

# Femtocells - Building the Quality Network for Mobile Operations - Oct 2010

## From coverage to quality: building the future network

*represented by:*

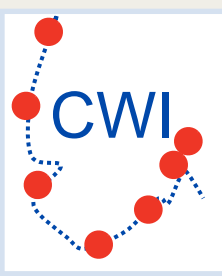
Josef Noll, Professor  
University of Oslo/UNIK  
[josef@unik.no](mailto:josef@unik.no)

*on behalf of the*

**Center for Wireless  
Innovation Norway**  
CWI Norway (<http://cwin.no>)



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# Outline

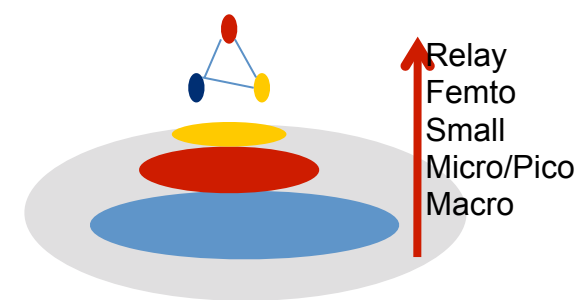
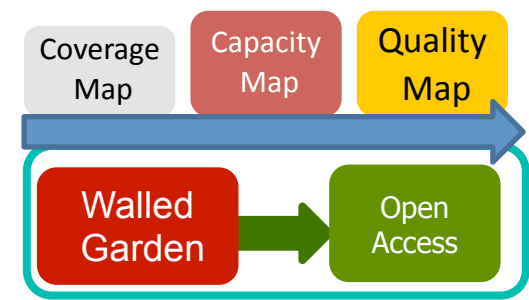
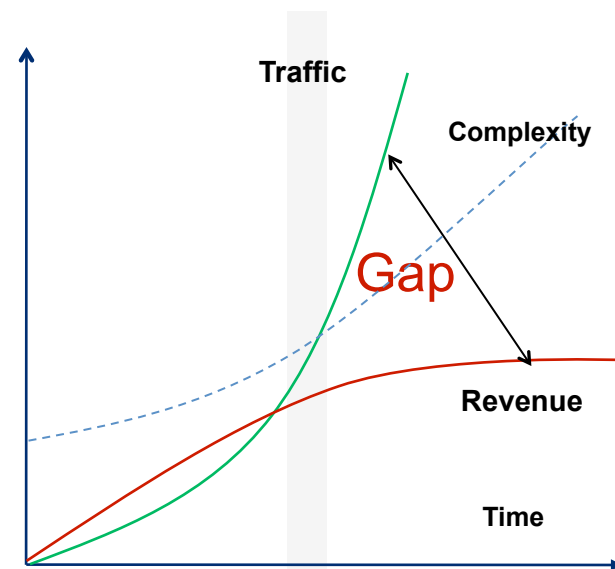
- Network capacity requirements
  - need for doubling the capacity of the mobile network
  - including customer equipment
- The core network challenge
  - indoor coverage for
- Analysis and experience
  - current models are not sufficient for Beyond3G
  - the academic offer for a Norwegian project



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# Diverged Traffic & Revenue Growth

- ✓ From Kilo ( $10^3$ ) bytes to Tera ( $10^{12}$ ) and Zeta ( $10^{21}$ ) bytes
- ✓ Global ubiquitous Internet-based solution with hyper Connectivity
- ✓ Hundred-fold increase in network flow brought by mass terminals and mass digital content, and the thousand-fold, increase in traffic flow on mobile networks
  
- ✓ Users are spending more time on the phone & internet
- ✓ Average household spending on communication falls
- ✓ Consumer pay less while getting better value -> they pay ~30% less than 5 years ago
  
- ✓ Significant growth in traffic while slow in revenue
- ✓ User experience at risk
  
- ✓ What do we do with a surging traffic
  - Limit/control it?
  - Turn it to revenue?
  - Bring the cost of it down?

