International Connectivity for the Provision of Broadband Services

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NPNOG Workshop, December 2016, Kathmandu

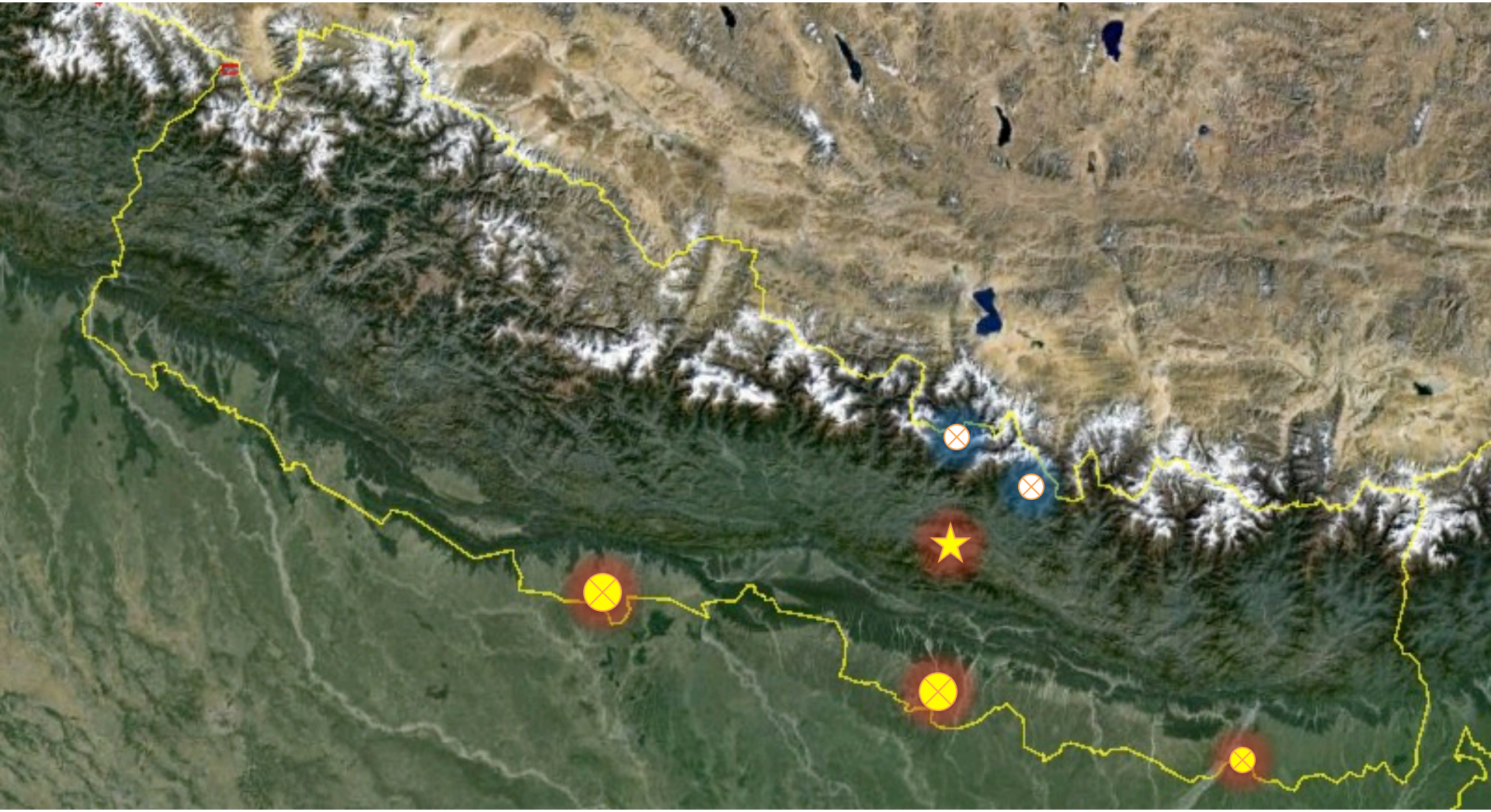
Internet Business

- Since Early ‘90s
  - Started with Dialup and Lease
  - With a low capacity, expensive satellite links
- Broadband and Optical Transit
  - Started in 2008/09
  - Started Internet growth revolution for the country
- Others
  - PON/GPON, Wireless BB, 3G…

