Panel AICT 2010

Challenges in Advanced Communications and Services

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Challenges in Advanced Communications and Services

Focuse on Wireless Communications

Well known :demand in services, in throughput increase
demand in ubiquitous connections

But: Spectrum rare and expensive
Near Shannon capacity

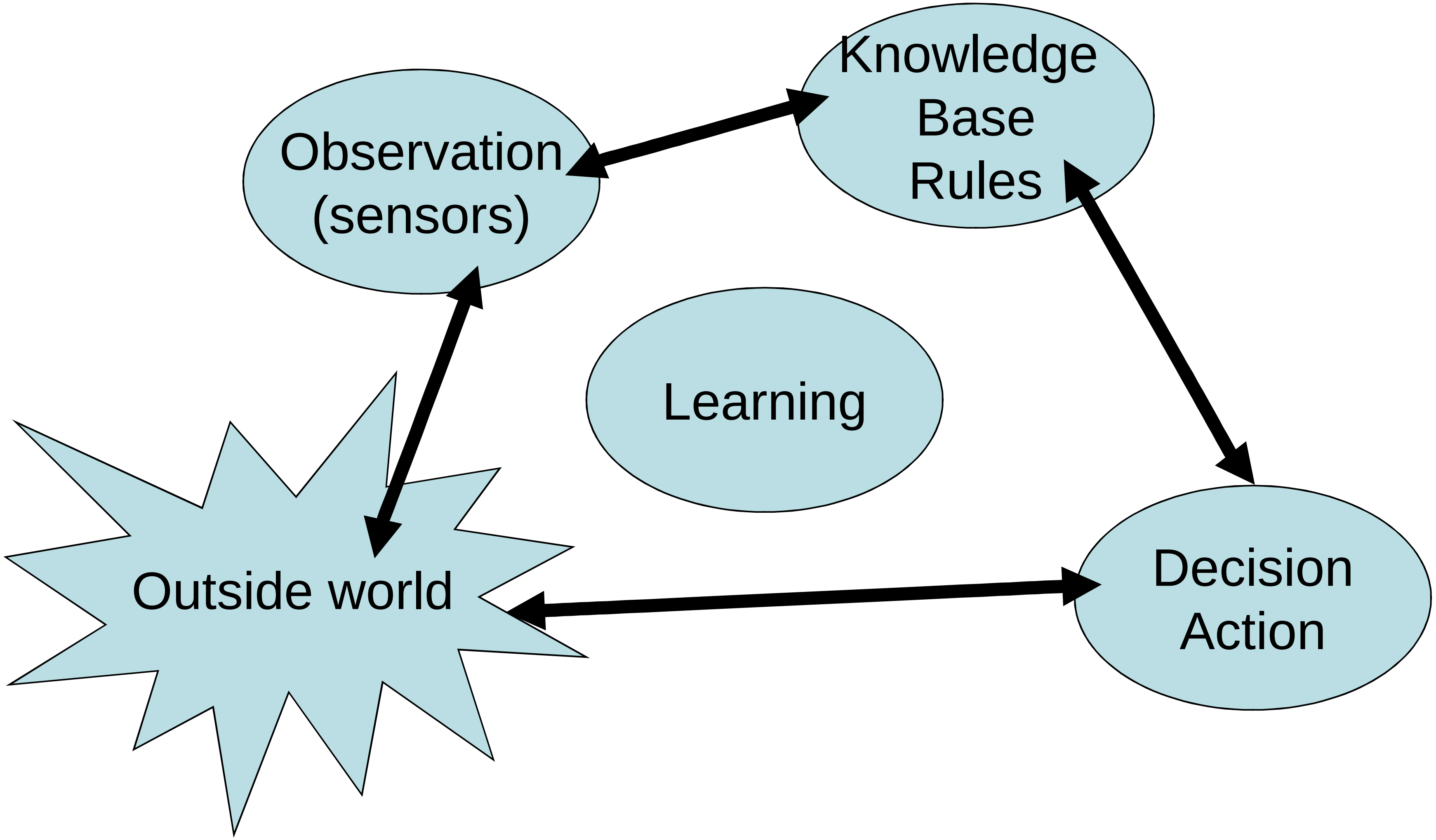
What could be done????