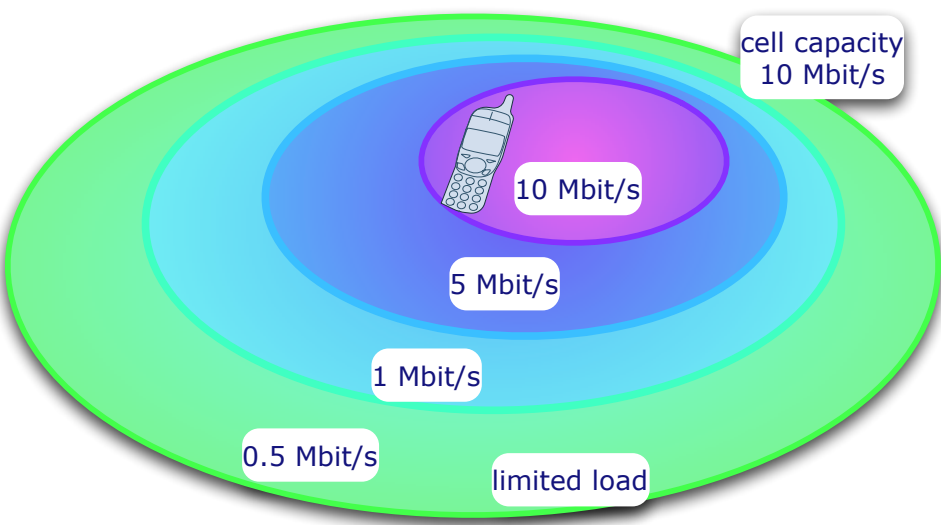


Cost reduction is a very critical aspect of the future networks. Telecom seems to be the only sector delivering price decrease

[source: Sharam G Niri, 2010] (adapted)

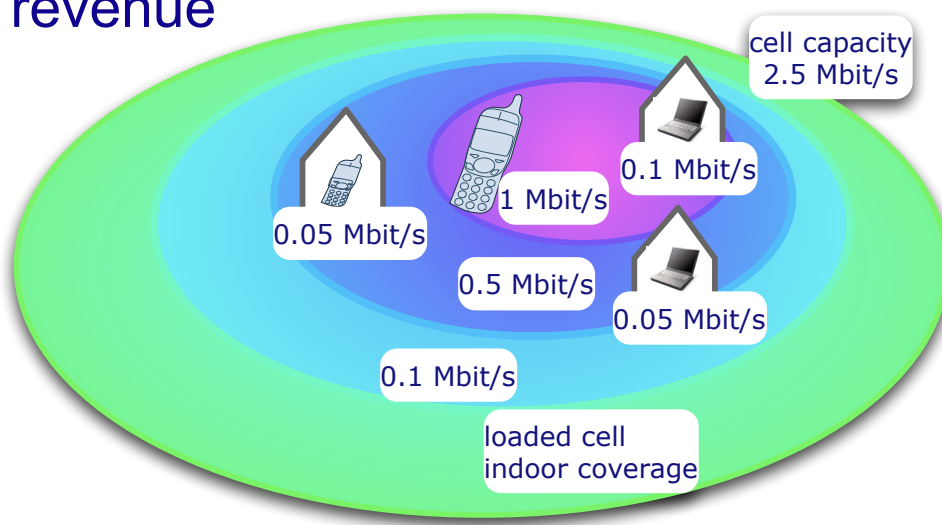
# 5G access - business considerations

- The radio dilemma
  - outdoor to indoor



“coverage cell”

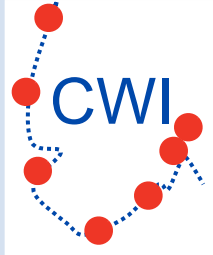
- The business dilemma
  - 5G access is expensive (range)
  - changing access means losing revenue



“70-80% indoor usage”

[drawings: Jørgen Grinnes, Telenor, 2010]