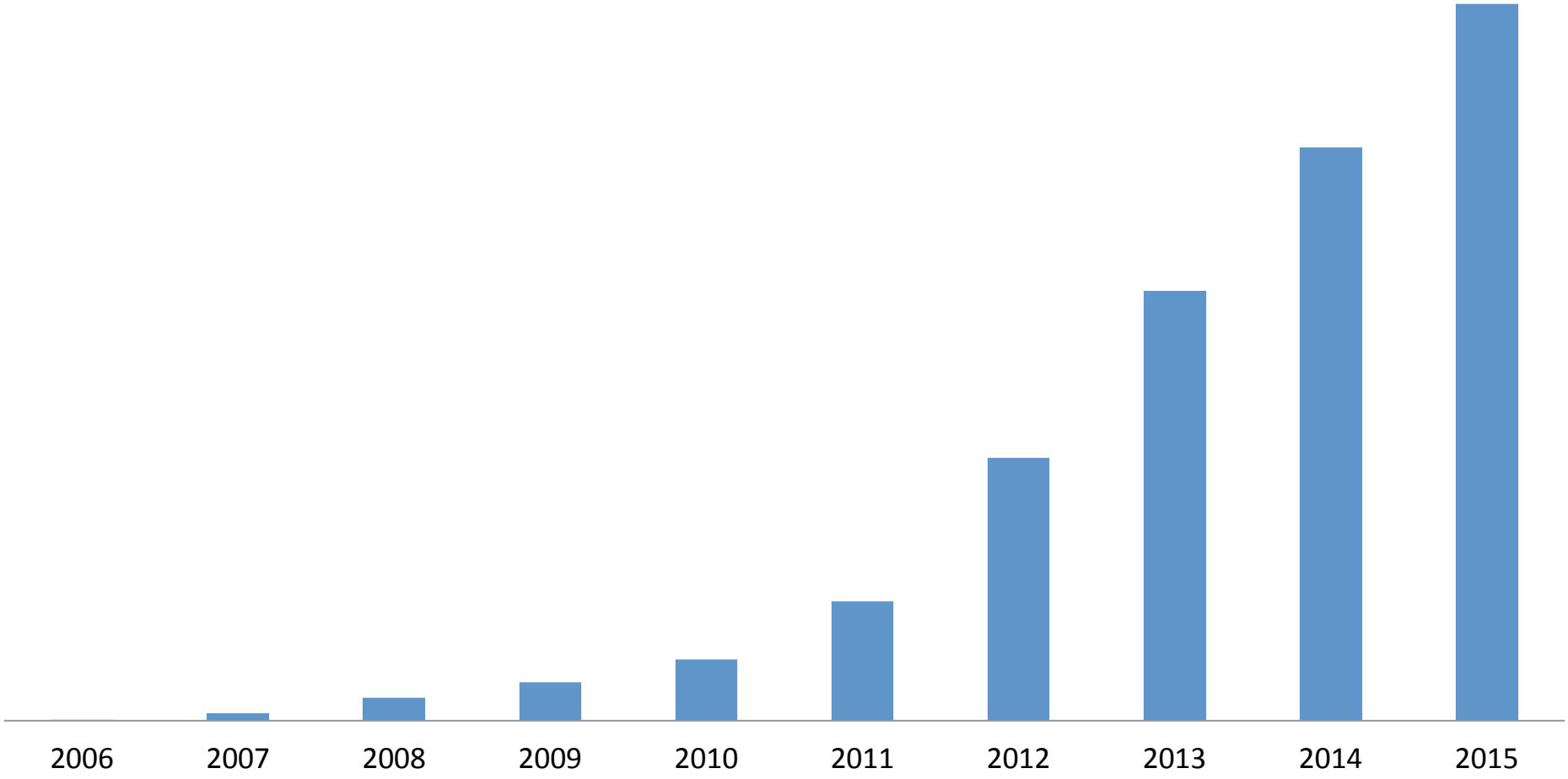
Connecting to the World

- Through upstream providers
- No direct access to landing stations
- High cost due to long transit path to submarine cable routes.
  - Nepal – Mostly through India

