

$$mms = // \text{Lux} \cdot \text{unit.no} / 308$$

## Assignments Part II

### Part II assignments

- Cell capacity, System capacity
- Traffic Modelling
- Mobility
- Basic Internet (free access to basic information (text & pictures) on the Internet)
- inverse MVNO: the customer owns the access network
- WLAN system for video communication
- ... (any other topic which you might find interesting)

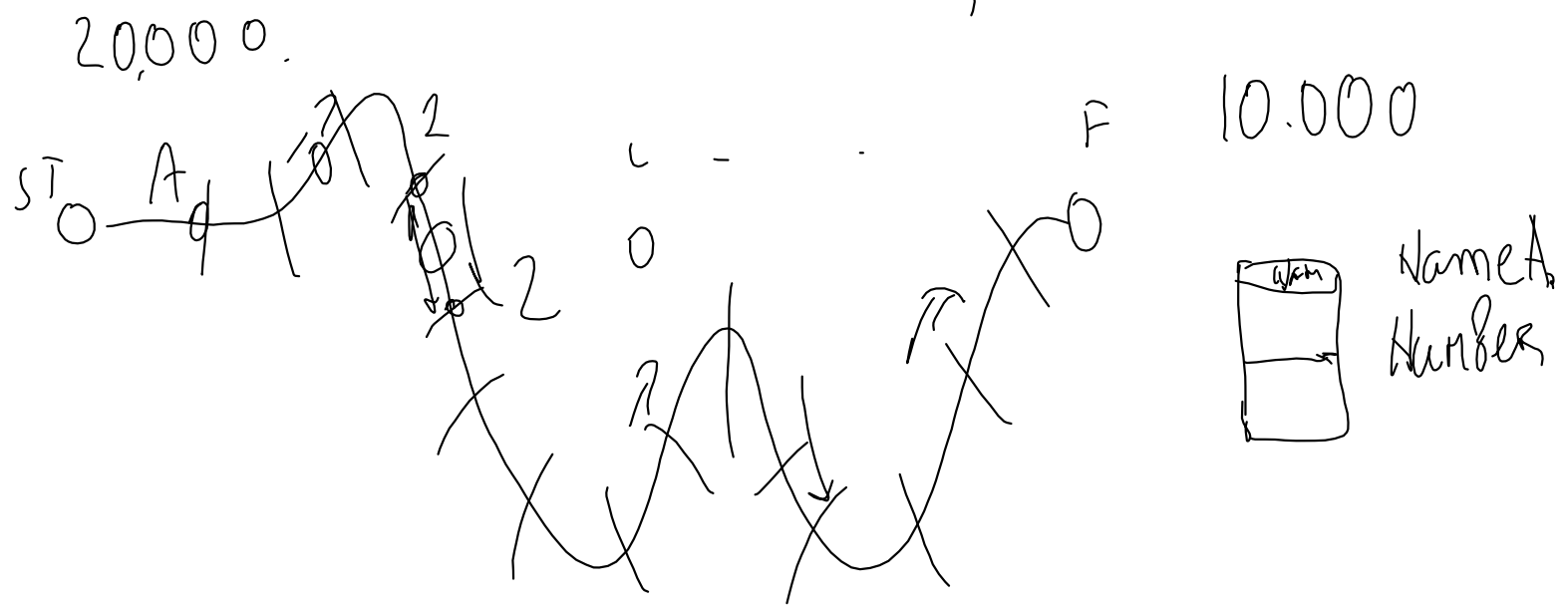
for further information, see [F1-Future\\_Networks](#)