2 key Words

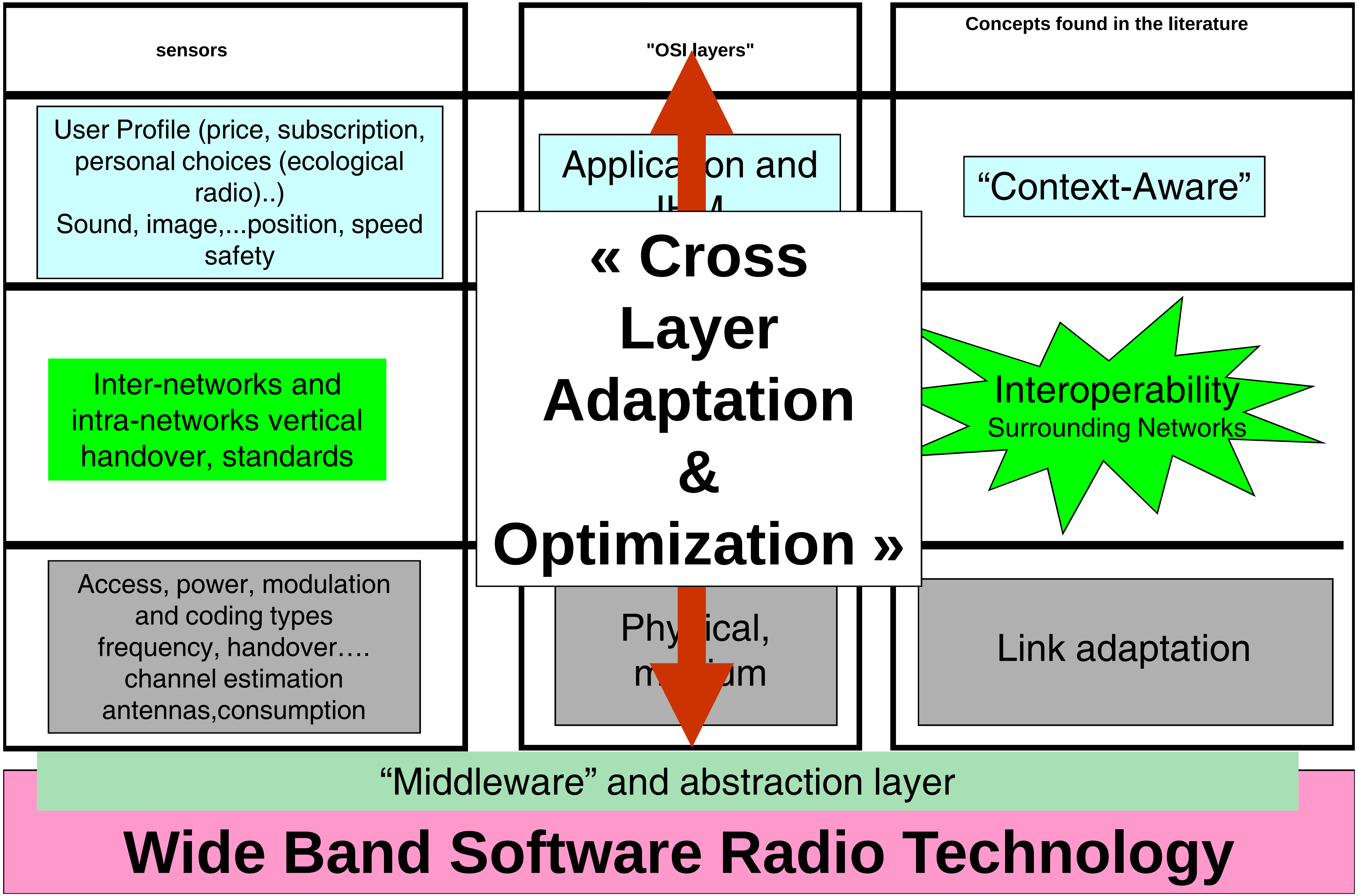
Intelligence

Sustainable Development

Conventional cognitive cycle

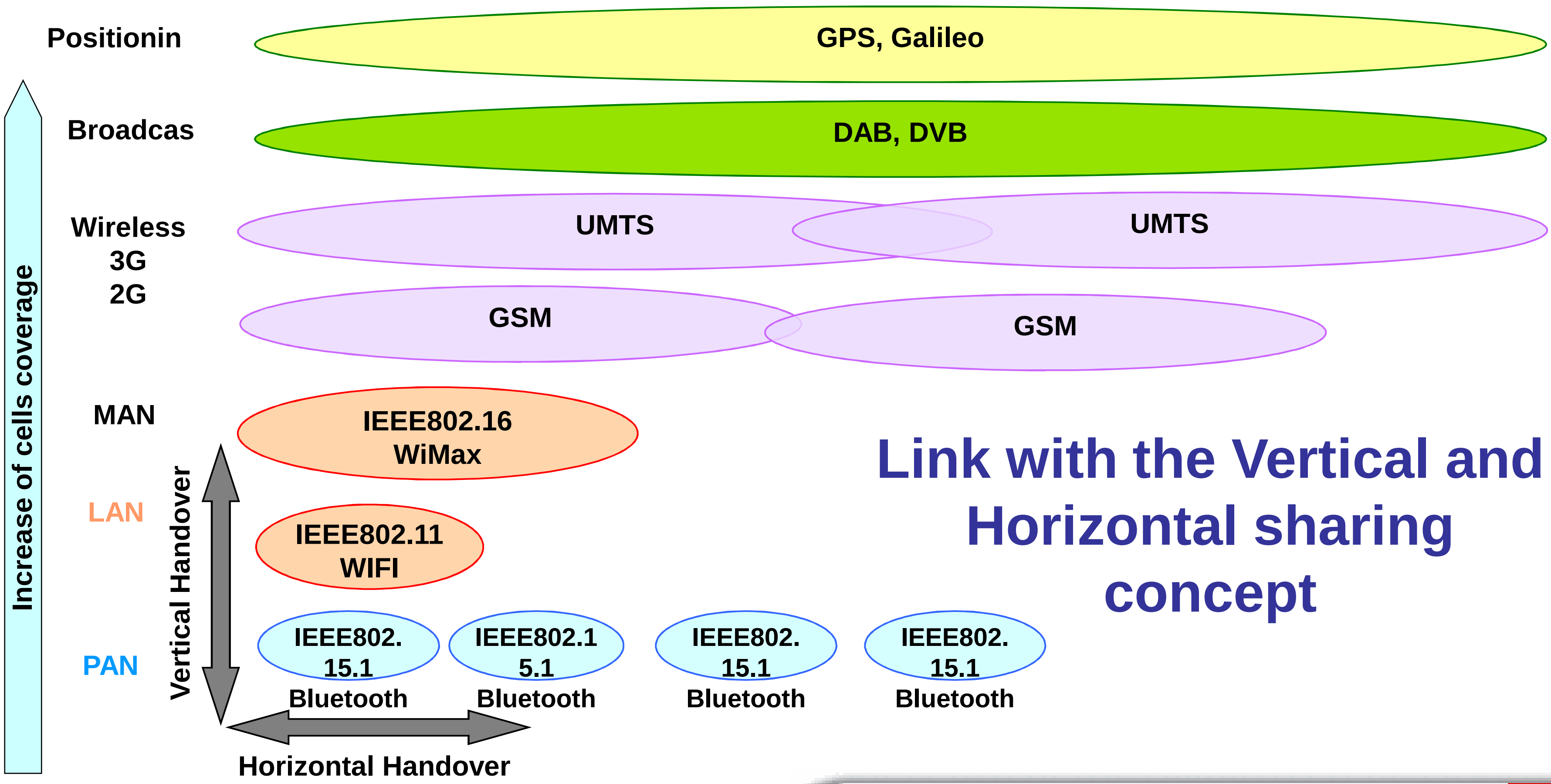


Cognitive Radio



•"Generalized Handover" concept:

- Geographic mobility : Conventional **« Horizontal Handover »**
- Mobility between Networks, Standards, Services :**« Vertical Handover »**



Link with the Vertical and Horizontal sharing concept

- Decentralized view associated with a local optimization of needs and resources versus a centralized view based on the worst case scenario needs.

  - Ex 1 : implementation of an equalizer independently of the channel IR

• First international workshop on Green Wireless[1]

– Currently, 3% of the world-wide energy is consumed by the ICT infrastructure which causes about 2% of the world-wide CO_2 emissions

– which is comparable to the world-wide CO_2 emissions by airplanes or one quarter of the world-wide CO_2 emissions by cars.

A positive way to interpret this fact may be the question How ICT can contribute in decreasing the rest of 98% ?

•May economize (1 to 4 times) its own emission

•Great R&D challenge

[1]http://www.cwc.oulu.fi/workshops/W-Green2008.pdf

- **Specific electricity* consumption in the residential sphere in FRANCE[4]**
  - Gain in consumption of white equipments (washing machine...) lost with the increase in consumption of brown equipments (TV set, PC..)
  - Multimedia equipments are the most power consuming equipments
    - New TV set with flat screens
    - Boxes (built without consumption consideration)
    - with termination of analog TV services
  - Standby mode: 10% of the specific electricity.
  - Cellular mobile consumption very low (< 1%, with new generation larger screen,…)

***Specific electricity: electricity used by equipments that can not use other energy (does not include heating, cooking,..)**

[4]H.Breuil, D.Burette, B.Flüry-Hérard, J.Cueugniet, D.Vignolles, « TIC et développement durable », Rapport du ministère de l'Ecologie, de l'énergie, du développement durable et de l'aménagement du territoire, décembre 2008, in French.

- **Carbon footprint in the residential sphere in FRANCE[4]**
  - ~40% of the ICT emission
- **Carbon footprint in the professional sphere in FRANCE[4]**
  - ~60% of the ICT emission
- **Multimedia equipments ~25% of the ICT emission**
- **Usage carbon footprint: low (French nuclear park)**
- **Production (conception, transport) footprint is preponderant.**
  - Mobile phones footprint no more negligible

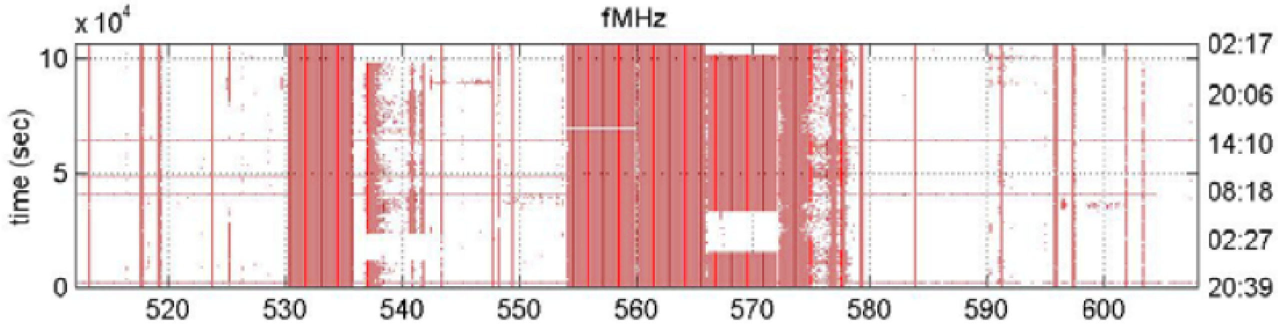
[4]H.Breuil, D. Burette, B. Flüry-Hérard, J. Cueugniet, D. Vignolles, « TIC et développement durable », Rapport du ministère de l'Ecologie, de l'énergie, du développement durable et de l'aménagement du territoire, décembre 2008, in French.

– CO_2 emission decreases thanks to power consumption optimization

- Computational efficient algorithm
  - » **Previously**, the research in efficient algorithms from the computational point of view was mainly imposed by the embedded processors capacity.
  - » **Now**, new algorithms should take into account the new computational constraints from the power consumption point of view
- To put off unused or unnecessary functions
  - » If Channel Impulse Response is good then put off the equalizer function
- Optimization of the transmitted power by beamforming
  - » With smart antennas, it is possible to form direct beams in the direction of the desired user.
  - » Therefore the transmitted power is optimized.
- Optimization of the transmitted power at the High Power Amplifier (HPA) level
  - » power consumption of the High Power Amplifier in a 2G device is about 60 to 70% of the total power consumption.
  - » need to find signal processing algorithms which decrease PAPR with minimal computational complexity
- Optimization of the transmitted power thanks to SP or digital communications gain (explained later)

– Frequency Spectrum Resources

- **Today** spectrum allocation is fixed, done for a long period
- The frequency spectrum is underused.
- ”Hic et Nunc” frequency spectrum occupancy concept.

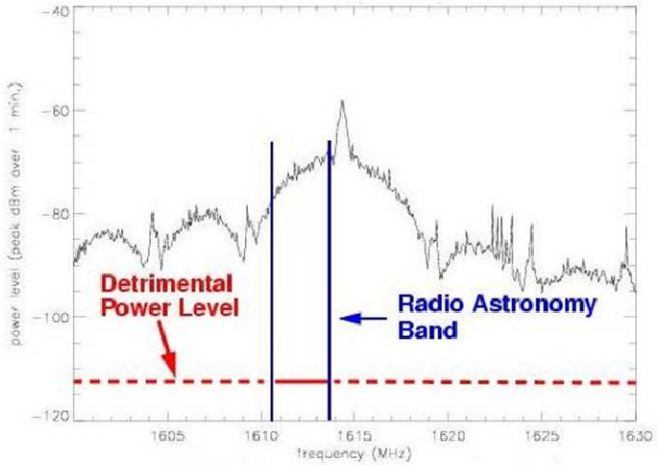


TV band occupancy
01/September/2004
in New York

- Optimize the spectrum use: Green spectrum[5]
- From a worldwide sustainable development point of view, this spectrum should be shared between countries and continents

[5]Honggang ZHANG, ”Cognitive Radio for Green Communications and Green Spectrum”, COMNETS 08 Co-located with CHINACOM 08,August 25-27, 2008, Hangzhou, China

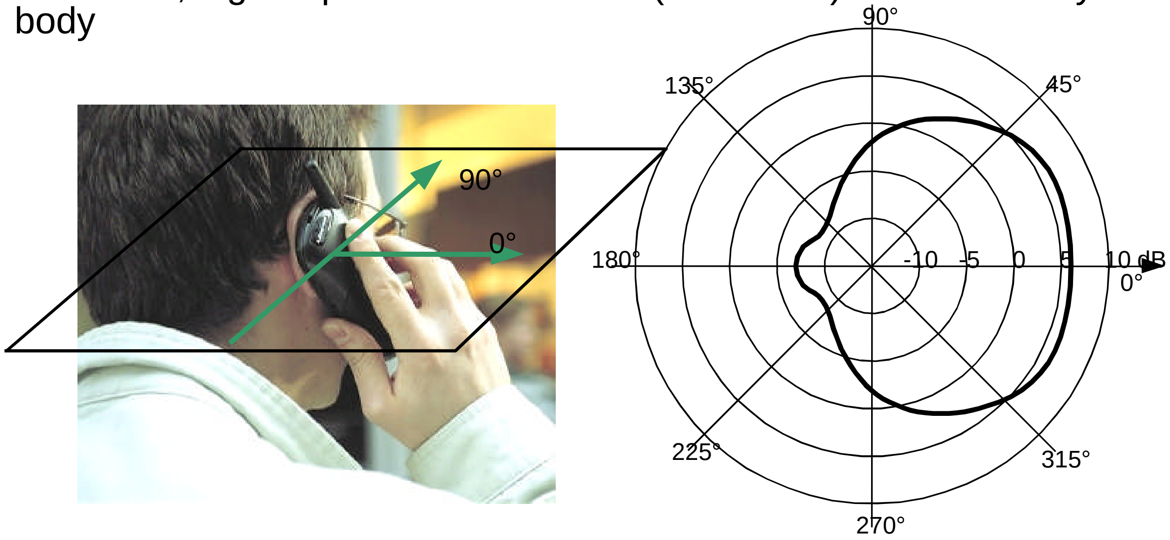
– Electromagnetic Pollution
  - increase in the absolute level of electromagnetic noise.
  - increase the noise level on many frequency bands.
  - Astronomic and meteorology communities are concerned over this increase of noise level (debate within URSI)
  - “Ironically, the technology that has made possible so many exciting astronomical discoveries is now jeopardizing the future of observational astronomy”[6]
  - “almost everyone can relate, first-hand, to the issue of light pollution. It is more difficult for people to relate to the astronomical windows in the electromagnetic spectrum”[7].
  - radio-astronomy signals coming from the universe are millions of times weaker than signals used by human communication systems. Radio-astronomers would consider that a cellular phone on the Moon is a strong radio source