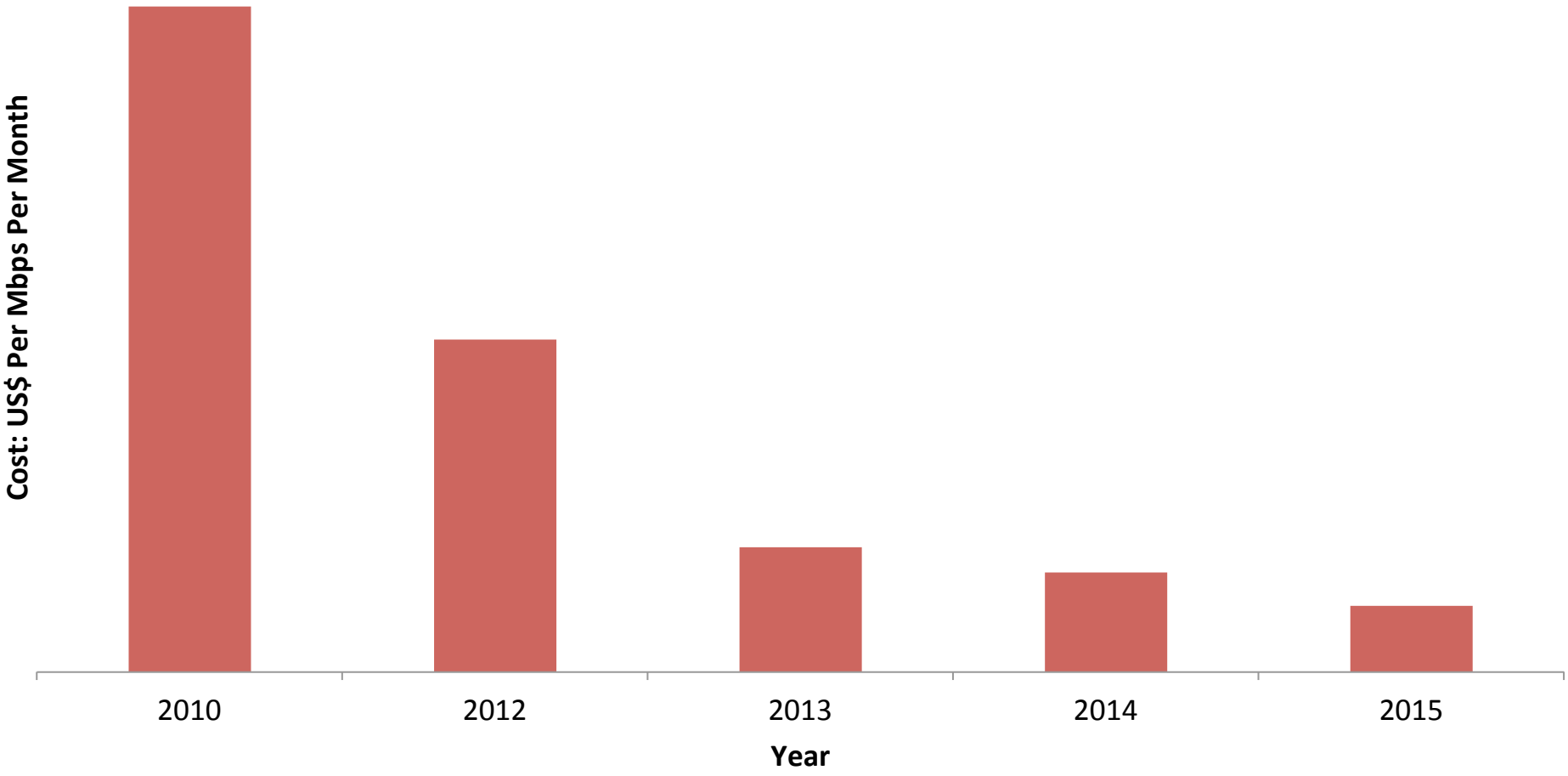
Major Cross-border Points