# Real network usage

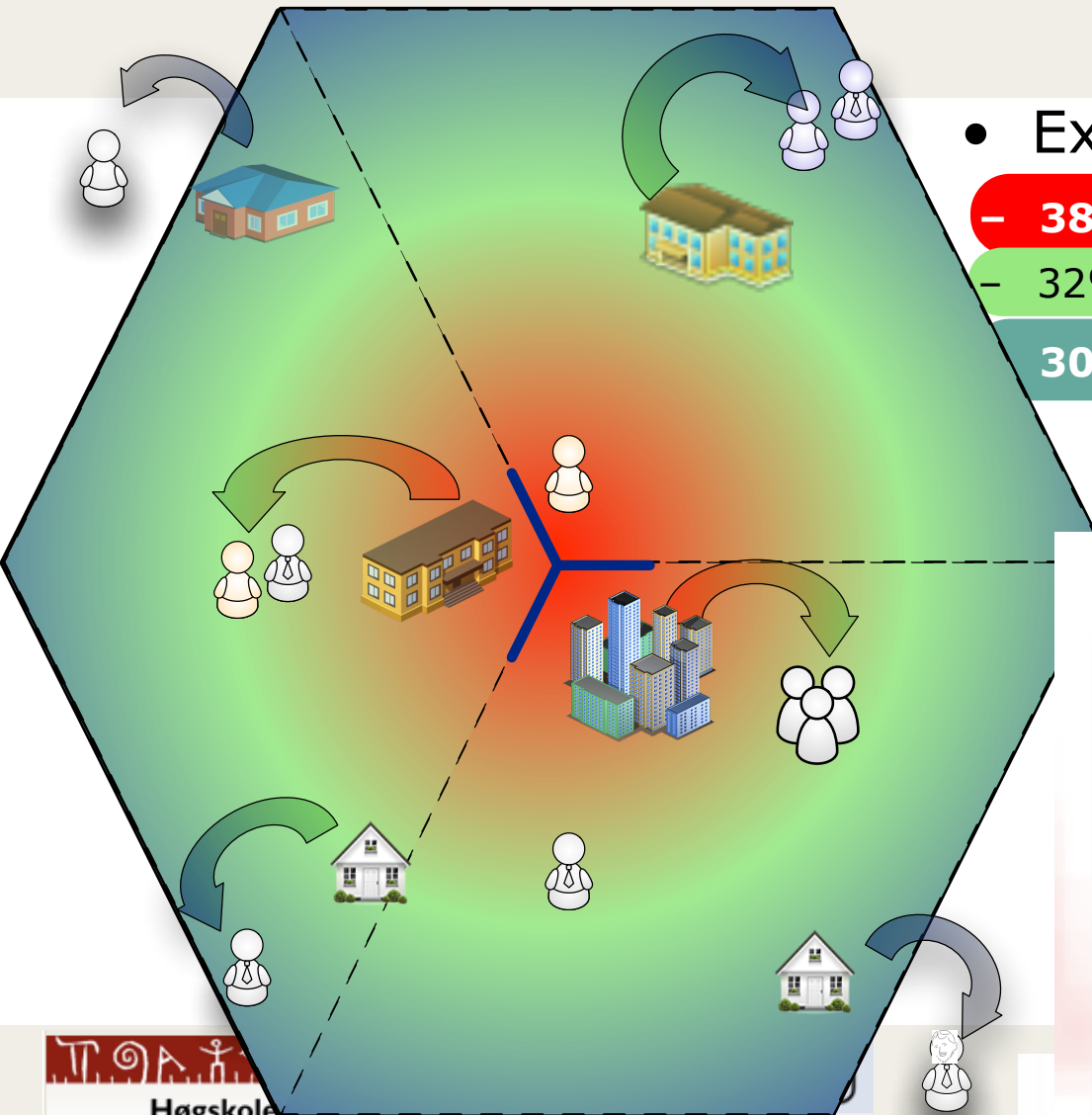


- Expectation [Motorola 2009]