[6]Derek McNally, “The Vanishing Universe”, pp. 208. ISBN 0521450209. Cambridge, UK: Cambridge University Press, October 1994

[7]John Percy, “Preserving the Astronomical" Windows" by/for Education and Culture”, ASP Conference Series, vol. 139, 1998

– Human aspects
  - Health aspect (Human exposure aspect)
    » There is a great reduction (> 30 dB) in the direction opposite the main lobe. Therefore, a great part of the radiation (max. 50%) is absorbed by the human body



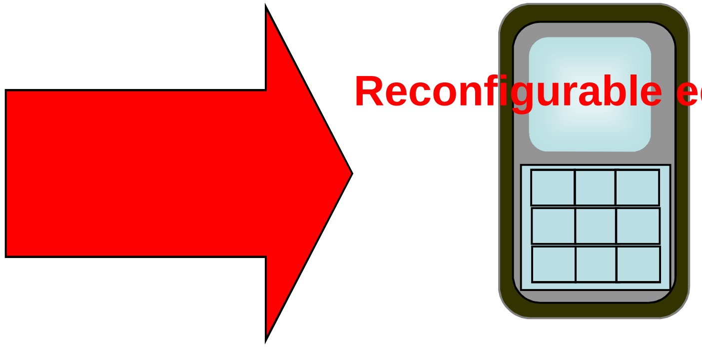
  - Social aspects
    » How it is possible to use wireless communications in order to help in the reduction of CO_2 emission in human being activities?
    » How it is possible to use wireless communications for helping the development of underdeveloped countries?

Green Cognitive Radio Concept

– Recycling the resources

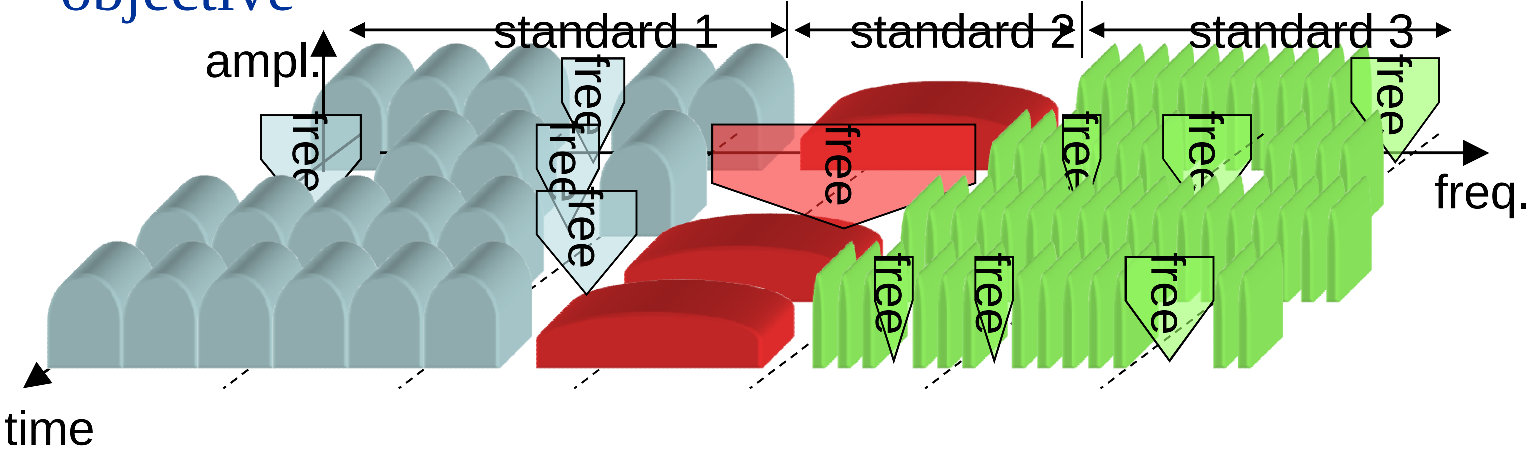
- Recycling of the equipments
  - » Clearly an industrial & operator problem
  - » Mobile phone price is often included in the contract
  - » No motivation to increase the equipment life time

•SoftWare Radio (SWR) may decrease the number of devices (multistandard, multimode,..)
•SWR Technology may increase the equipment life time



Spectrum use optimization: Green spectrum[1]

•CR is obviously an enabler because it was one of its main objective

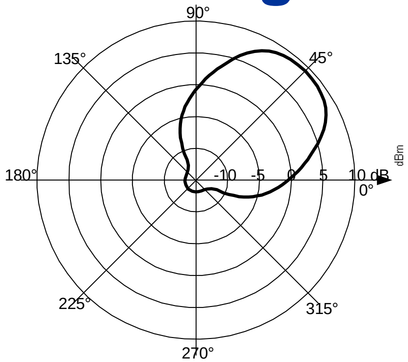


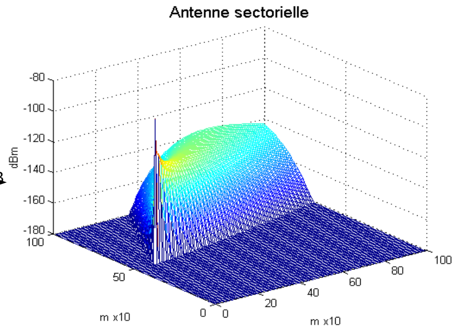
Holes (or wathever the term) in the spectrum

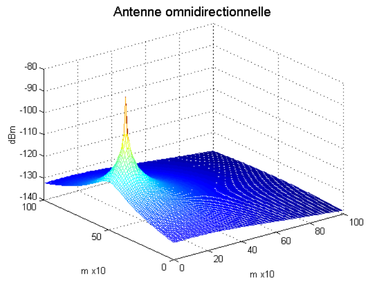
- Filtering phase
- Detection phase (sensing itself)
- Decision phase
- Insertion phase (modulation with good PSD), under sensor constraints as ACPR,PAPR,….
- But this implies advance signal processing algorithms which are computationally expensive and then consume power!

« We would like to decrease the electromagnetic level by sending the right signal in the right direction with the optimal power, only when it is necessary, for the same QoS ».[1] Useful radio waves concept

Beam forming: to decrease the radiation level



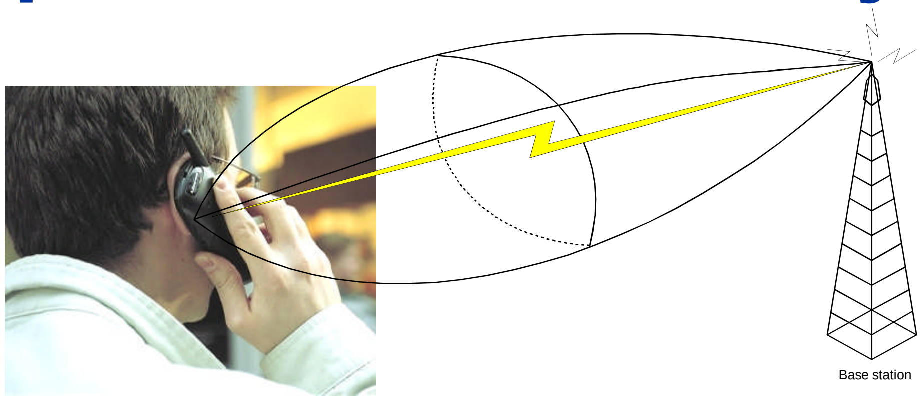




The question here is: can an operator accept to use this gain for the same user number instead of increasing the user number?

[1]Jacques Palicot, Christian Roland "On The Use Of Cognitive Radio For Decreasing The Electromagnetic Radiations",URSI 05, XXVIII General Assembly , New Delhi, India, October 23-29, 2005.

Beam forming: to avoid transmitting power in the human body



Proposed Algorithm

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1. Activate DoA sensor, which determines the relative position of the BS and the terminal.
2. User interface requests the user to turn in the right direction.
3. Form the main beam towards the BS.

