

Economically Relevant Communications Research or The future: *Cheaper bits*

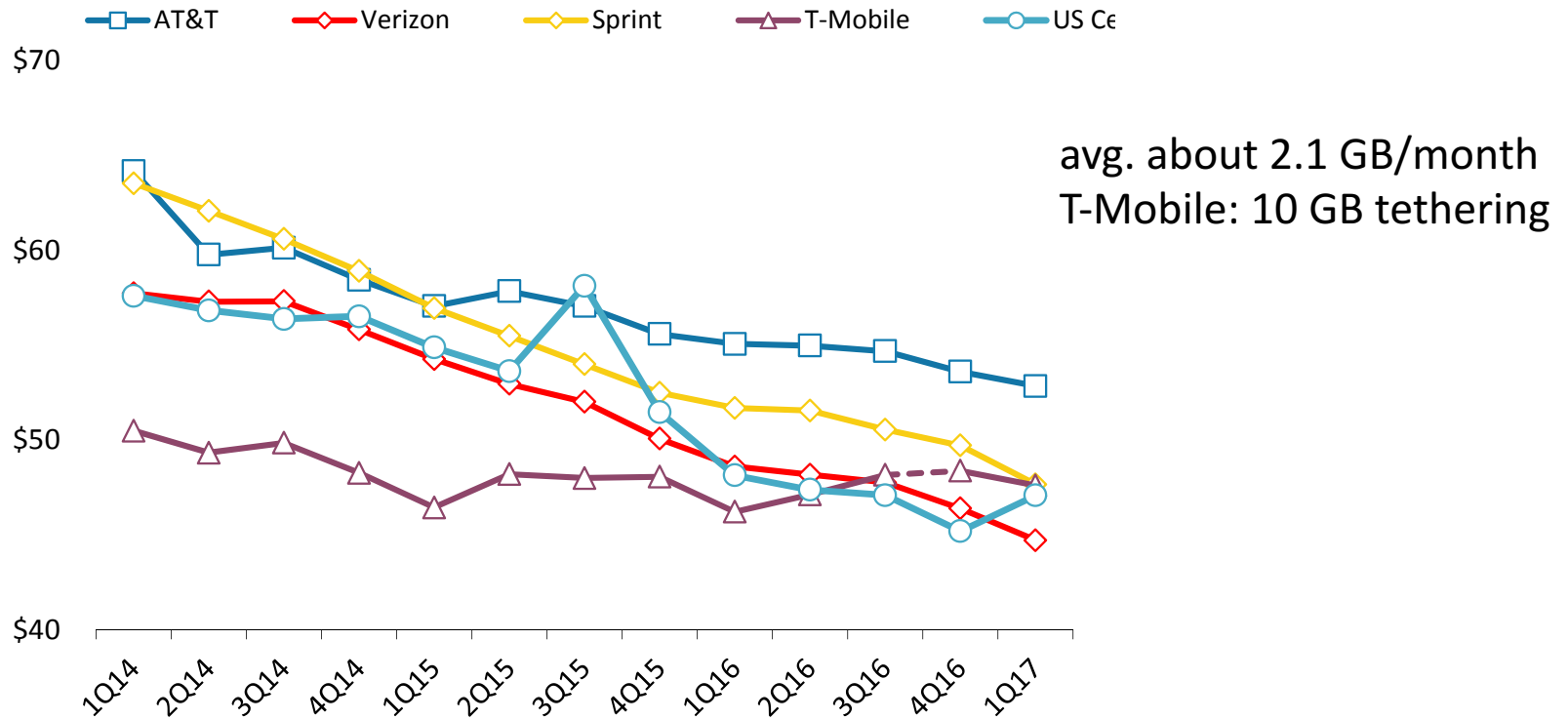
HENNING SCHULZRINNE

Economics drives deployment

- Networking is now a mature field – we can transmit anything anywhere at nearly any rate, whether fixed or moving
 - limited upside for transmission efficiency (except mmWave)
 - transitioning from EE to CS discipline
- → Research focuses on the economically less interesting parts
 - that's where the data is & where you can apply advanced math 😊
- Two economically interesting areas:
 - **telecom outages** cause extensive economic collateral damage → resiliency
 - **network operations** dwarves capital investment → automation
- Building out broadband in rural areas requires cheap digging, not (just) wireless
- Wireless networks (except satellite) are 99% fiber

What's the economic case for 5G?