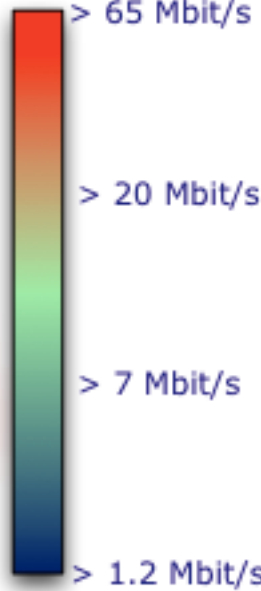
– 38% of users > 20 Mbit/s

– 32% of users 7...20 Mbit/s

30% of users 1.2...7 Mbit/s



Aggregated data rate

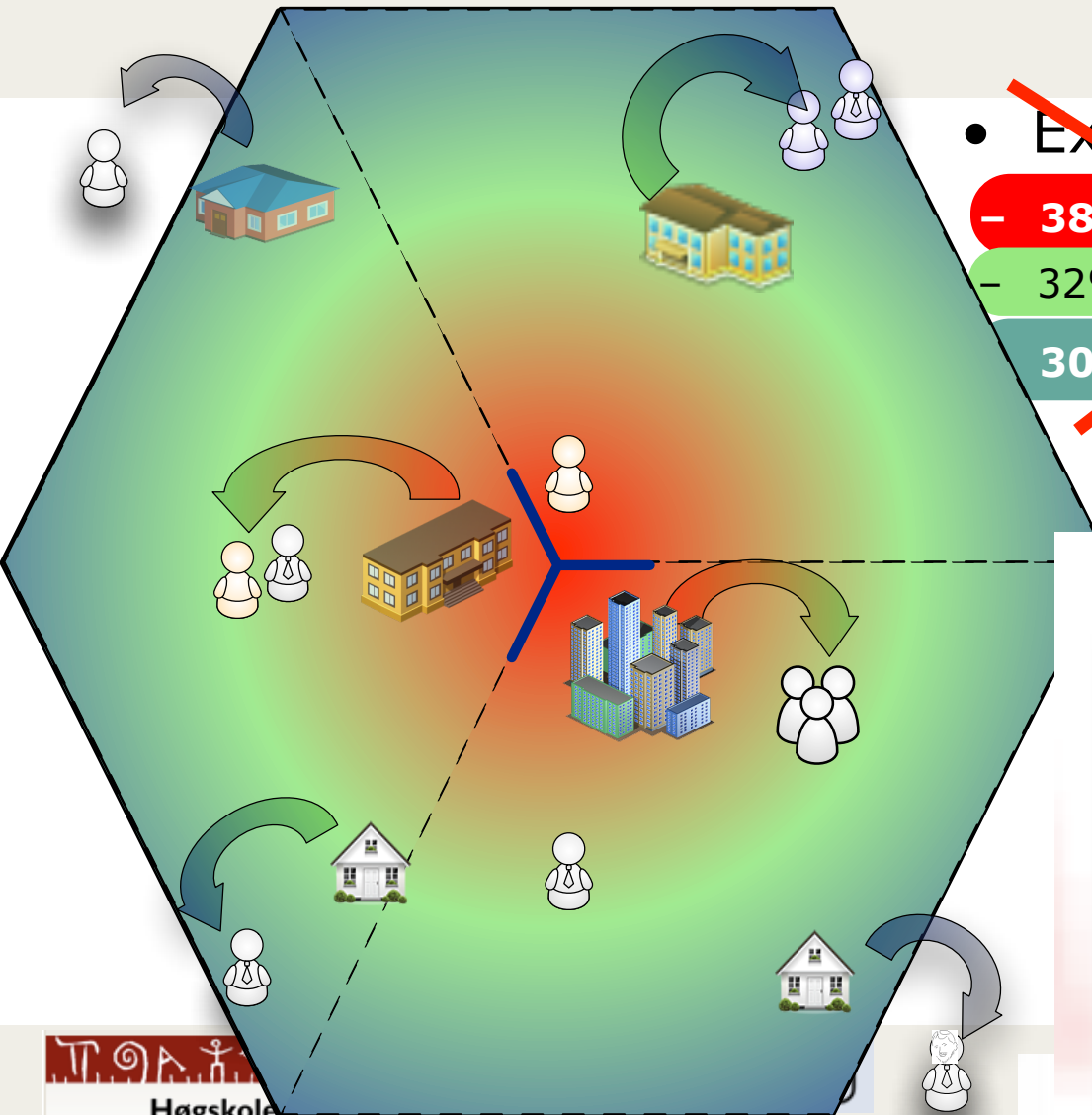
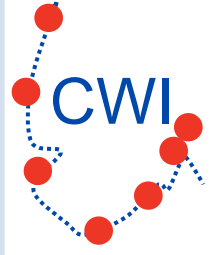


70% indoor users means 30% ...