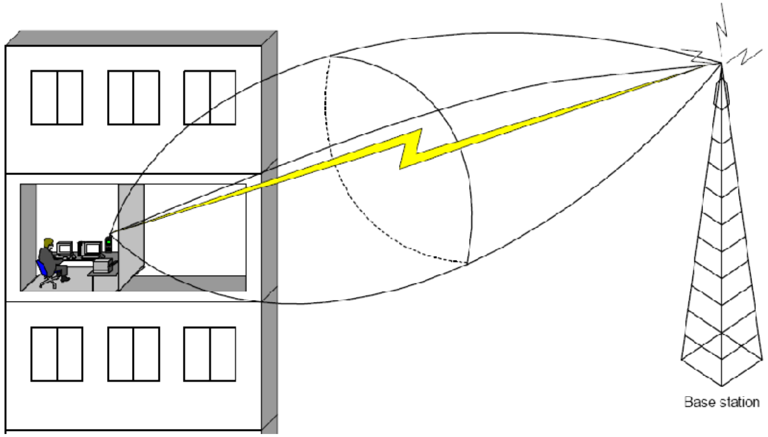
Of course, there remain some questions:

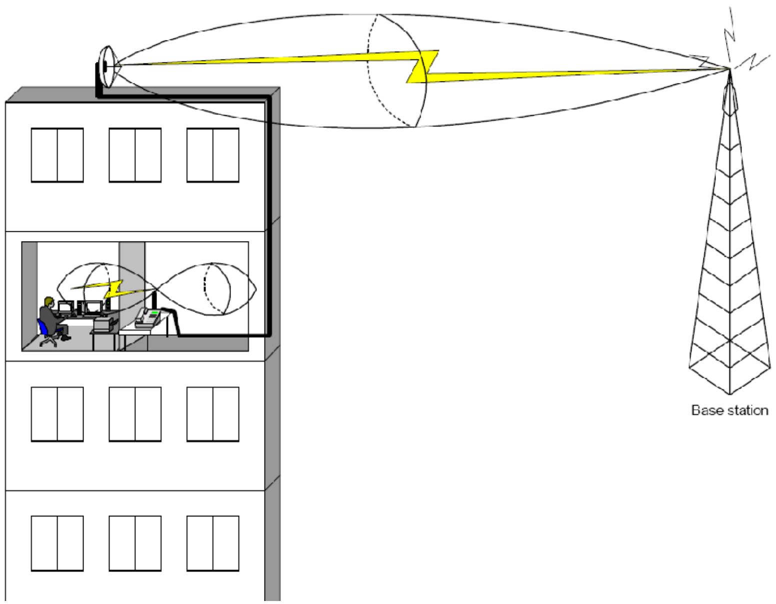
• This is difficult to execute for fast moving terminals.

• This implies advance signal processing algorithms which are computationally expensive and consume power. Therefore a power consumption budget should be done carefully.

• This solution is not yet validated by experiments.

Network Management



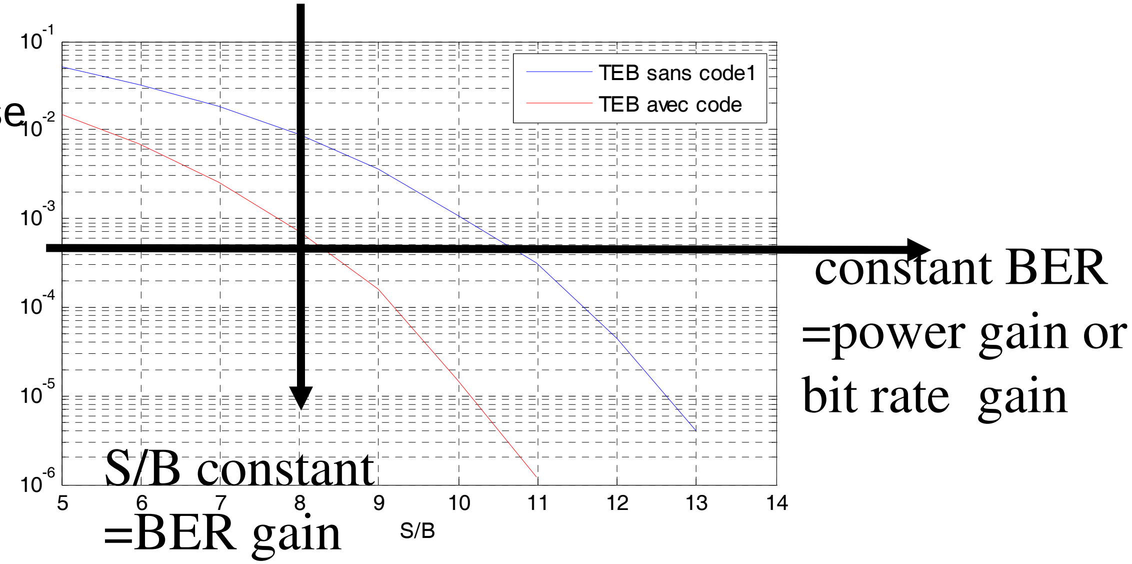


•The terminal or the Base Station could recognize the spectrum occupancy and therefore decide which band (with the associated power) is the best from the point of view of electromagnetic radiation. This could be performed thanks to the standard recognition sensor

•it is always better to have a local wireless connection or a wired connection in indoor and to have a roof connection with the cellular network

- **On the use of Signal Processing gains or/and digital communications gains to decrease the transmission power**

Possible CR sensors to activate these gains
- SNR
- Channel Impulse Response
- Direction of Arrival
- Blind standard recognition
- ......



Example: The SNR sensor gives (locally) a very good value. Then Tx and Rx agree to use a channel code to decrease the power

If choice of power decrease then indirect gains (HPA efficiency, less temperature....)

Conclusion

- **Green Communications and Green Spectrum: Is Cognitive Radio an Enabler or Anyone else?**
  – My answer: Yes, it is an enabler[1]
- **Electromagnetic radiation problem should be take into account:**
  – For the future networks design,
  – For the future smart terminals .
- **Promote the use of Cognitive Radio in this context[1]**
  – Validation of our proposals through real platforms and measurements.
- **Questions**:
  – Can an operator accept to use the technological gain for the same user number (decreasing the transmitted power) instead of increasing the user number?
  – Is there a market for CR terminals that takes into account this ecological aspect of electromagnetic transmission?
  – Is there a financial argument for operators willing to find the best compromise between health, spectrum, efficiency, power consumption and cost etc.?
  – Can an operator/industrial make a selling point out of the fact that its mobile phones emit less radiation than those of its competitors?
  – Are users prepared to pay more for a less polluting mobile phone?

[1]J.Palicot, « Cognitive Radio: An Enabling Technology for the Green Radio Communications Concept », IWCMC, Leipzig, Germany June 2009

Panel Discussion AICT2010
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Barcelona Spain

Challenges in Advanced Communications and Services

Variety of Wireless Channels and System Requirements

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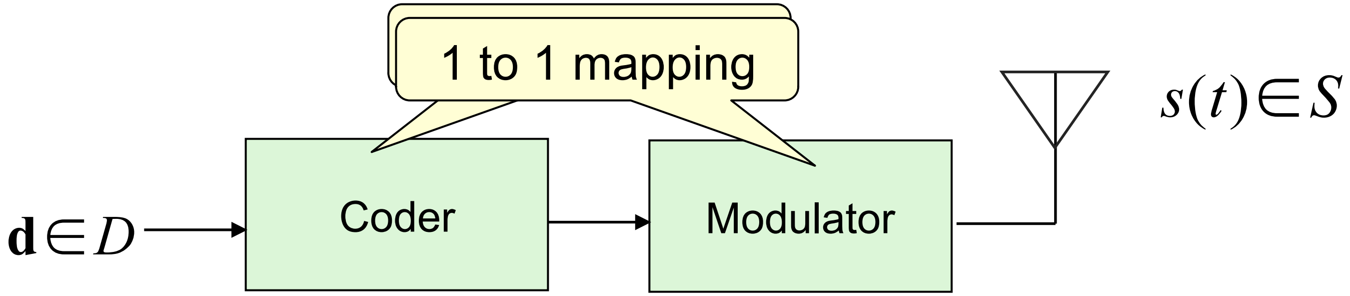
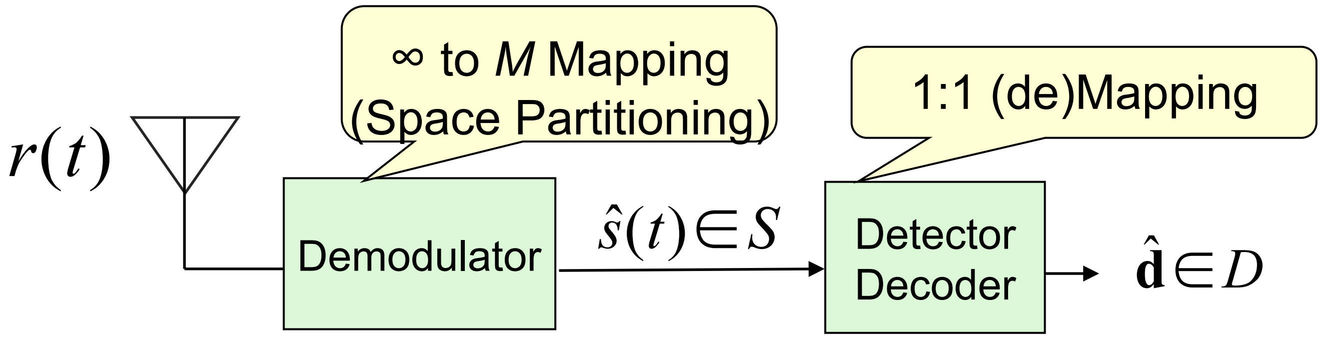
JAPAN

Conceptual Model of Radio Systems



Transmitter: one-to-one mapping of a data sequence to a wave form.