Big 4 Postpaid ARPU



Metrics: not Gb/s or b/s/Hz, but \$/GB and \$/year

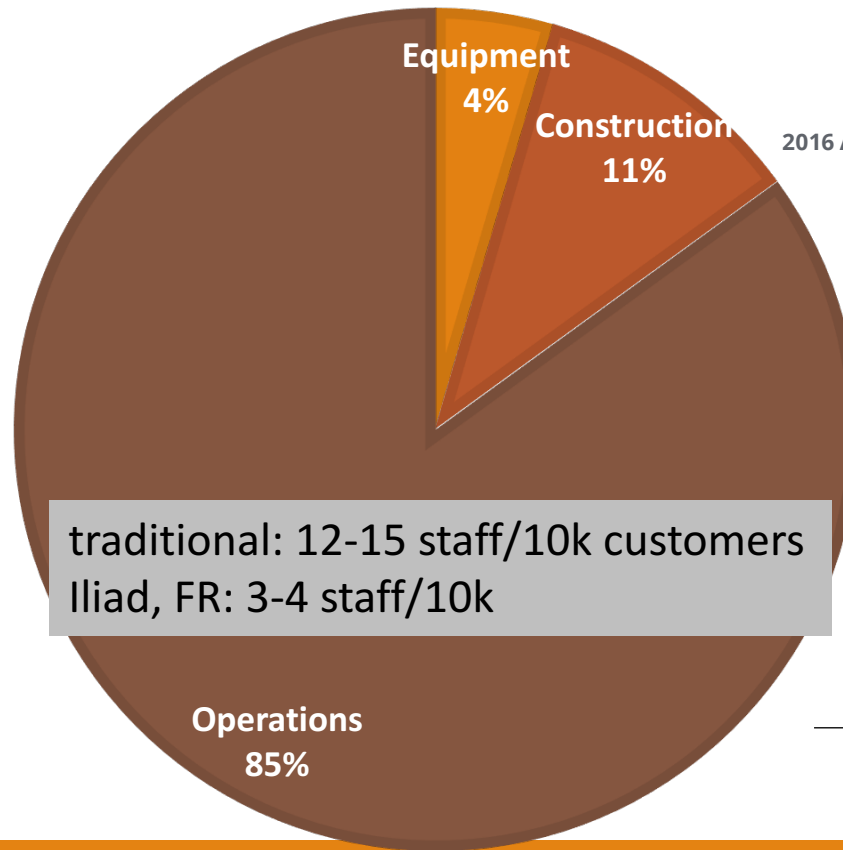
- Consumer market: **\$/GB delivered**
 - little willingness to pay for speed above 10 Mb/s for now
 - unless \$/GB \rightarrow 0, 1 Gb/s just threatens wallet
- NB-IoT: **\$/device + \$/year cost**
 - compete with \$0 incremental cost BT/Zigbee/WiFi or LPWAN
 - most of the 50 billion devices – indoors, factories, ...?
 - typically, \ll \$1/month
 - predictable coverage & international reach
 - alternative for one-way: ATSC 3.0 (50+ miles reach, no incremental cost)

Network economics, (over)simplified

% OF REVENUE

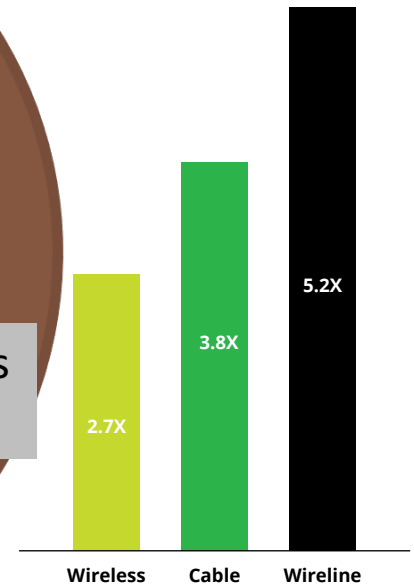


■ Equipment ■ Construction ■ Operations ■



traditional: 12-15 staff/10k customers
Iliad, FR: 3-4 staff/10k

2016 Average OPEX to CAPEX ratios⁴⁴



How can 5G be cheaper by GB?