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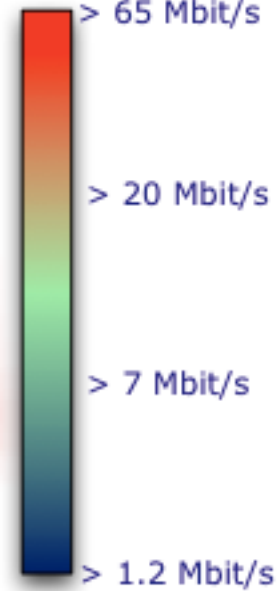
# Real network usage



<del>Expectation [Motorola 2009]</del>	Reality
<del>- 38% of users &gt; 20 Mbit/s</del>	16%
<del>- 32% of users 7..20 Mbit/s</del>	17%
<del>- 30% of users 1.2..7 Mbit/s</del>	32%
	<b>35%</b>

- no femto  
- indoor usage

Aggregated data rate



Høgskolen i Østfold

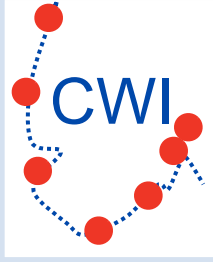
70% indoor users means 30% ...

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led users

Universitetet i Stavanger

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# Open issues and Suggestion for Project

- Realistic values for
  - usage pattern for LTE (>90% indoor?)
  - current models are not sufficient for Beyond3G
  - core network capacity reduction due to indoor usage
- The business perspective for femtocells
  - Single operator cells versus multi-operator cells
  - Regulation, frequency, interference
  - User-managed femtocells
- Academia can support
  - stress-testing the outdoor network
  - Outdoor-indoor
  - Femtocell coverage and interference

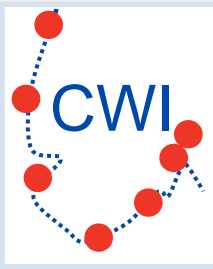
Femtocell equipment:  
 Rate of return on capital 5%  
 Term of loan 15 years  
 CapEx cost of one home BS - 350 \$  
 Core network packet router CapEx per BS - 77\$  
 Maintenance cost as a fraction of CapEx 12%/year