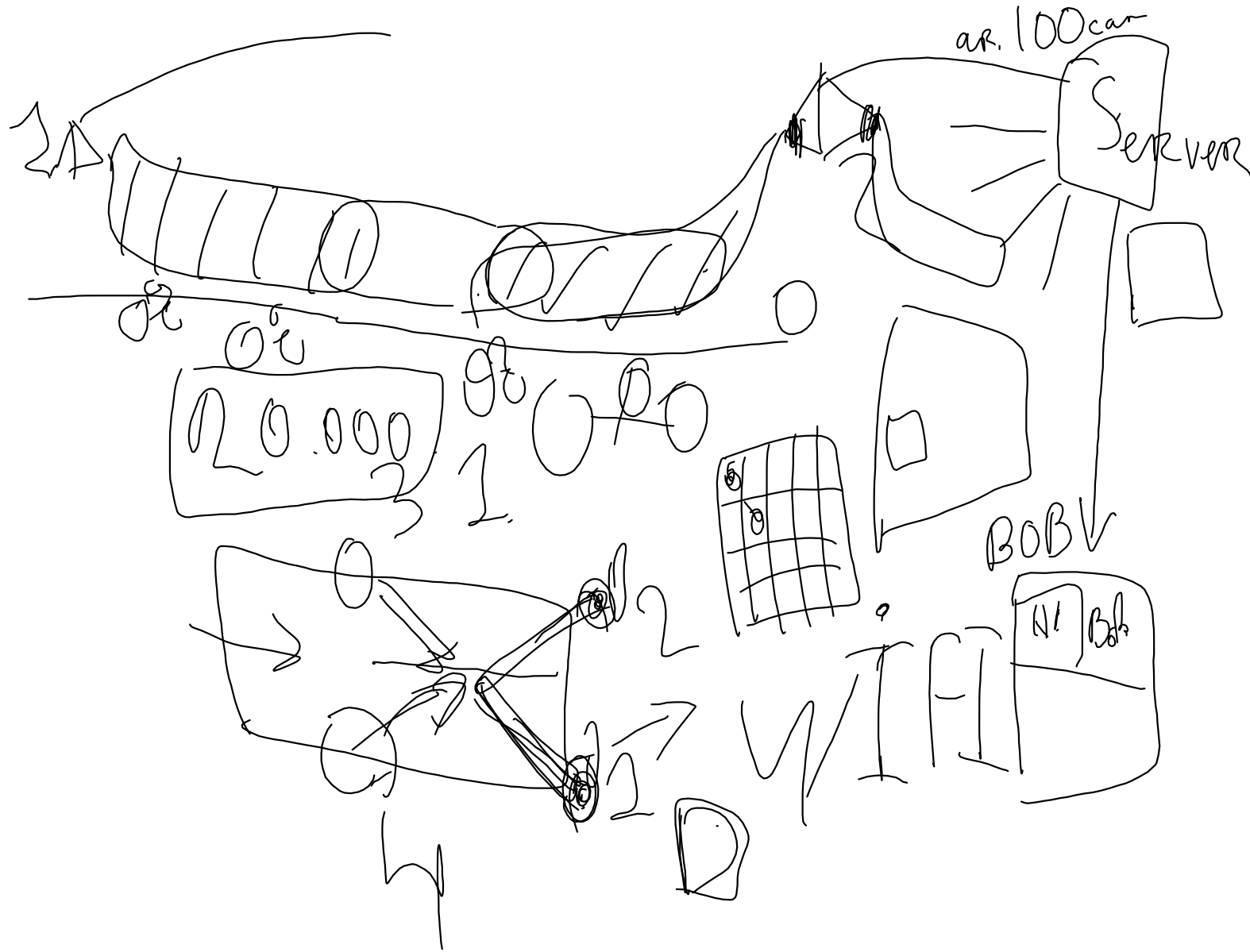
Seraj Technical

Kazi : buz model  
 "disruptive innovation"  
 → customer "owns"

- Yun Ai : Distribution of inc. waves in microcell
- Qihao Li : WiMAX for video systems
- Raul : WiFi for video systems

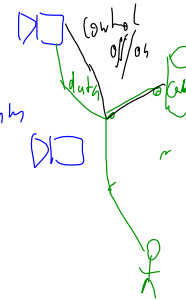
# Wifi / WiMAX video distribution system





## Questions to Raul

- real or simulation
  - ↳ mobile phones with U.F.I + camera
  - ↳ laptop with Web Cam
- cyclists (video from behind?)
- distances → be specific dimension [m], [km]
- equipment: what
- spectators at home, Spectators along the track?
- central server
  - ↳ all data?
  - ↳ only signalling
  - ↳ separate data stream
- network & antenna topology
- type of antennas, range



