Mobile carriers experience margin pressure.

Data for mobile operators in Western Europe: revenue is nearly flat and margins are rapidly decreasing.

“European mobile operators’ revenues per minute for voice and data are decreasing far faster than their costs.”

Source: A.T. Kearny analysis, 2009

Mobile carriers experience margin pressure.

Hypothesis for high costs of carriers

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost Drivers</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core layer</td>
<td></td>
<td>Network elements utilization rates are low</td>
</tr>
<tr>
<td>consolidations</td>
<td></td>
<td>Single use of physical infrastructure</td>
</tr>
<tr>
<td>3G rollout</td>
<td></td>
<td>Use of single vendor equipment</td>
</tr>
<tr>
<td>LTE rollout</td>
<td></td>
<td>Low level of innovation</td>
</tr>
<tr>
<td>Fiber infrastructure deployment</td>
<td></td>
<td>High complexity of network operations</td>
</tr>
</tbody>
</table>

The LTE architecture: EPS network elements

- UE = user equipment
- eNodeB = E-UTRAN Node B
- MME = mobile management entity
- PCRF = policy control and charging function
- SGW = serving gateway
- PGW = packet data network gateway
- HSS = home subscriber server
- IP router

The LTE architecture: EPS network elements

Previous study

Results:
1. 79% lower total cost of ownership
2. 80% lower capital expenditures
3. 79% lower operational expenditures

Source: ACG Research, 2011
A tailored techno-economic modeling approach for CapEx

Control is shifted to the core
1. Simpler core devices
2. Extra SDN component: OpenFlow controller
   1. Cost: Average price of available controllers + extra controller for redundancy
   2. Tailored software – 10 full time software engineers

Virtualization of the infrastructure with SDN
1. Virtualization isolates administrative domains of different operators
2. Active sharing in mobile backhaul

Active sharing of mobile backhaul
1. Virtualization isolates administrative domains of different operators
2. Active sharing in mobile backhaul

CapEx reduction of 12%

<table>
<thead>
<tr>
<th>location</th>
<th>#</th>
<th>reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-aggregation site</td>
<td>2000</td>
<td>17.74%</td>
</tr>
<tr>
<td>aggregation site</td>
<td>160</td>
<td>9.49%</td>
</tr>
<tr>
<td>core site</td>
<td>12</td>
<td>7.32%</td>
</tr>
<tr>
<td>inner core site</td>
<td>12</td>
<td>7.66%</td>
</tr>
</tbody>
</table>

Simpler network devices

Active sharing in mobile backhaul

Network Model and Traffic Forecast for 2017

CapEx reduction of 2012 - 2017

| Total CapEx (2012 - 2017) Classical Scenario | €186,914,729 | Pre-aggregation sites | €93,457.36 |
|                                           |              | Aggregation sites     |              |
|                                           |              | Core sites            |              |
|                                           |              | Inner core sites      |              |
|                                           |              | First time installation|              |

2,608.20 Mbit/s
5 radio base stations per access ring
5 access rings per pre-aggregation site
25,000 radio base stations
1,000... device is connected to 2 distinct core sites
No more heavy tailing

Heavy tailing (factor 3)
12 core sites
127,95 Mbit
276.60 Mbit/s
1383.00 Mbit/s
1383.00 Mbit/s
5 radio base stations per access ring
5 access rings per pre-aggregation site
25,000 radio base stations
1,000... device is connected to 2 distinct core sites
No more heavy tailing

Heavy tailing (factor 3)
12 core sites
Virtualization isolates administrative domains of different operators.

Active sharing in mobile backhaul

Virtualization of the infrastructure with SDN

1. Active sharing of network equipment
2. Second operator on the same network (70% of customers of first)

Active sharing of network equipment

- Virtualization of the infrastructure with SDN
- Simplers network devices
- Main SDN advantages for Carriers
- General CapEx reduction of 44%