Receiver: Infinite Possible Waveforms --- Partitioning of the Signal Space

D: a set of all possible data sequence $|D| = M$

S : a set of all possible transmitted waveform $|S| = M$

Minimization of Errors (MLSE)

Bayes' theorem

$$\Pr[\mathrm{S} \mid \mathrm{R}] = \frac{\Pr[\mathrm{R} \mid \mathrm{S}]\Pr[\mathrm{S}]}{\Pr[\mathrm{R}]}$$

$$\begin{aligned}\hat{s}(t) &= \underset{s^{(m)}(t)\in S}{\arg\max}\ \Pr[s^{(m)}(t) \mid r(t)] \\ &= \underset{s^{(m)}(t)\in S}{\arg\max}\ \Pr[r(t) \mid s^{(m)}(t)]\Pr[s(t) = s^{(m)}(t)]\end{aligned}$$

$\Pr[r(t) \mid s^{(m)}(t)]$: Channel
(Propagation, Noise, Interference)

$\Pr[s(t) = s^{(m)}(t)]$: Nature of the Source

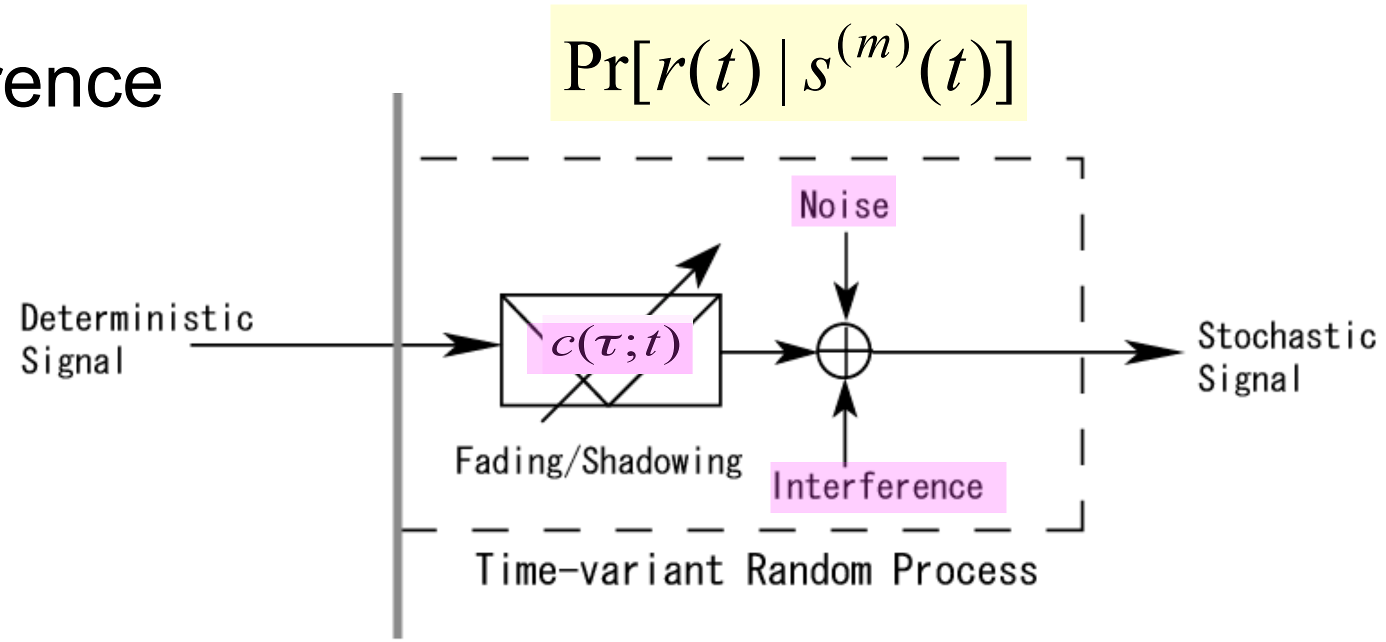
System Design

- Design of a Wireless System is Adaptation to a Channel. $\Pr[r(t) \mid s^{(m)}(t)]$
- <u>Adaptation to what channel?</u>

Stochastic Aspects of a Channel

$\Pr[r(t) \mid s^{(m)}(t)]$

- Stochastic Process / Not one-to-one Mapping
  - Impulse Response
    (Fading, Shadowing)
  - Noise
  - Interference
  - etc.



Optimum RX for AWGN

Additive
$\mathbf{r} = \mathbf{s} + \mathbf{n}$

Gaussian : n

Log

$$\hat{\mathbf{s}} = \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \Pr[\mathbf{s}^{(m)} \mid \mathbf{r}]$$

Bayes' theorem
$$\Pr[S \mid R] = \frac{\Pr[R \mid S]\Pr[S]}{\Pr[R]}$$

$$= \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \Pr[\mathbf{r} \mid \mathbf{s}^{(m)}]\Pr[\mathbf{s} = \mathbf{s}^{(m)}]$$

$$= \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \Pr[\mathbf{n} = \mathbf{r} - \mathbf{s}^{(m)}] \cdot \Pr[\mathbf{s} = \mathbf{s}^{(m)}]$$

$$= \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \ln\left(\prod_{n=1}^{N} \frac{1}{\sqrt{2\pi}\sigma_n} \exp\left[\frac{-(r_n - s_n^{(m)})^2}{2\sigma_n^2}\right] \cdot \Pr[\mathbf{s} = \mathbf{s}^{(m)}] \right)$$

$$= \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \left[\left(\sum_{n=1}^{N} \frac{-(r_n - s_n^{(m)})^2}{2\sigma_n^2} \right) + \ln\left(\Pr[\mathbf{s} = \mathbf{s}^{(m)}]\right) \right]$$

Euclidian Distance

$$= \arg\max_{\mathbf{s}^{(m)} \in \mathbf{S}} \left[\left(\sum_{n=1}^{N} \frac{2 r_n s_n^{(m)} - (s_n^{(m)})^2}{2\sigma_n^2} \right) + \ln\left(\Pr[\mathbf{s} = \mathbf{s}^{(m)}]\right) \right]$$

Correlation

$$\Pr[r(t) \mid s^{(m)}(t)]$$

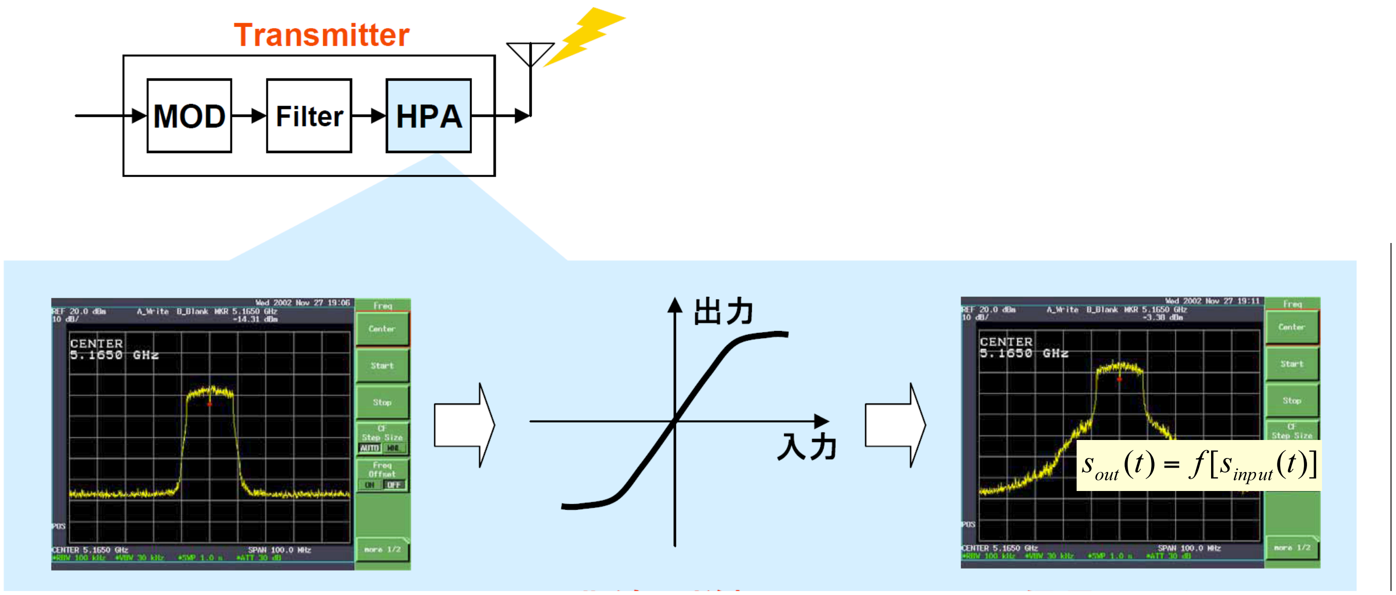
review of

Some Interesting Channels

not a simple AWGN

$$\Pr[r(t)\,|\,s^{(m)}(t)]$$

Nonlinear Channel (in TX)



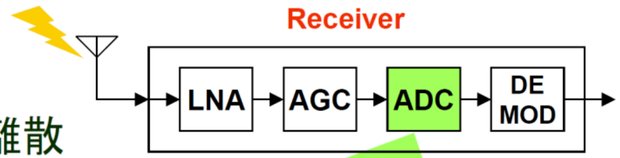
- Deterministic Channel
- Not one-to-one (but N-to-one)
- Cause of Peformarnce Degradation
  - Inter Symbol Interference
  - Inter Subcarrier Interference
  - Inter Code Interference

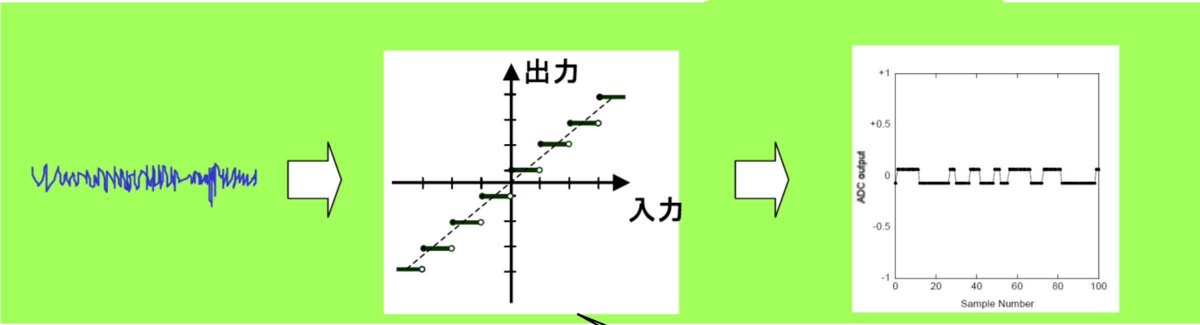
$$\Pr[r(t)\,|\,s^{(m)}(t)]$$

Nonlinear Channel (in RX:ADC)