## Real outcome?

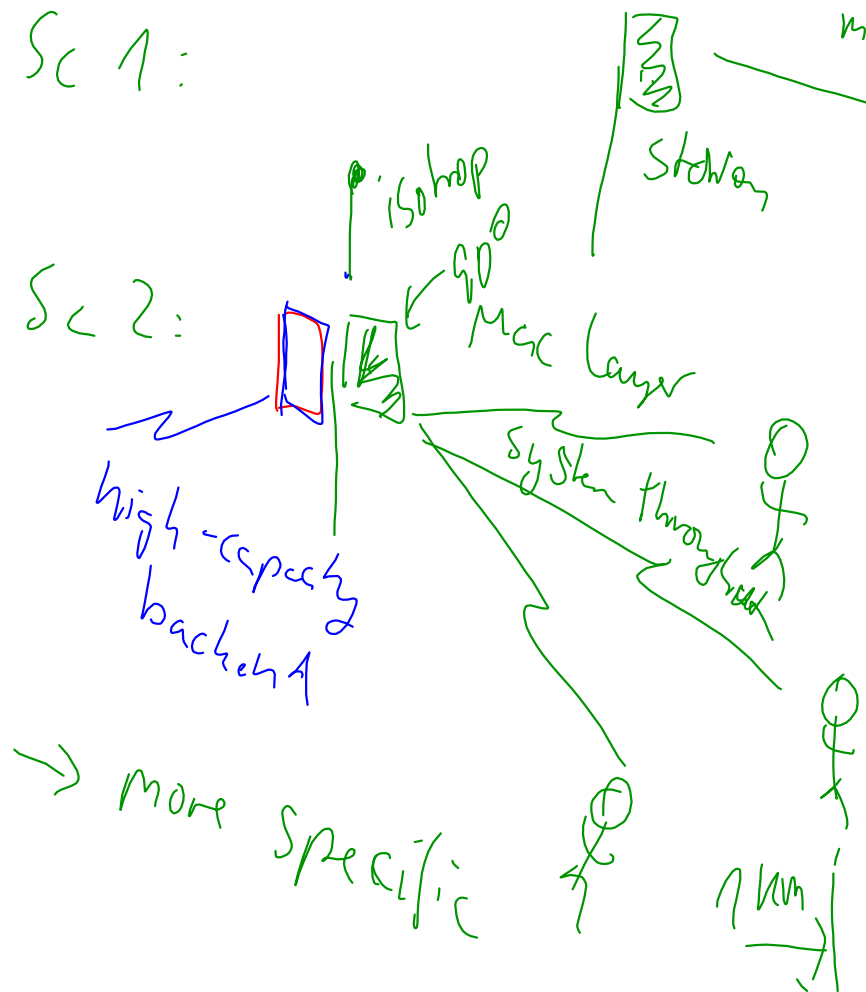
- simulation of capacity
- " of bandwidth
- References / literature ⇒ state-of-the-art

Video over (WiMAX) → Wi-Fi;  
physical modulation error/rate

Buz: heavy stuff

Sc 1:

Sc 2:



802.16 e  
LTE

# of people 5-10 ... 1000

range  
802.11 ac ← or 802.11n

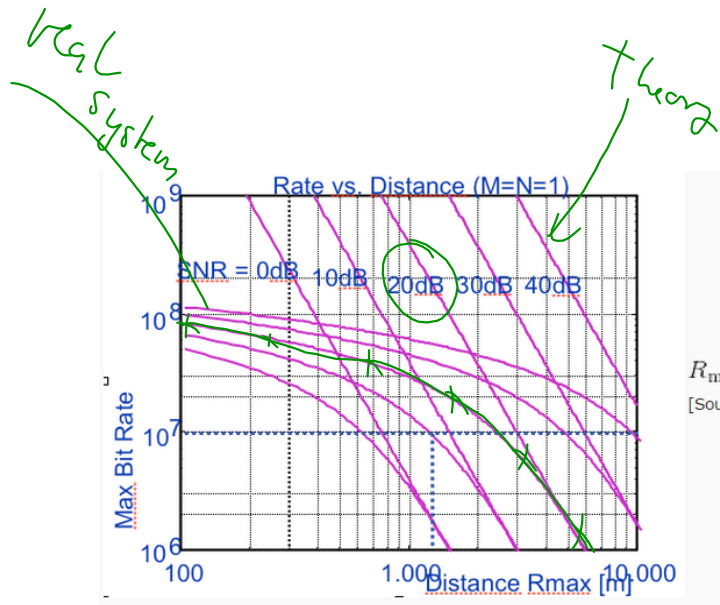
→ more specific

Output

Literature

② "Curves" (models)

③ interpolation / linearisation  
is only valid for .....