- Backhaul is major cost factor
 - “Backhaul costs represent almost 6% ... of a wireless carrier total operating expenses (OPEX) and 30% of total network costs.”
- Re-use existing fiber to residential users
 - Requires cooperation of cable/FTTH provider
 - or shared indoor infrastructure (ok for airports & stadiums, unlikely for commercial buildings)
- Reduce license cost for spectrum → unlicensed, mmWave
 - first step: LTE-U

Table 5. Wireless Network Cost Breakdown (OPEX and Headcount CAPEX)

Subcomponents	Carrier A	Carrier B	Carrier C	Carrier D	Average of All Carriers
Strategy and Support	13	8	10	19	14%
Network infrastructure rent	36	45	33	37	39%
Transmission	6	5	13	8	7%
Core Network	10	9	13	3	8%
Radio ops & maintenance	11	15	18	14	14 %
Radio deployment	13	8	8	10	10 %
Radio design	10	9	5	8	8 %

Source: Wireless Carriers Benchmarking Study

Economic models for carriers

- **Commodity (utility):**

- efficiency to reduce cost/unit
- small number of highly generic products
- value added by customers or system integrators

- **Bespoke:**

- create custom services for verticals
- old PSTN model (special circuits, directory services, ...) → QoS
- generally, mostly failures, except...

- **Rent seeking:**

- leverage competitive position (access to spectrum, RoW, functionality, terminating monopoly) to seek “income paid to a factor of production in excess of what is needed to keep it employed in its current use”

IMS /VoLTE

IMS = It Mostly Speaks
VoLTE = Voice-Only Later than Expected

VoLTE: Taking Carriers Beyond Voice

🕒 Mon, 06/06/2011 - 12:43pm

👤 by Maisie Ramsay

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Project yourself into the future – let's say mid-2012. It's been about a year and a half since Verizon Wireless first launched its LTE network in December 2010, and after a long wait, the company has finally come out with the first smartphone running voice over LTE (VoLTE) technology.

You go out and buy the device, turning it on the second you have it out of the box. One of the first things you notice: The phone's native voice application isn't limited to just voice. It has an option for video calls, and there's also an option to send multimedia messages, along with presence indicators that show when people on your contact list can participate in a video call.

AT&T, Verizon Target VoLTE Interop in 2015, RCS Later

By Doug Mohny / November 04, 2014

AT&T and Verizon have officially declared they are working on Voice over LTE (VoLTE) connections between their respective networks and customers. VoLTE calls between Verizon and AT&T customers "is expected" in 2015, according to a statement from the companies. And, there's also some Rich Communications Services (RCS) news buried in the text.



The announcement comes as three out of four major U.S. carriers promote LTE networks and a number of countries plan to turn up LTE and VoLTE in the next 15 months. "Interoperability among VoLTE service providers in the United States and around the world will create a better and richer mobile experience for customers," declares Verizon's press release.

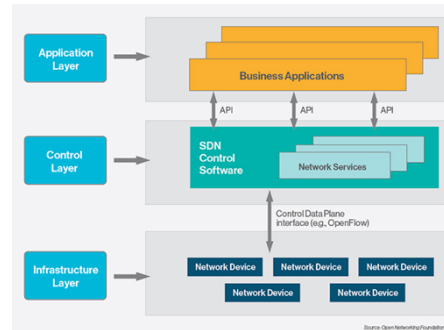
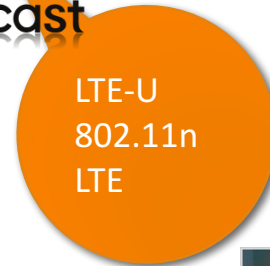
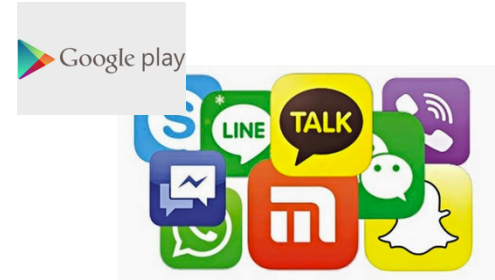
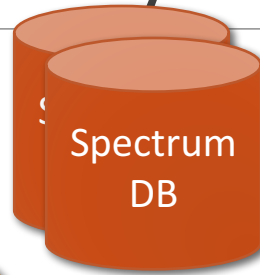
Vodafone Germany announces VoLTE rollout