特徴

入力:信号＋雑音
出力:信号レベル及び時間⇒離散





- Stochastic Channel (because of input noise)
- Not one-to-one (but N-to-N')
- Cause of Performance Degradation
  - Inter Symbol Interference
  - Inter Subcarrier Interference
  - Inter Code Interference

- Full Scale Range
- Quantization Nise

$$r_{out}(t) = g[\tilde{s}(t) + n(t)]$$

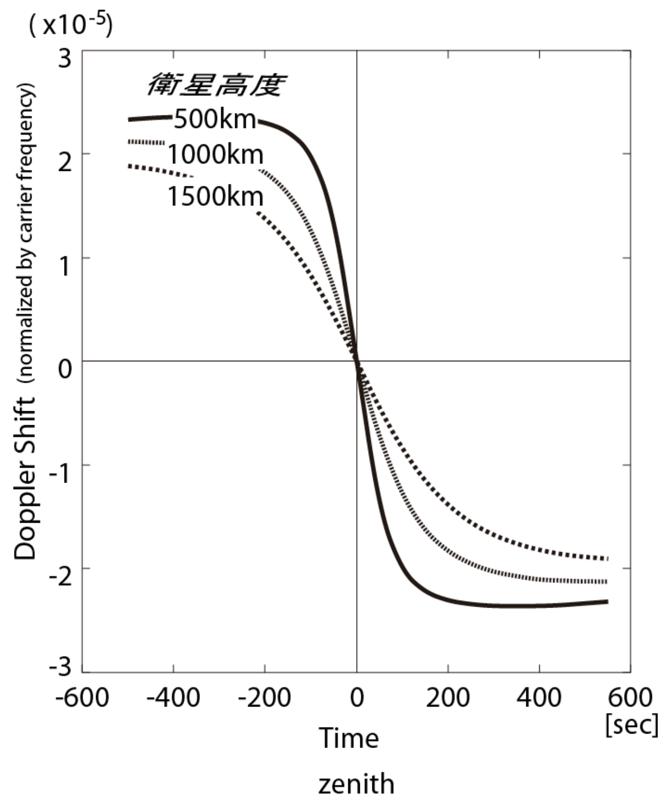
Doppler Channel

$$\Pr[r(t) \mid s^{(m)}(t)]$$

$$r(t) = \mathrm{Re}[(s_I(t) + j s_Q(t)) \exp(j\omega_c + \Delta)t] + n(t)$$

- Not one-to-one (but N-to-one)
- Cause of Performance Degradation
  - Loss of Synchronization
  - Inter I-Q Interference
  - Inter Symbol Interference
  - Inter Subcarrier Interference
  - Inter Code Interference

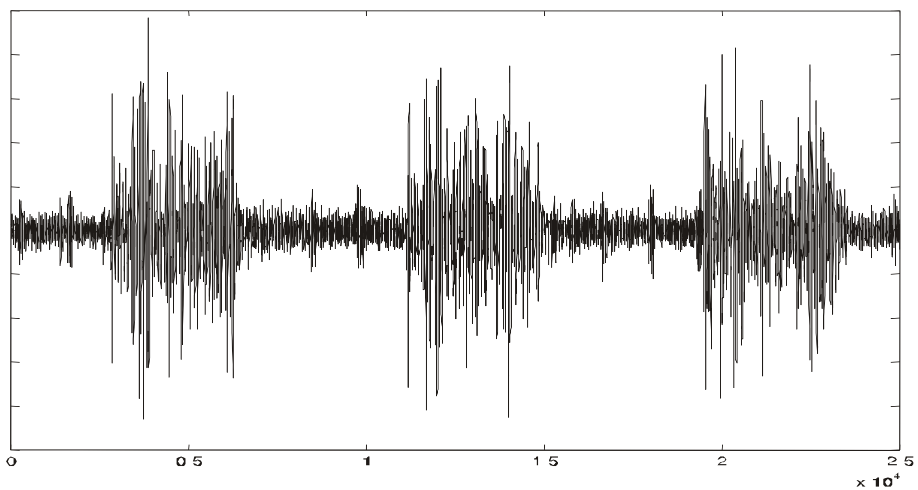
- Terrestrial: Stochastic Channel
  - Difficult to know value of freq. shift.
- LEO: Predictable Channel
  - Doppler is predictable as
  - Speed/Location of LEO dominates the shift.



Non-Stationary Non-White and Non-Gaussian Channel

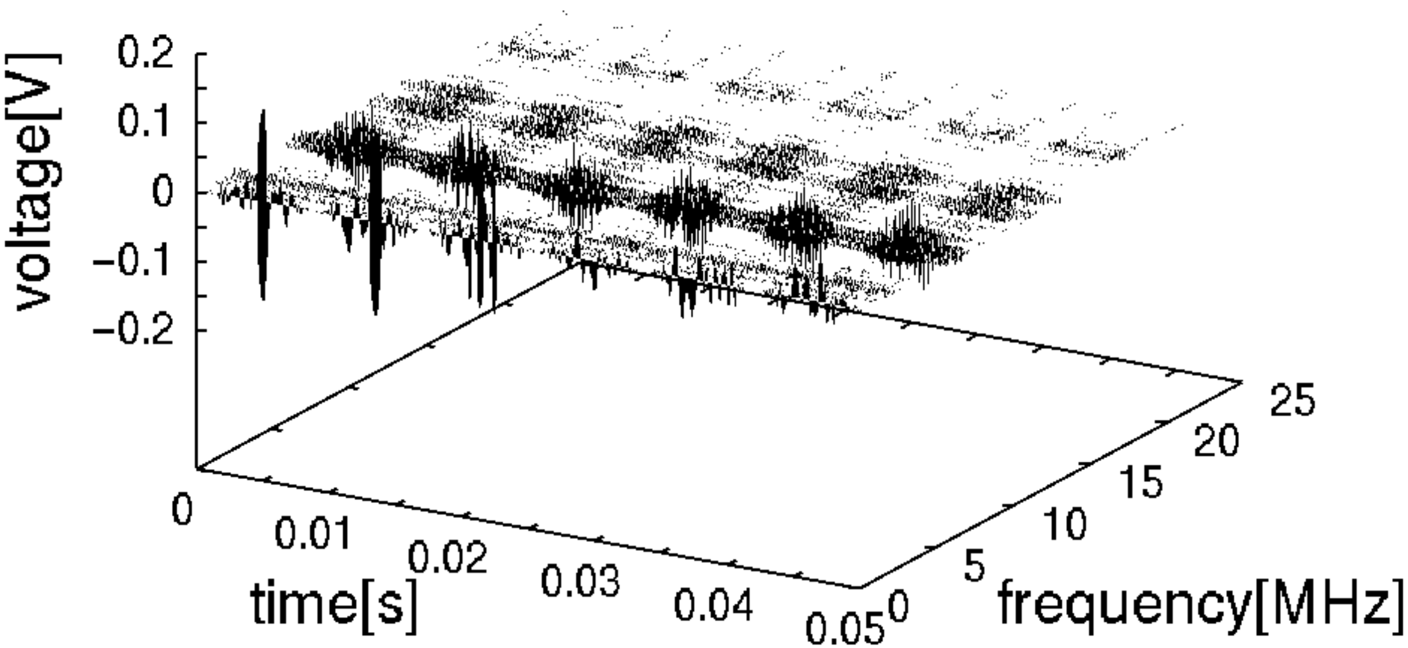
$\Pr[r(t) \mid s^{(m)}(t)]$

- Artificial Noise is often
  - Non-Stationary (Possibly Cyclo-Stationary)
  - Non-White
  - Non-Gaussian
- Examles
  - PLC Noise
  - VLC Noise