$$R_{\max} = \log_2(1 + SNR)$$

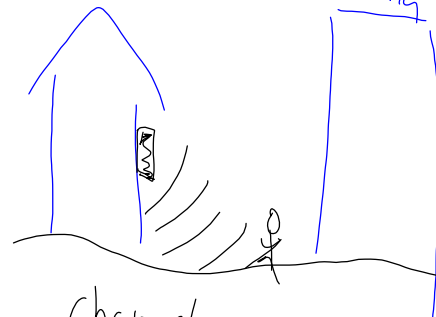
[Source: Valenzuela, BLAST project]

Yun Ai: incoming waves in micro cells

Macro ~ Range isotropic vs directional antenna  
 ~ 1.5... 10km

Micro ~ 300-500m  
 (1 km)

Pico }  
 Femto } Small cell } indoor ~ 50m  
 Nano } "Outdoor street lamp" stadium

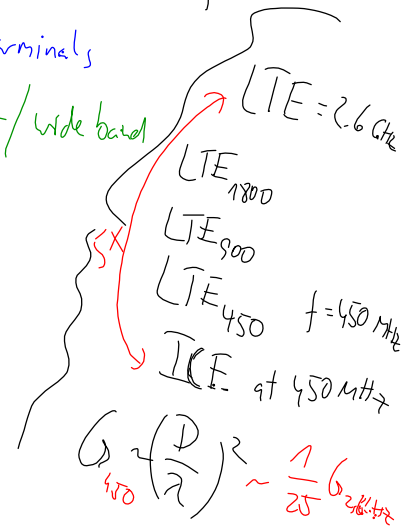


Channel  
 - reflection \* - mobility  
 - scattered \* - type of traffic  
 - diffraction - bandwidth  
 - frequency f ~ 2.6 GHz

Outcome:

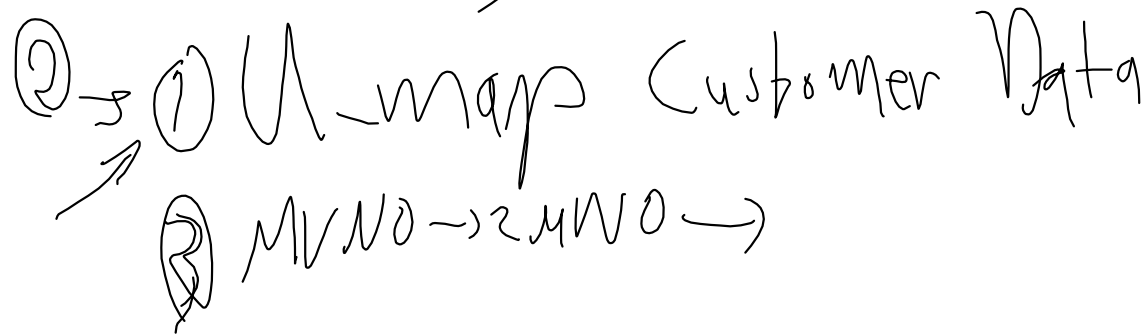
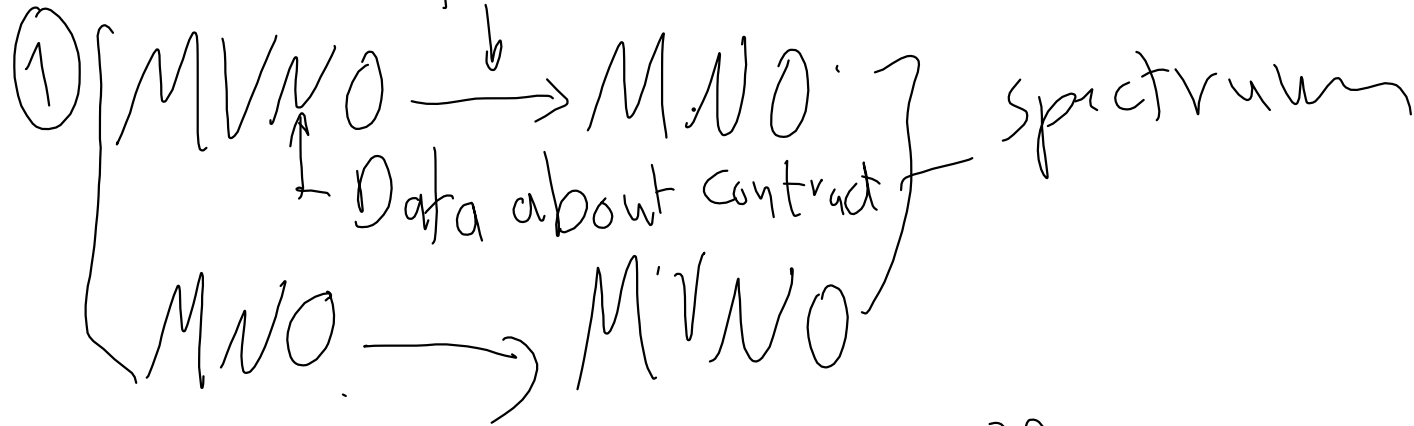
- angle of arrival from mobile terminals