17 Mar 2015

🇩🇪 Germany

Vodafone Germany claims it has become the first German operator to initiate the rollout of voice-over-LTE (VoLTE), having demonstrated the first live VoLTE call on its network at the CeBIT 2015 technology fair in Hanover. The UK-owned operator says that the technology offers customers an 'unprecedented voice service and telephony experience', ensuring 'crystal clear voice quality, super-fast call set-up and encrypted phone calls' across its LTE network, which currently covers 70% of Germany. Vodafone revealed that it will soon be launching new LTE smartphones for VoLTE, including handsets from manufacturers such as Samsung, Sony and HTC. The announcement follows reports last week that Vodafone plans to introduce both Wi-Fi calling and VoLTE in the UK this summer, following trials of the technologies in laboratory conditions.

5G – what exactly is a carrier?



Automation

► TOPICS / AUTOMATION

'Brutal' Automation & the Looming Workforce Cull

This digital reinvention, using Internet companies as a template, is deeply unsettling for workers in the telecom sector. Last year, Facebook generated about \$27.6 billion in sales with only 17,000 employees. That works out at more than \$1.6 million in revenues per employee. Deutsche Telekom's sales in 2016 were more than three times as much, but it needed a workforce of 221,000 employees to earn them. Productive next to some of its peers, the German operator fared poorly in comparison with Facebook, bagging only €331,000 (\$389,000) per worker. Making that figure look more respectable portends a grisly cull of staff.

Telecommunications US: 853,500 employees
Europe: 808,000

Indian Telecom Industry Set for Huge Layoffs



A recent wave of consolidation in India's telecom market could leave thousands of sector employees without jobs in the coming months.

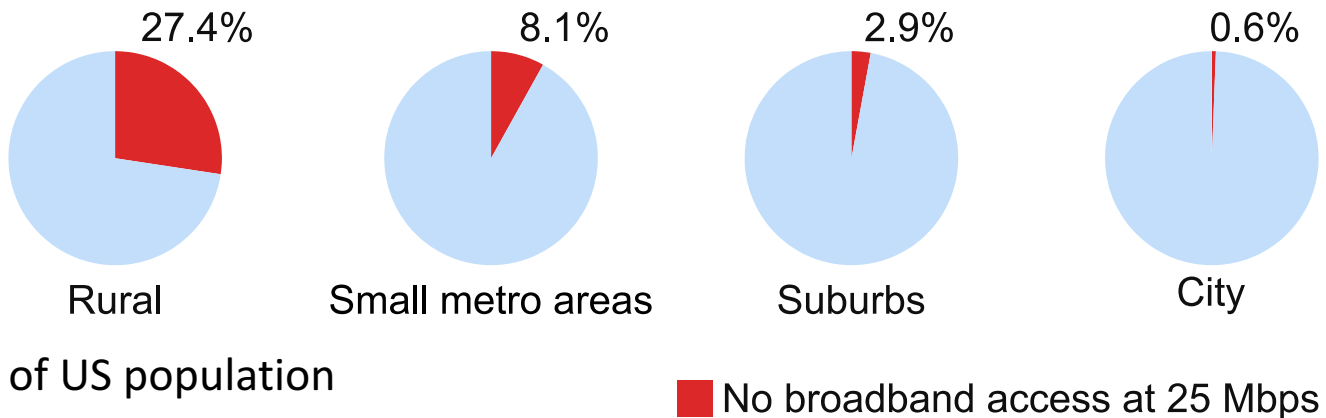
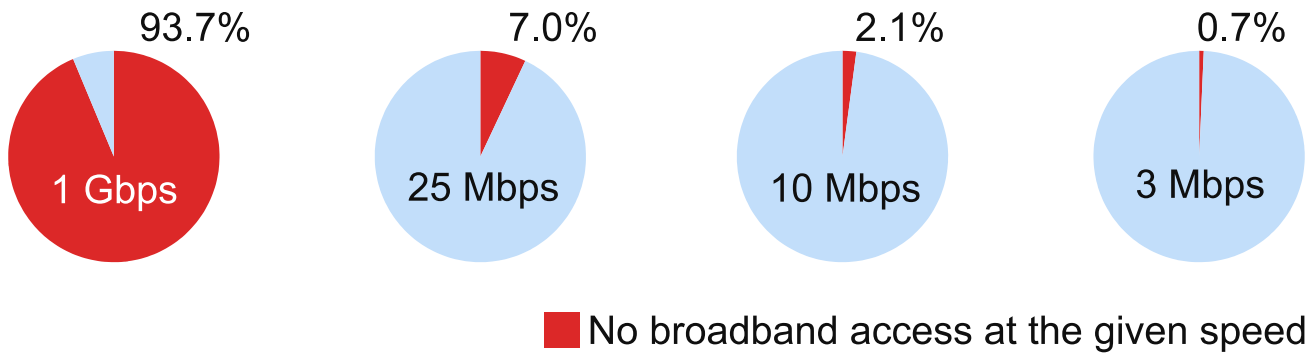
Either directly or indirectly, nearly 150,000 people could find themselves out of work as a result of the mergers and acquisitions that are now sweeping through the market, according to press reports.