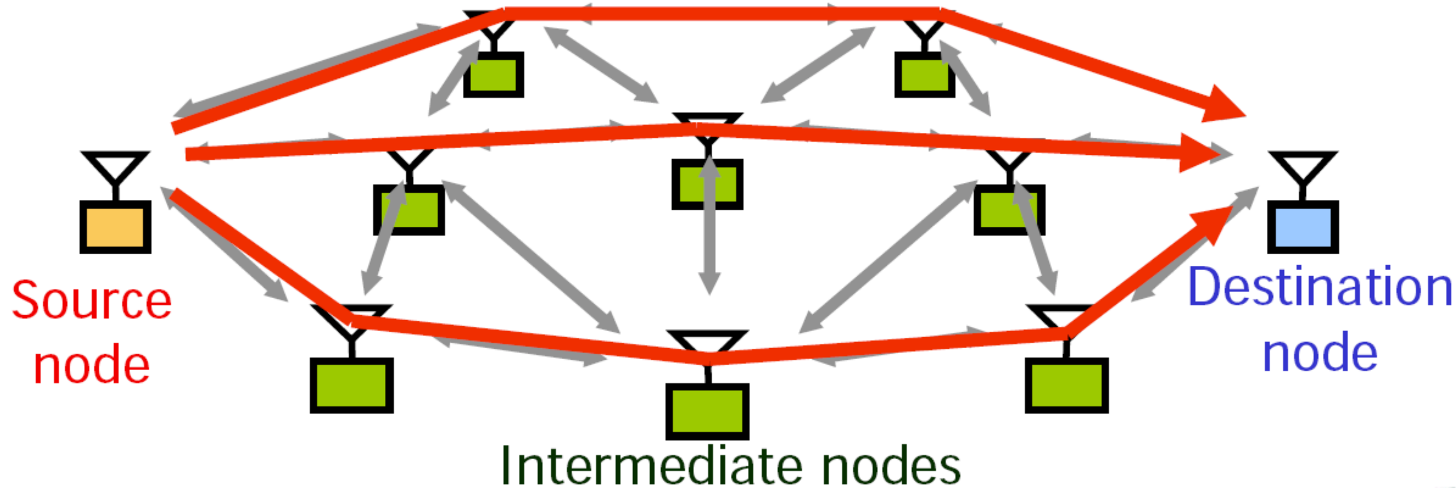


Non-Stationary Non-White PLC Noise

$$\Pr[r(t) \mid s^{(m)}(t)]$$
$$= \Pr[n(t) = r(t) - s^{(m)}(t)]$$



Multi-Route Multi-Hop Network

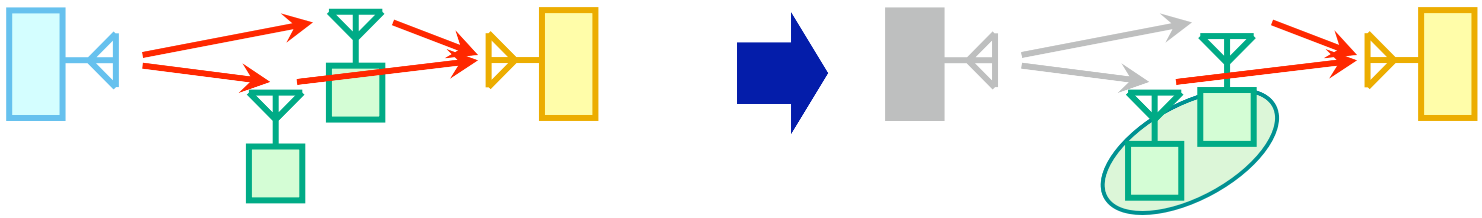


MIMO Channel

- Best Route Selection
  - Selection Diversity
- Route-Dimensional Coding
  - Combined Diversity

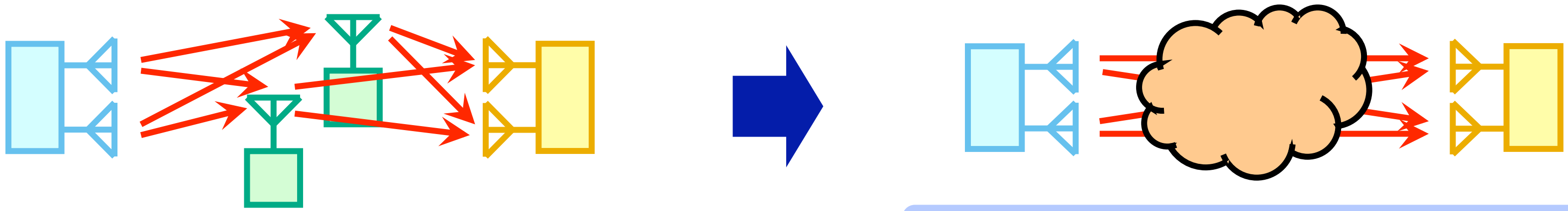
Channel with Multiple-Repeaters

- Cooperative Diversity



Multi-ANT TX --- RX

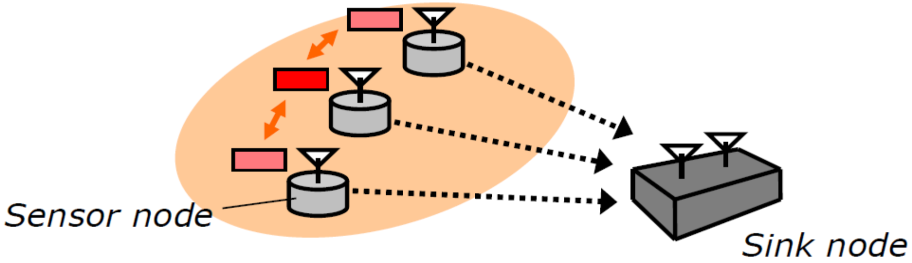
- Repeater Cloud



TX --- MIMO ---- RX

Hidden MIMO

- If Sensors observe the same area,
- Their information may have spatial correlation.



Hidden MIMO

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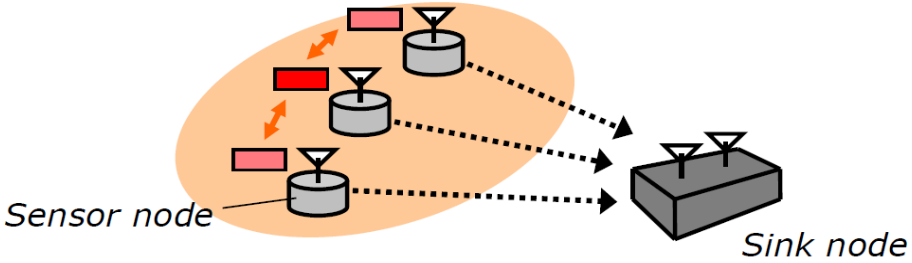
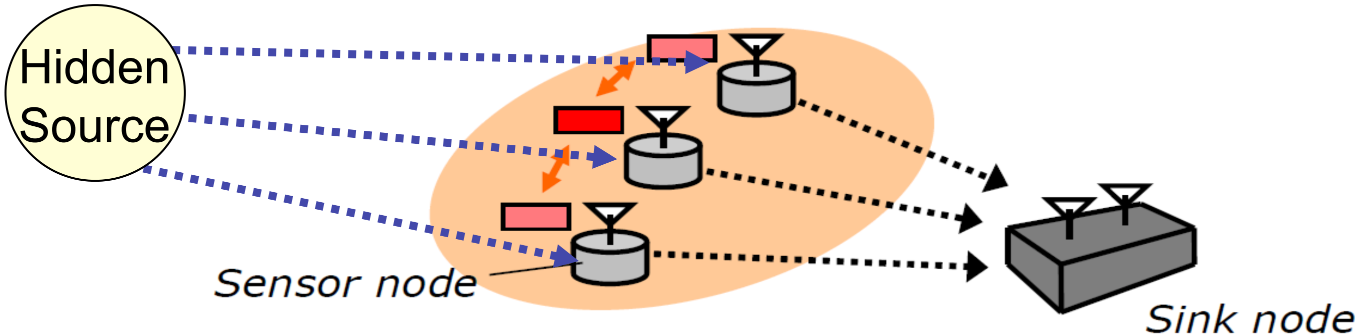


- Sensor nodes can be assumed as MIMO TX of Space Coding with non-intentional correlation.



System Design

- Design of a Wireless System is Adaptation to a Channel.
- Adaptation to what channel?

- Adaptation can be reworded as Optimization.
- <u>Optimization of what?</u>

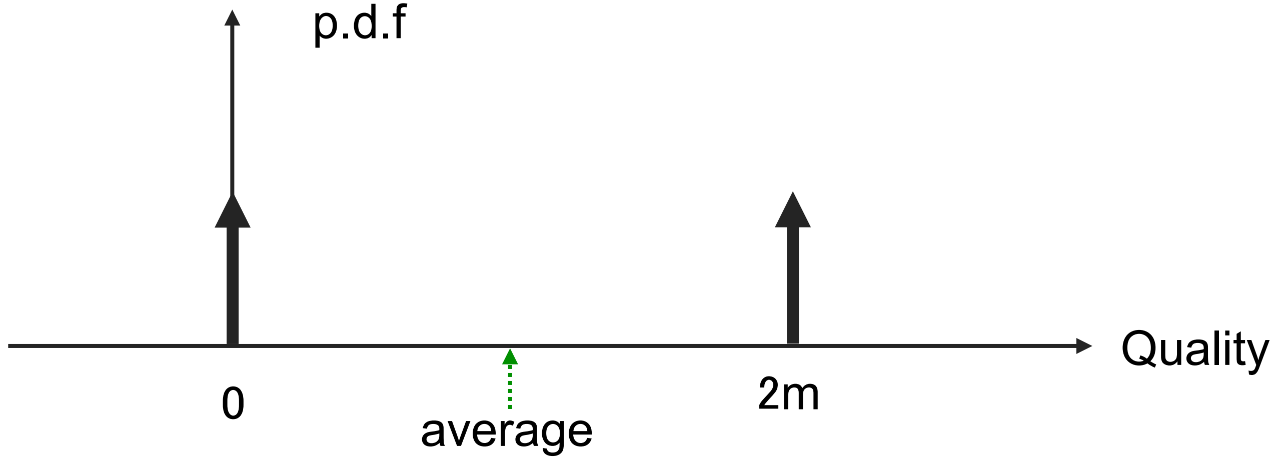
Performance Measures of Wireless Systems

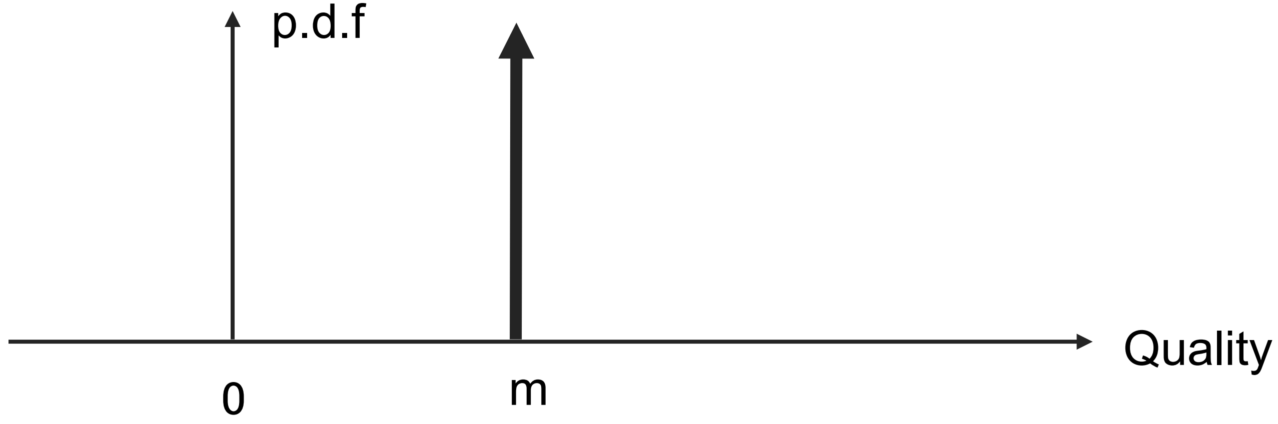
(cited from IEEE Trans. COM 2002 Mar.)