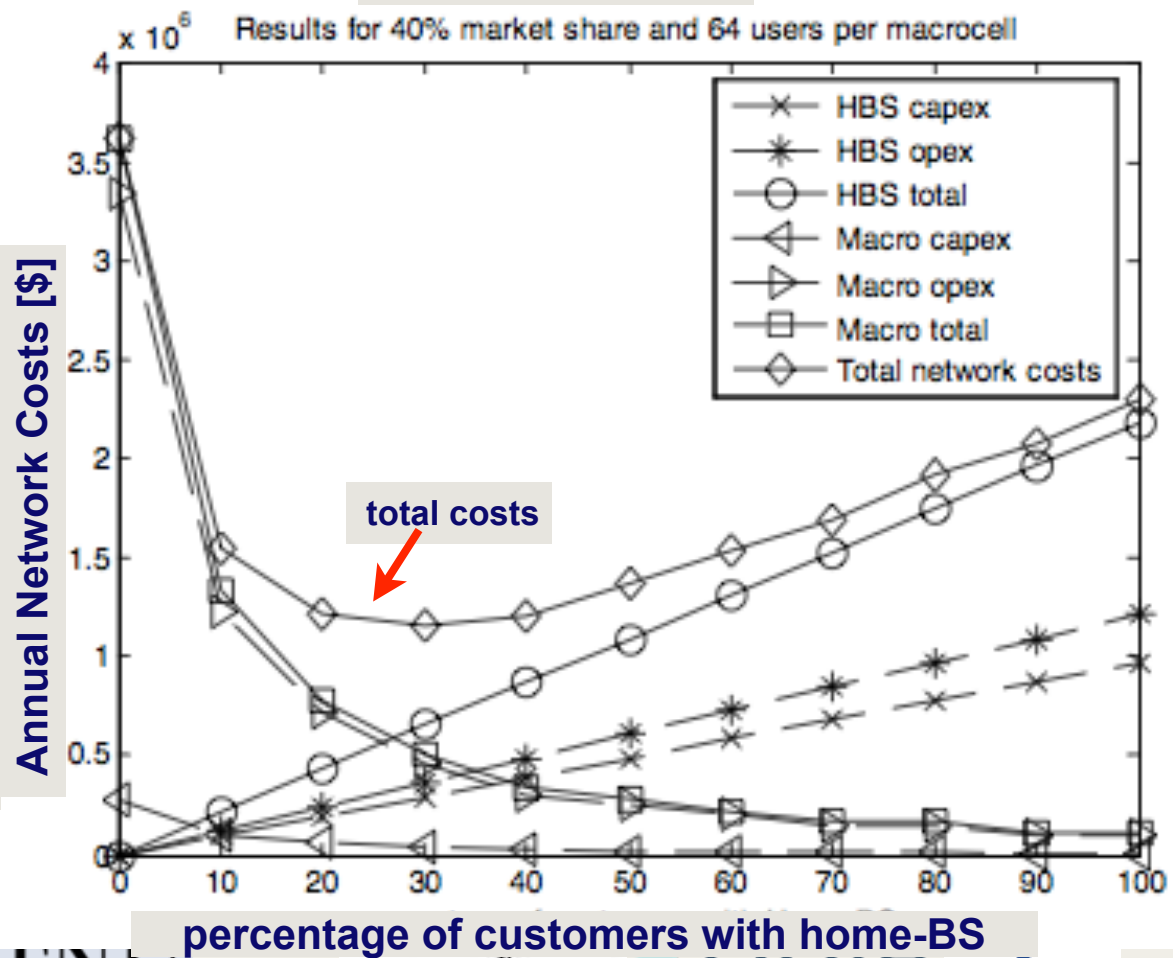
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# Business perspective of Femtocells



40% market share



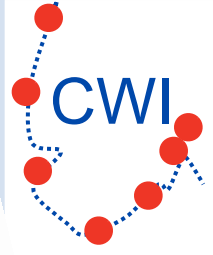
OpEx and CapEx calculations based on “free provisioning” of home base stations

[source: H. Claussen, 2007]



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# Business perspective of Femtocell

