Deeper Peering (US)

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Why interconnect deeper?

• Additional reliance on the internet since last century
  • Latency sensitive services are now on the IP network
  • (E.G.) VOIP, VPN, CDN, Video, Gaming

• Even more reliance on the internet in the future
  • (E.G.) VR, AR, SD-WAN, SASE, more CDN & Video, Edge

• Reduce reliance on “Tier1” interconnection markets

• Better cost economics for access circuits
  • Access component is larger than IP cost
Hurdles for Deeper Peering

- Outdated Architecture
  - Some carriers still haven’t merged peers and customers to same edge PEs. Route reflection. ($$$)

- Capacity Planning
  - Smaller markets may need to provide failover capacity to larger markets ($$$)

- Customer procurement mentality (chicken & egg)
  - Without local peering, customers long line into larger markets since their traffic routes there anyway to get off-net
  - Without local customers, no traffic/justification for peering in smaller markets
IP Port Capacity Bottleneck

- Chicago, Dallas and Atlanta comprise 40% of total IP port capacity out of the existing nine Tier1 interconnectivity markets.

- Decreasing reliance on the US for international connectivity.
Chicago, Dallas and Atlanta (24/50 States and 47% of the US Population)

- Chicago (20% Pop)
  - IL, OH, MI, IN, MO, WI, MN, IA, NE, SD, ND

- Dallas (16% Pop)
  - TX, CO, LA, AR, OK, KS, NM

- Atlanta (14% Pop)
  - GA, NC, SC, KY, TN, AL, MS, N FL
Decision Making Factors for Tier 2 Markets

- Population Density (MSA)
- Fiber Routes
- RTT to Nearest Tier 1
- Existing Inter-Connectivity Markets
- Long Lined Circuits to Nearest Tier 1
- Gross Domestic Product
- Various Other Gauges
  - Number of Datacenters
  - Number of ASNs
## US Tier 2 Selection

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>MSA</th>
<th>GDP</th>
<th>DCs</th>
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<tbody>
<tr>
<td>New York</td>
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<td>Los Angeles</td>
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<tr>
<td>San Fran</td>
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<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Seattle</td>
<td>15</td>
<td>11</td>
<td>16</td>
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RTT reduction with these nine cities is nearly 8ms

<table>
<thead>
<tr>
<th>Tier 2</th>
<th>MSA</th>
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<th>Peers</th>
<th>RTT</th>
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<td>14</td>
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<td>9</td>
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<tr>
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<tr>
<td>Nashville²</td>
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<td>34</td>
<td>9</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

¹Cleveland would be #6 MSA and #10 in GDP with Columbus and Cincinnati
²Nashville would be #18 MSA and #20 in GDP with Memphis
Peering Markets in US

Tier 1 Markets
Seattle, San Francisco, Los Angeles, Dallas, Chicago, Atlanta, New York, Northern Virginia and Miami

New Tier 2 Markets
Phoenix, Denver, Houston, Minneapolis, St Louis, Nashville, Cleveland, Philadelphia, and Boston
Distribution of State Pop to Tier1/2 Markets

Chicago (11% Pop)
- IL, MI, IN, WI, IA

Dallas (6% Pop)
- TX, AR, OK, KS

Atlanta (10% Pop)
- GA, NC, SC, AL, MS, N FL

Reduction of RTT of states adjacent to Tier2 markets
MSA Population % Change Last 10 Years

- SE US is fastest growing region over last 10 years
- Adapt network to population and migration patterns
Looking ahead, Tier3?

RTT reduction with these nine cities is nearly 6ms

<table>
<thead>
<tr>
<th>Tier 3</th>
<th>MSA</th>
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<td>4</td>
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<tr>
<td>Las Vegas</td>
<td>27</td>
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<td>2</td>
<td>5</td>
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<tr>
<td>Boise</td>
<td>77</td>
<td>81</td>
<td>5</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

¹Charlotte would be #15 MSA and #17 in GDP with Raleigh/Cary
Peering Markets in EU

Tier 1 Markets

Peering Markets in EU

**Tier 1 Markets**

**New Tier 2 Markets**
Marseilles, Vienna, Dusseldorf, Sofia, Copenhagen, Budapest and Warsaw
Summary

• There is too much reliance on interconnection in Tier 1 interconnectivity markets in the US
  • Fat Pipe / Skinny Backbone
• Large swaths of the country has traffic travelling > 1000 miles to switch off-net
  • Both because customers are buying in remote markets or buying in local markets but traffic is carried to remote market since there is no peering in local market
• Internet and applications riding on IP are a more integral part of business (and life) than twenty years ago
Recommendations

• Carriers need to offer customers internet access with rich connectivity options in local markets, not just in existing Tier 1 peering markets.

• Lumen has updated peering requirements to mandate peering in all Tier 1 interconnectivity markets and 2/3 of Tier 2 interconnectivity markets in the US.