Arash Ashouriha, [Deutsche Telekom AG](#) (NYSE: DT)'s deputy chief technology officer, said the only way that his company could now succeed was through a process of "brutal automation."

"At Deutsche Telekom we now have a vision of zero-touch network service management with no human involvement," he told attendees during a keynote presentation this morning at the SDN NFV World Congress in The Hague. "Similar to the journey with NFV [network functions virtualization], we are now keen to drive this within an industry study group."

The remarks come just a day after the [European Telecommunications Standards Institute \(ETSI\)](#) announced the formation of a new group dedicated to "zero-touch" networks and automation. (See [Automation Gets Its Own ETSI Group](#).)

Broadband access by speed & geography



15% of US population

Rural electrification

- Early 1920s, between 2 and 3% (likely less)
 - 1921: DC had 98.2%, MA 97.8%
- “In 1935, only 10.9% of American farms (744,000) enjoyed central station power, compared with Germany and Japan at 90%, France between 90 and 95%, and New Zealand at 60%.”
- “In 1940, just four and a half years after Roosevelt signed Executive Order No. 7037 (followed by 1936 “Rural Electrification Act”), 25% of American farms had been electrified.”
- 1950: 90% had been electrified nationally
- Today: 850 distribution coops serving 14 M homes

Rural electrification

- “In 1935, only 10.9% of American farms (744,000) enjoyed central station power, compared with Germany and Japan at 90%, France between 90 and 95%, and New Zealand at 60%.”
- “In 1935, Morris Llewellyn Cooke... Appointed by Roosevelt as the REA's first administrator, Cooke applied an engineer's approach to the problem, instituting what was known at the time as "scientific management"—essentially systems engineering. Within 2 years it helped bring electricity to 1.5 million farms through 350 rural cooperatives in 45 of the 48 states. By 1939 the cost of a mile of rural line had dropped from \$2,000 to \$600. Almost half of all farms were wired by 1942 and virtually all of them by the 1950s.”
- Cost of aerial **fiber** installation: \$14k/mile material, \$39k/mile installation (Singer, 2017)



\$10,958 in
2017

Conclusions

- Networks as infrastructure → technology, economics & policy
- We don't understand the cost drivers beyond equipment
 - almost no data
 - no good mechanism to evaluate the impact of (say) SDN
- Think in decades, not conference cycles
- Network performance is rarely the key problem
 - except maybe at wireless physical layer
- Many of the problems are incentive problems
 - we know how to solve them, but levers are missing
 - or are politically not feasible