**CELL PHONES / VOIP**  
**Operators Ready to Open up Femtocells, Says Ubiquisys**  
 June 30, 2010 8:30 AM

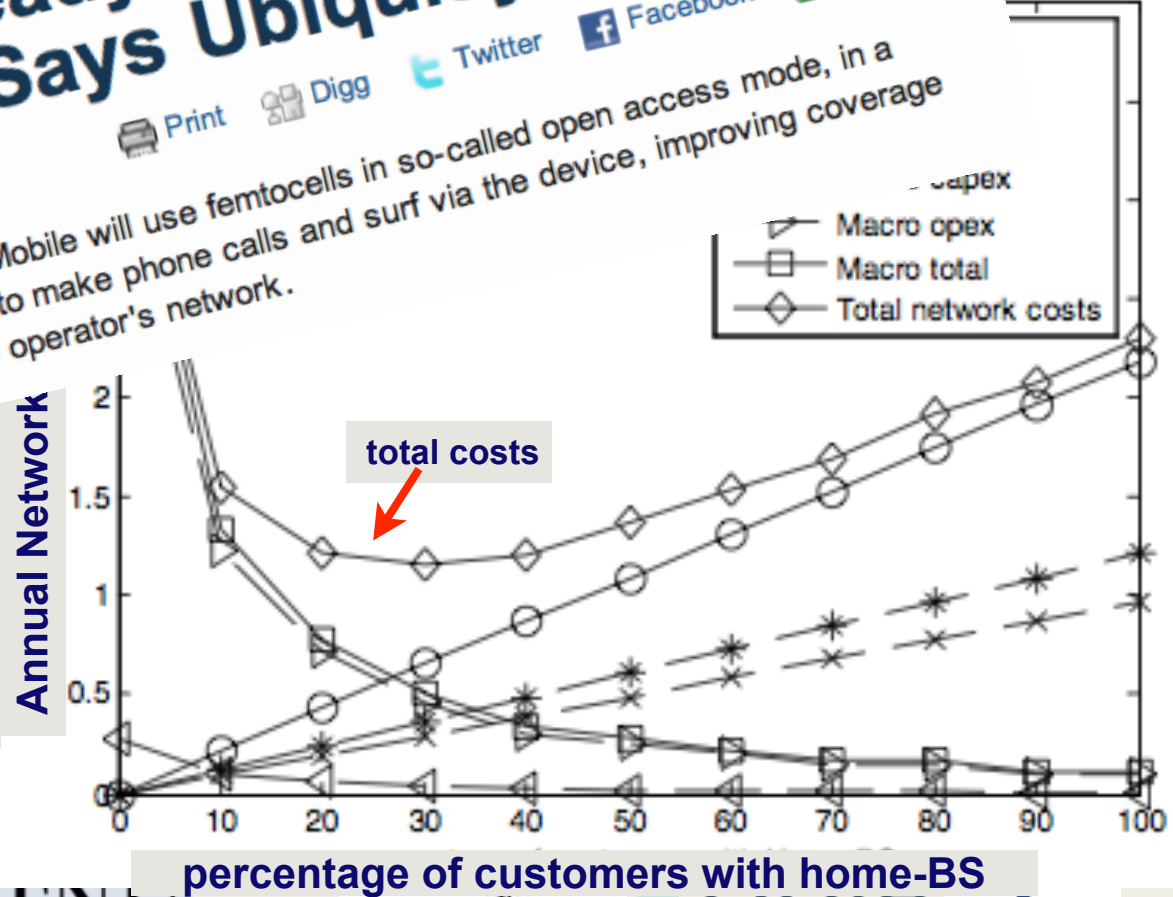
By Mikael Ricknäs, IDG News

Japanese operator SoftBank Mobile will use femtocells in so-called open access mode, in a move to allow all subscribers to make phone calls and surf via the device, improving coverage and offloading traffic from the operator's network.

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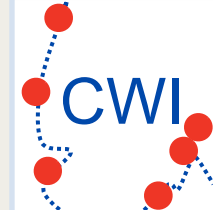
**OpEx and CapEx calculations based on "free provisioning" of home base stations**

[source: H. Claussen, 2007]



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# Conclusions



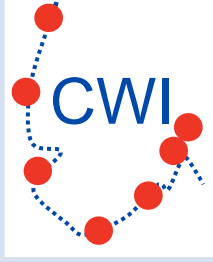
- 70-80% of indoor users 3G from

	expectation	reality
>20 Mbit/s	38 %	16 %
7-20 Mbit/s	32 %	17 %
1.2-7 Mbit/s	30 %	32 %

**-35%**

- Open issues
  - usage pattern for LTE (>90%?)
  - Reduction of network load through femtocells
  - user experience "where is my operator"
- Suggestion for national project





# Thanks to

My colleagues at UNIK

- **Mohammad Mushfiqur Rahman Chowdhury** for 5G discussions and calculations
  - see tutorial ICWMC 2010 for whole picture
- **Arlindo Bengui André** for LTE work

My colleagues at CWI

- **Frank Reichert** for comments on 5G

Our cooperation partners at CTIF (Aalborg University)

- **Ramjee Prasad** for initiating the “discussion”

Our industrial partners

- **Bjørn Amundsen** from Telenor for discussions on coverage and capacity
- **Tom Guldborg** from Network Norway for femtocell
- **Vegard Kjenner** from Netcom for LTE usage

- **Per Hjalmar Lehne** from Telenor for generations
- **Jørgen Grinnes** from Telenor for 3G examples
- **Bent Bentsen** from DnB NOR for the information on Payment and TSM Nordic
- **Truls Berg** from Movation for mobile usage data
- **Linda Firveld** from MobileMonday for femtocell industrialisation
- **Shahram G Niri** from NEC for collaborative discussions

My Telecom colleagues from various Eurescom projects

- and many, many more....

more info: "Collaborative Radio for 5G Mobile and Wireless Communications, ICWMC 2010 tutorial, Valencia, Sep 2010



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