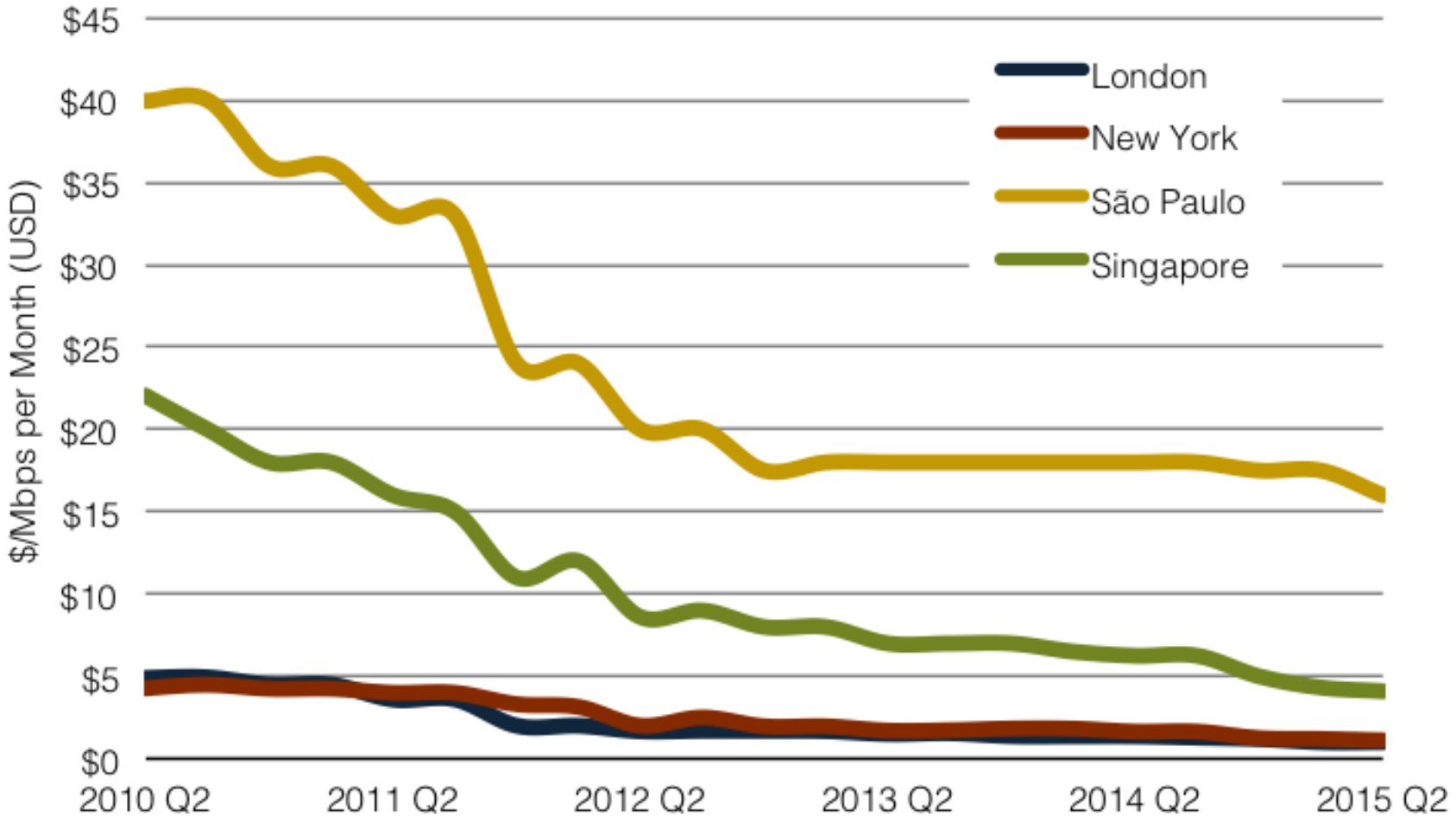
Bandwidth Consumption



Bandwidth Cost (US$/Mbps/Month)