\* narrow-/wide band



$$G_{450} = \left(\frac{D}{\lambda}\right)^2 \sim \frac{1}{25} G_{2.6GHz}$$

Kazi, Seraj — invers MVNO  
 Rent from

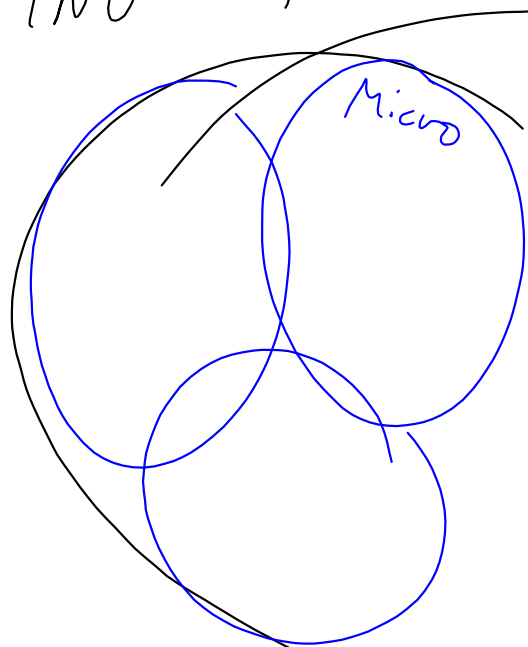




# Future network

- Capacity  
Spectrum is owned by MNO

MNO Macro



## Options:

U.O has agreement with foreign operator

Cloudberry

$f = 2.6$  GHz  
2.1

new / disruptive  
tech

SE, WL

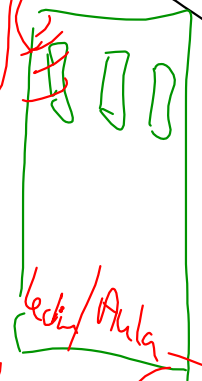
Spectrum is free available

for Comm.  
50 buildings  
BW = 40 MHz  
100 MHz

Old:



LTE, UO



Leazi =>  
Senzi =>

Telcelar SIM  
UO SIM // Swap profile

Cloudberry  
Small cells

+ roaming with MNO

2 small cells

work  
home

### technical questions

### biz questions

traffic, handover  
 signalling  
 coverage interference  
 $BW_i = 40$  . or 100MHz  
 how much traffic  
 # base stations  $\leftarrow \begin{matrix} * \\ SiO \end{matrix}$

Case: - foreign operator  
 Suraj - T-Mobile  $\leftarrow$  Roaming  
 \ /  
 UiO  
 Telenor  
 Traffic split: UiO  $\leftrightarrow$  Telenor Macro Network  
 - home fcn to cell  $\rightarrow \begin{matrix} \geq 80\% \\ 20\% \end{matrix}$   
 \ /  
 Customer?  
 UiO, SiO  $\leftarrow$   
 Cloudberg  
 type of service

indoor, outdoor Campuses

Cooperating access points  $\leftarrow$  "free spectrum"  
 power, interference  
 voice  $\rightarrow$  termination fee  
 - who owns equipment  
 - SIM (customer)

