SMART DATA PRICING
SDP 2016

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SDP That We Have Seen (in U.S.)
All carriers require caps for iPad LTE (March)

AT&T introduces $10/GB overage charges (June)

Comcast moves towards tiered usage-based billing (May)

AT&T begins throttling (April)

Verizon caps all new data plans (July)

AT&T throttles unlimited iPhone users (July)

T-Mobile throttles over data caps (May)

Verizon to phase out unlimited data plans (May)

Verizon introduces shared data plans (June)

Verizon eliminates data contracts (March)

T-Mobile ends overage charges on existing data plans (April)

AT&T offers sponsored data plans (January)

Netflix agrees to pay Comcast for prioritized traffic (February)

FCC proposes net neutrality rules allowing paid “fast lanes” (May)

Wireline
Demand Drivers

Video Streaming + Cloud Services + Data-Hungry Apps + High-Res Devices = A Perfect Storm
SDP Dimensions

A. How?
   Usage-based, quota trading, demand response/dynamic…

B. Who?
   Toll-free (1-800, zero rating, sponsored data, split billing)…

C. What?
   App-based (no data plan), cloud pricing, IoT pricing, PMP…

D. More…
   Offloading, Quota-aware preloading, roaming, peering, virtual operators…
DYNAMIC PRICING

ACM Sigcomm 2012
IEEE ICDCS 2011, ACM SigChi 2013
Data Traffic Varies Over the Day

- Costs are driven by the peak
- Revenue is driven by the average

Average demand < 30% of peak
TDP for Mobile Data

Network Measurement

User Behavior Estimation

Price Calculation

Prices

Usage

User Interface
Optimized TDP Impact

Does peak usage decrease with TDP?
Does this come from an overall decrease in usage?

PAR decreases by 30%
Overall usage increases by 130%
OPEN TOLL-FREE
IEEE INFOCOM 2015
To an ISP, Sponsored Data Is…

A way to extract revenue from content providers

also known as:
- Zero rating
- Toll-free data
- Split billing
- 1-800 data
- Two-sided pricing

AT&T (January 2014)

Any content provider can partner with AT&T to subsidize data transfers to clients, also known as:
- Zero rating
- Toll-free data
- Split billing
- 1-800 data
- Two-sided pricing
To a Content Provider, It Is…

A way to increase user demand

CPs can benefit from demand increases in different ways

<table>
<thead>
<tr>
<th>CP Type</th>
<th>Benefit Source</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>Advertisements, Subscriptions</td>
<td>boingo, Pandora, V</td>
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</tbody>
</table>
Spot Price Bidding

User Client
- Price Monitor
- Price Distribution Calculator

User Input (job type, etc.) → Bid Calculator → Cloud Provider

Cloud Provider
- Spot Price Calculator
- Job Monitor

Spot Price

User Bid
Example of MapReduce Jobs

The cost is reduced by up to 92.6% with just a 14.9% completion time increase.
Sustained-use Discounts

Regressive unit price

Total payment

Usage (%)

<table>
<thead>
<tr>
<th>Usage (%)</th>
<th>Regressive unit price</th>
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</thead>
<tbody>
<tr>
<td>0%</td>
<td>Bar graph showing regressive unit price for different usage percentages</td>
</tr>
<tr>
<td>25%</td>
<td>Bar graph showing regressive unit price for different usage percentages</td>
</tr>
<tr>
<td>50%</td>
<td>Bar graph showing regressive unit price for different usage percentages</td>
</tr>
<tr>
<td>75%</td>
<td>Bar graph showing regressive unit price for different usage percentages</td>
</tr>
<tr>
<td>100%</td>
<td>Bar graph showing regressive unit price for different usage percentages</td>
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Cloud Virtual Service Providers
New Services

Technology Evolution

User Experience

SDP $$$
Title II in US

- Disclaimers:
  - Court decisions may revoke the ruling
  - Legislative action may supersede FCC
  - Executive branch may reverse the decision

- Networking not by managing bytes
- Instead, manage network indirectly by pricing signals
  - Especially with end user making opt-in decisions
Implications

1. "No price control"
   - Usage pricing, family plan, quota rollover…

2. Not allowed: Unlimited + Throttling
   - Need: some form of SDP

3. Toll-Free must be Open
   - Closed toll-free may not be neutral

4. Utility Pricing
   - One possibility: demand response
   - Crucial differences: quality depends on congestion
• Think $ 
• Not B
SDP Impact

More choices/simplicity
Lower $/GB

Consumer and Business

Content Provider

Network Operator

More effective customer acquisition
Stronger customer engagement

Broaden revenue base
Manage congestion/cost
Prediction of **SDP 2020**

- Prediction the future is almost always wrong
  - 2007: almost no one saw the rippling impact of iPhone and Kindle on pricing
  - 2010: almost no one believed AT&T’s usage-pricing would stick
  - 2012: almost no one believed zero-rating would stick
Prediction on “Not” SDP

1. Demand response to consumers
   • Too complex for typical consumers
   • Except perhaps: Transparent Preload in Valley (TPV)

2. Advertisement-sponsored long video content
   • Economics doesn’t scale for advertisers

3. Closed toll-free
   • Regulatory uncertainty
Could Go Either Way

1. Mobile: Quota-engineering

2. B2B: Peering pricing at IXP or at edge

3. Cloud: latency-based SLA+pricing
Prediction on “Hot” SDP

1. “No postage/data plan” (developing countries)
   - App-based pricing + open toll-free
   - Democratizing mobile data access to all consumers

2. Revenue-broadening (developed countries)
   - IoT pricing has to be new for new services
   - Enterprise pricing will evolve

3. Pricing becomes network management tool
   - “Thermostat” for HetNets in 5G
SDP as a Research Area

Network Engineering

HCI, Consumer Behavior

Economics

Methodologies

Practice

Systems

User Trials

Theory
Thank you

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