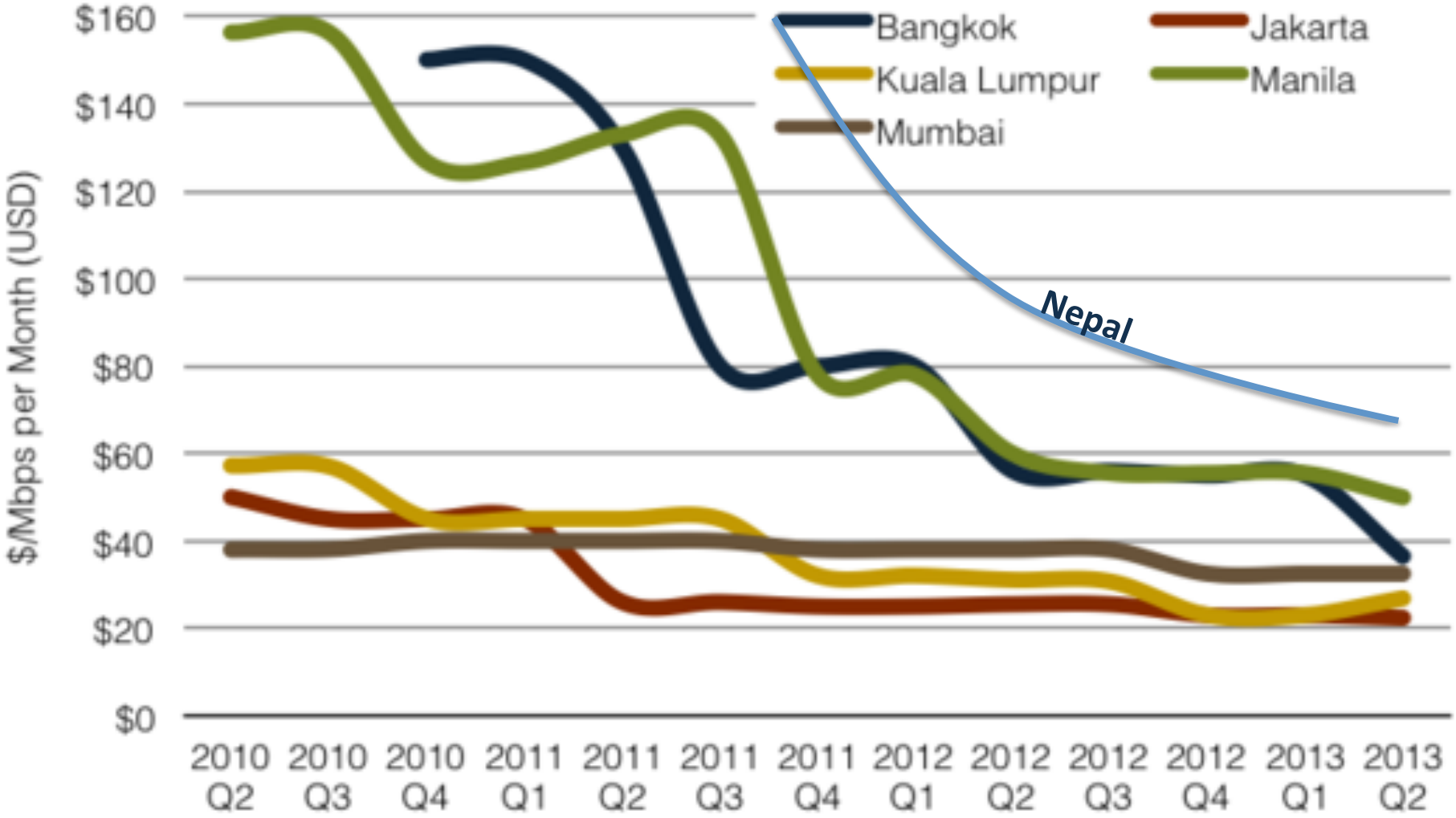


Global Price



Median 10GigE IP Transit Pipe Cost (Telegeography)

Regional Price



Median 10GigE IP Transit Pipe Cost (Telegeography)

Why More for Us?

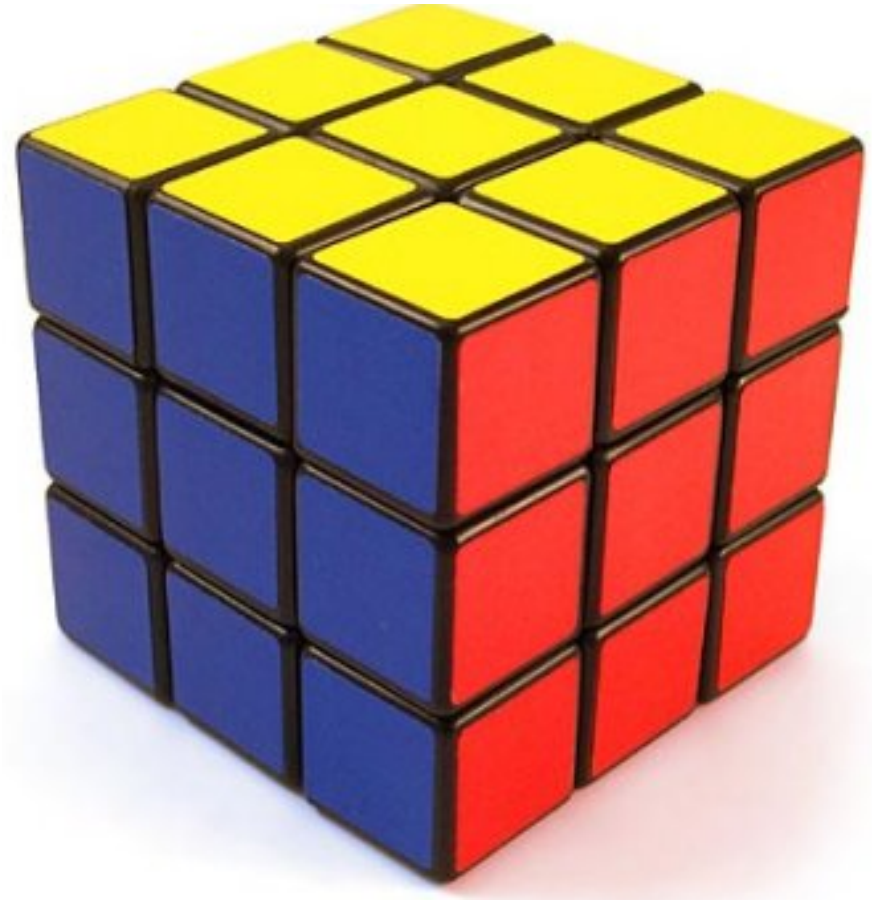
- No direct access to submarine landing stations
- Long transport path to the major landing stations
  - Usually a bottleneck in terms of cost and quality
- Relatively small volume
- Less number of alternatives

Challenges for Further Growth

- Cost of bandwidth
- Upstream dependency
- Less organic traffic
- Dynamic content
  - Conventional caching is not effective

But growth resulting from technological evolution cannot be avoided. (4G, BB, FTTx)

Overcoming Them



- Content Localization
- Caching
- Compression: bit-stream level ?
- Local peering
- From transit to peering (too many?)