SiO, Telenor?  
 $\rightarrow$  "SSID": Telenor  
 : UiO

Security

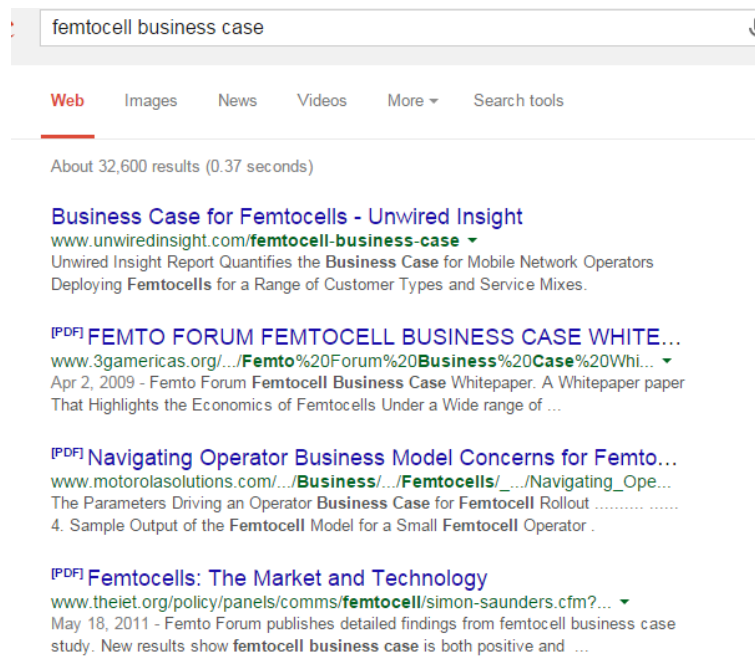
[From coverage to quality: building the future network Δ](#), Femtocells - Building the Quality Network for Mobile Operations - Oslo, 28 Oct 2010

Ayaz Khan Afridi, "[Macro and Femto Network Aspects in Realistic LTE Usage Scenarios Δ](#)", Master Thesis, Network Services and System in Department of Electrical Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden, May 2011.

### Standalone Femtocell Operator Business Case | Use Cases ...

[www.thinksmallcell.com](#) > Business Case > Use Cases ▼

Nov 14, 2013 - This led me to reconsider if there is a **business case** for an operator to launch with a **femtocell** only approach. Femtocells do require the ...



femtocell business case

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**Business Case for Femtocells - Unwired Insight**  
[www.unwiredinsight.com/femtocell-business-case](#) ▼  
Unwired Insight Report Quantifies the **Business Case** for Mobile Network Operators Deploying **Femtocells** for a Range of Customer Types and Service Mixes.

**FEMTO FORUM FEMTOCELL BUSINESS CASE WHITE...**  
[www.3gamericas.org/.../Femto%20Forum%20Business%20Case%20Whi...](#) ▼  
Apr 2, 2009 - Femto Forum **Femtocell Business Case** Whitepaper. A Whitepaper paper That Highlights the Economics of Femtocells Under a Wide range of ...

**Navigating Operator Business Model Concerns for Femto...**  
[www.motorolasolutions.com/.../Business/.../Femtocells/\\_.../Navigating\\_Ope...](#)  
The Parameters Driving an Operator **Business Case** for Femtocell Rollout .....  
4. Sample Output of the Femtocell Model for a Small Femtocell Operator .

**Femtocells: The Market and Technology**  
[www.theiet.org/policy/panels/comms/femtocell/simon-saunders.cfm?...](#) ▼  
May 18, 2011 - Femto Forum publishes detailed findings from femtocell business case study. New results show **femtocell business case** is both positive and ...

## Summary

- be specific (numbers!) of your use case
- literature (CWI, Google scholar, ...) state of the art
- Assumptions (reduce complexity)
  - ↳ why?
- expected outcome

Future steps

Today: "rough" scenario (area)

7 Nov detailed scenario  
+ literature SOTA → idea about outcome  
State of the art

14 Nov start simulations "framework"

⋮

27 Nov - 5 Dec (?) Simulation results  
+ Presentation

Feedback

### IBM's Watson Supercomputer Destroys Humans in Jeopardy ...



[www.youtube.com/watch?v=WFR3IOm\\_xhE](http://www.youtube.com/watch?v=WFR3IOm_xhE) ▾  
Jan 14, 2011 - Uploaded by Engadget  
IBM's **Watson** supercomputer destroys all humans in **Jeopardy**. »  
Subscribe To Engadget Today: [http://bit ...](http://bit...)

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### Jeopardy! IBM Challenge - Day 1 - YouTube

[www.youtube.com/watch?v=uMpPT\\_2gADM](http://www.youtube.com/watch?v=uMpPT_2gADM) ▾

Feedback