000. with 5 members
- ❖ CIX (January 2008.)
 - ◆ 17(+2) members; 100Mbps average traffic



www.cix.hr





Number of IXP per country (EU)

Country	No. IXP
France	13
Germany	12
United Kingdom	12
Sweden	7
Spain	6
Netherland	5
Poland	5
Russia	5
Italia	4
Switzerland	3
...	..
31 countries	99

Number of IXP per city

City	Country	No. IXP
Paris	France	9
London	United Kingdom	8
Frankfurt	Germany	4
Madrid	Spain	3
Amsterdam	Netherlands	2
Berlin	Fermany	2
Brussels	Belgium	2
→ Bucharest	Romania	2
Dusseldorf	Germany	2
Edinburgh	United Kingdom	2









→ Zagreb	Croatia	1

IXP traffic per mil. inhabitants country ranking

Rank	Country	Traffic Gbps	Population M	Gbps/M people	Rank traffic
1	Netherlands	180,80	16,41	11,02	1
2	Sweden	61,74	9,05	6,82	4
3	Norway	12,00	4,60	2,61	10
4	Hungary	23,80	10,08	2,36	7
5	Finland	10,93	5,26	2,08	11
6	Estonia	2,29	1,33	1,72	18
7	Iceland	0,48	0,28	1,71	23
8	United Kingdom	100,27	60,21	1,67	2
9	Czech Republic	15,00	10,24	1,46	9
10	Spain	63,39	45,06	1,41	5
11	Austria	8,95	8,21	1,09	12
12	Germany	80,98	82,42	0,98	3
13	Belgium	6,50	10,45	0,62	14
14	Switzerland	4,30	7,25	0,59	15
15	Italy	26,14	58,46	0,45	6
16	Slovakia	2,30	5,43	0,42	17
17	France	15,60	63,59	0,25	8
18	Portugal	1,59	10,61	0,15	20
19	Ireland	0,56	4,13	0,14	22
20	Greece	0,97	11,24	0,09	21
21	Poland	3,00	38,62	0,08	16
22	Romania	1,62	22,33	0,07	19
23	Russia	8,24	143,20	0,06	13
Total		631,43	628,46	0,99	
Total excl. Russia		623,19	485,26	1,27	

Note: This traffic data was captured on the 30th of August 2006

IXP in SEE Region

Country	City	No. IXP
 Albania	-	-
 Bosnia and Herzegovina	-	-
 Bulgaria*	Sofia*	
 Croatia	Zagreb	1
 Republic of Macedonia	-	-
 Moldova	-	-
 Montenegro	-	-
 Romania	Bucharest	2
	Suceava	1
 Serbia	-	-

SIX - Sofia Internet eXchange – status unknown

DIGITAL DIVIDE!!

Directions

- ❖ Governments should encourage telecom/Internet market
 - ◆ Adapt laws in line with *new Internet age*
 - ◆ Liberalization of telecom market → competitive environment → lower Internet costs → expansion of Internet users community
 - ◆ Regulate but do not over-regulate!
- ❖ Governments and/or A&R community initiate IXP in absence of 'real ISP market' – *push up*
- ❖ Place 'government public IT services' to:
 - ◆ GOV-ISP cloud connected to national IXP or
 - ◆ '*force*' host ISP to open exchange through national IXP with other

Make it happened tomorrow – find neutral place and start IXP



Thank You!

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