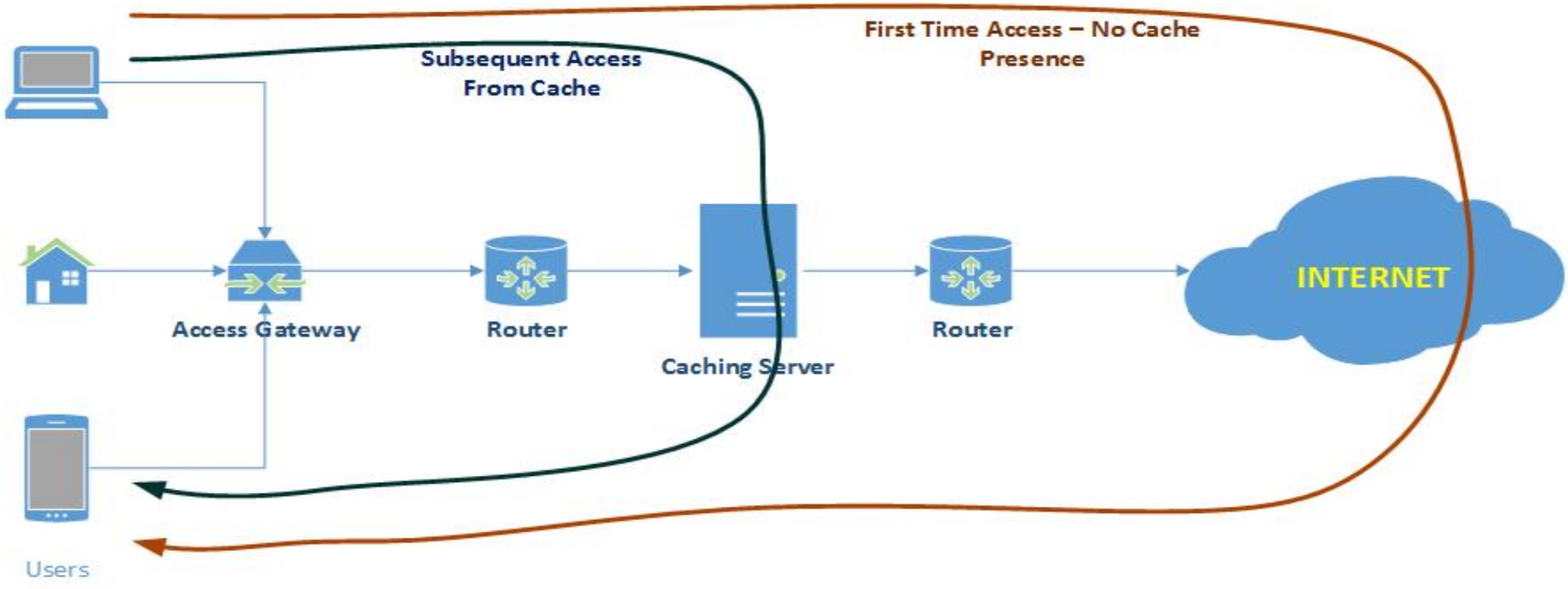
Content Localization

- CDN colocation
- Dedicated Cache Colocation
- Peering over IXP
- Mirror and repository colocation
- …

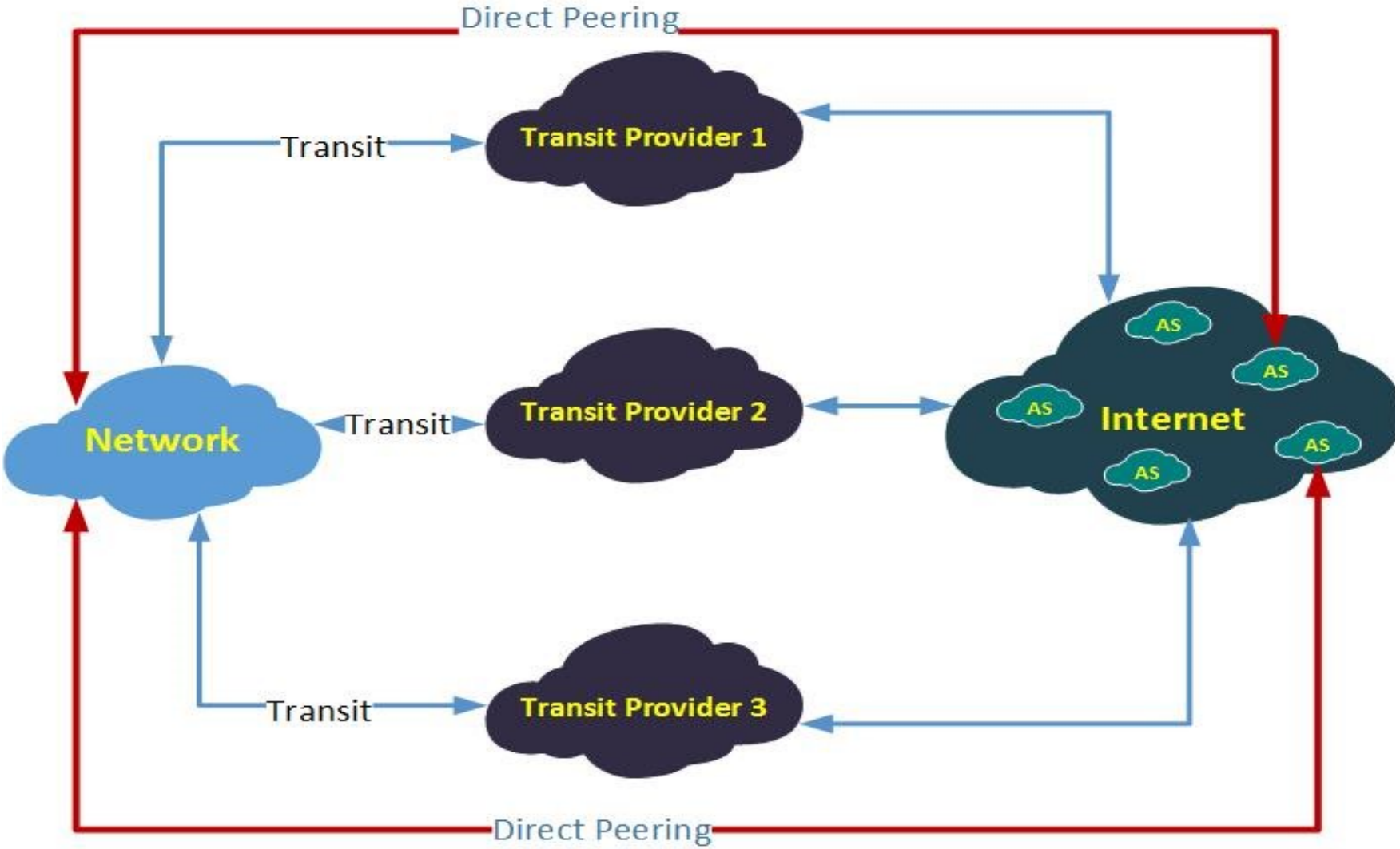
- **Promoting development of local content / services / local clouds**

Proxy / Bitstream Compression?

- Apart from CDN and GGC, work going on for deployment of advanced proxy and caching system that shall handle other traffic.



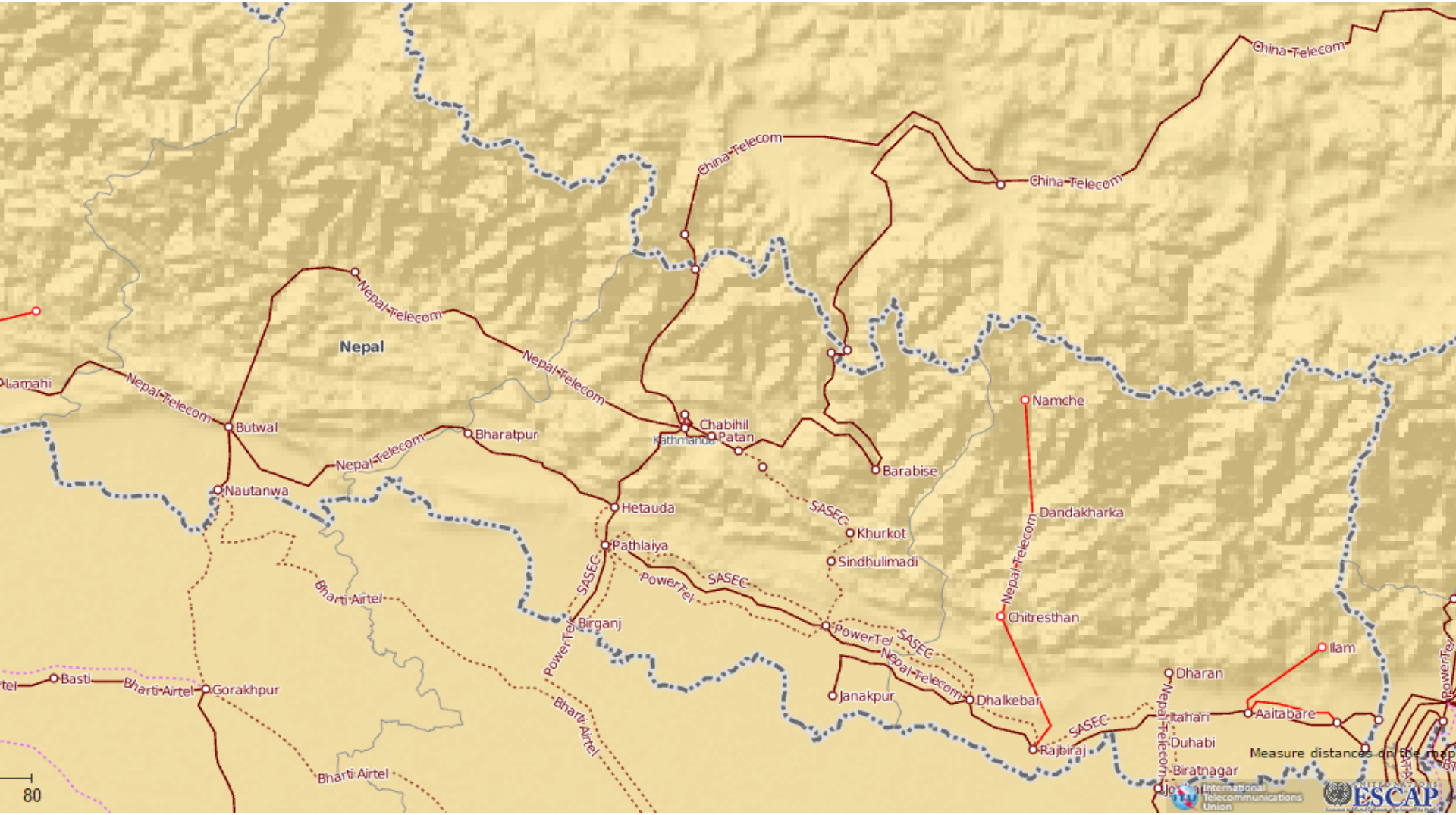
Transit → Peering



Northern Routes

- Possibility
- Financial viability
- Operational feasibility

Possible but Unproven



Long-term Strategy

- Arrangement for landlocked countries
- Why needed
  - Smaller economies
  - Smaller volume
  - Higher per unit cost (mainly due to transit)
- Need collective approach by regional operators, regulators and other stakeholders.

ITU Resolutions

- World telecommunication development conference
  - RESOLUTION 16 (Rev. Dubai 2014) - *Special actions and measures for the least developed countries, small island developing states, landlocked developing countries and countries with economies in transition.*
- World conference on international telecommunications
  - RESOLUTION PLEN/1 (DUBAI, 2012) - *Special measures for landlocked developing countries and small island developing states for access to international optical fiber networks.*

DAI – Long Way to Go

- Ranking done in 2002 by ITU
- Region
  - Bangladesh (0.18)
  - Bhutan (0.13)
  - India (0.32)
  - Iran (0.43)
  - Maldives (0.43)
  - Nepal (0.19)
  - Pakistan (0.24)
  - Sri Lanka (0.38)

HIGH ACCESS	
Sweden	0.85
Denmark	0.83
Iceland	0.82
Korea (Rep.)	0.82
Norway	0.79
Netherlands	0.79
Hong Kong, China	0.79
Finland	0.79
Taiwan, China	0.79
Canada	0.78

Metrics
Infrastructure
Affordability
Knowledge
Quality
Usage

ITU IDI – Similar Picture

Economy	Rank 2015	IDI 2015	Rank 2010	IDI 2010
Korea (Rep.)	1	8.93	1	8.64
Denmark	2	8.88	4	8.18
Iceland	3	8.86	3	8.19
United Kingdom	4	8.75	10	7.62
Sweden	5	8.67	2	8.43
Sri Lanka	115	3.64	115	2.97
Belize	116	3.56	104	3.17
Syria	117	3.48	106	3.14
Namibia	118	3.41	120	2.63
Bhutan	119	3.35	128	2.02
India	131	2.69	125	2.14
Gambia	135	2.60	129	1.99
Nepal	136	2.59	140	1.75
Côte d'Ivoire	137	2.51	142	1.74

Conclusion

- We are net 'Net' consumers
- A lot of transit costs
- Localization --> sustainability
- Need a consorted approach to reduce cost – cooperation across nations, regulators, operators
- Exploration of alternatives – routes, providers, technologies, approaches
- We have a long way to go
  - Great challenges and equally great opportunities.

Thank You