- Out of Band Power
- mean SNR
- Bit Error Rate (mean)
- Symbol Error Prob. (mean)
- Mean Square Error (freq. estimate)
- Mean Number of Training Bit
- Capacity in bits
- Throughput
- Average Transmission Delay
- Handoff Prob.
- Packet Dropping Prob.

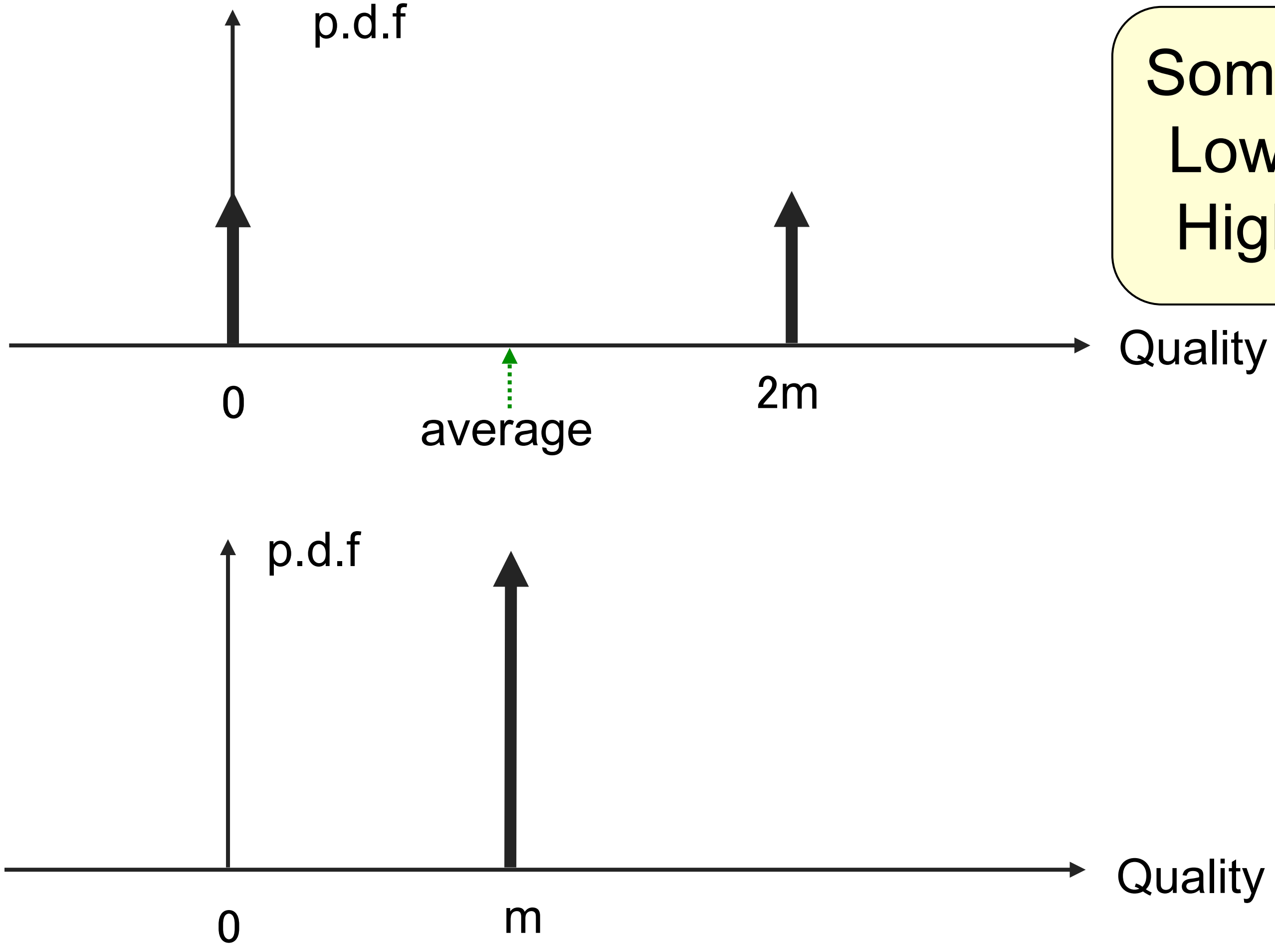
Effects of Channel variation are averaged out.

Same Quality?





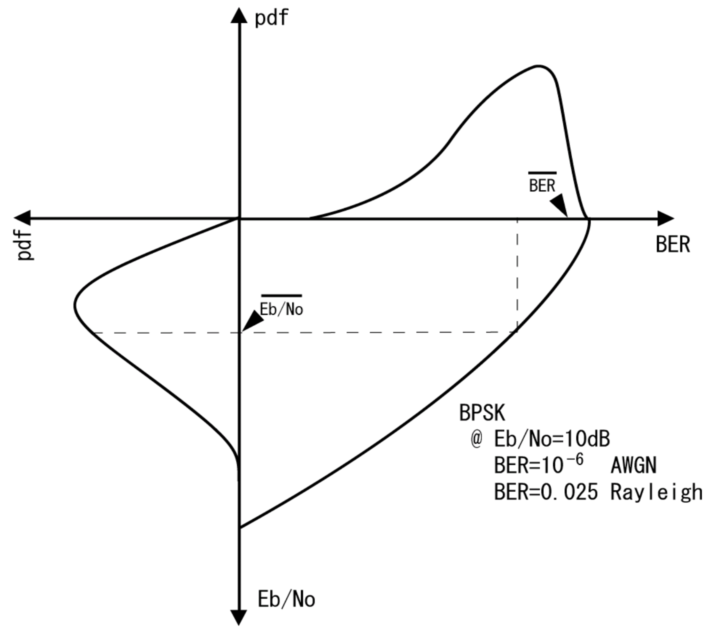
Same Quality?



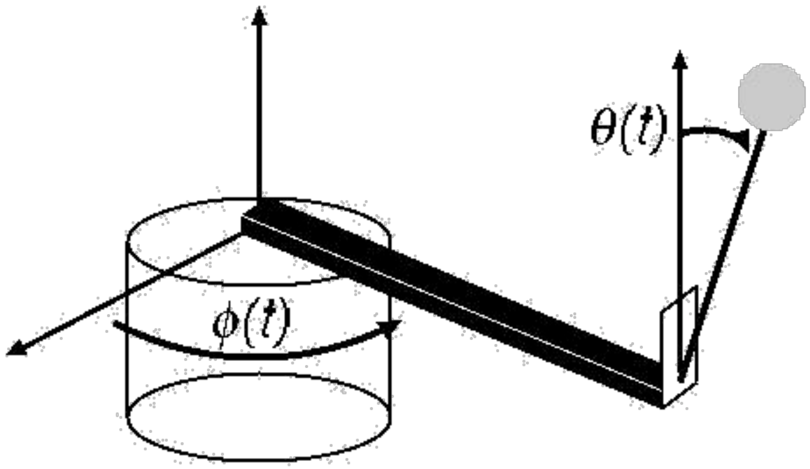
Some System needs Lower Outage than Higher Best-score.

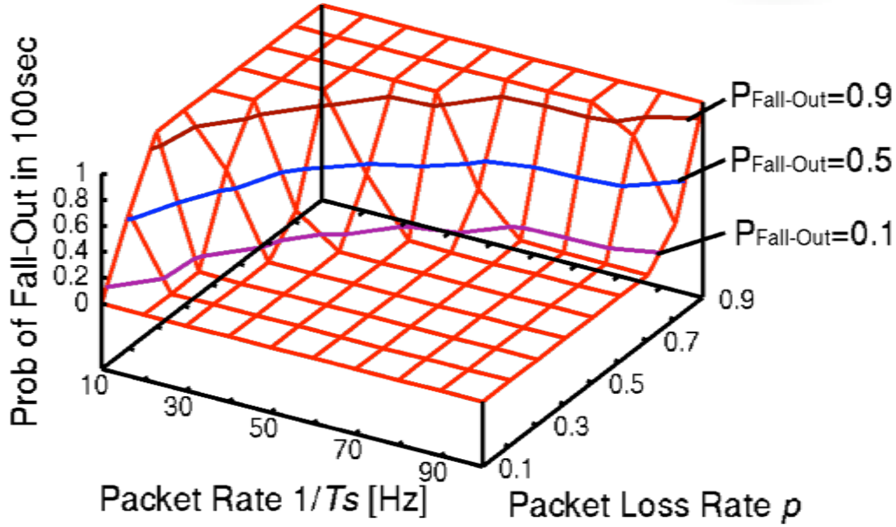
Layered Performance Indexes

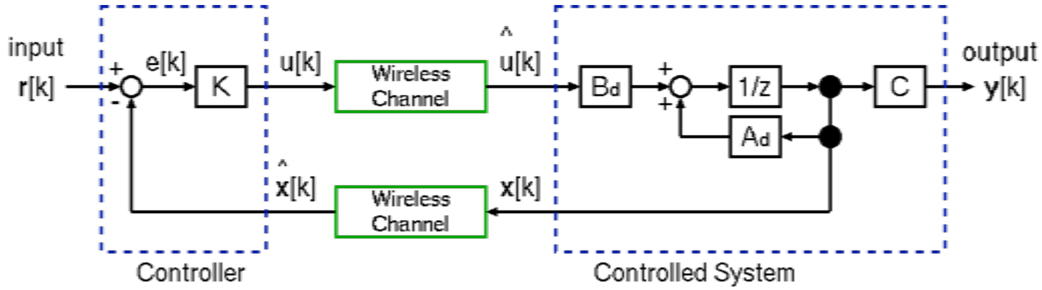
- a performance index is a function of another index as BER $= f($ Eb/No $)$
- If the function is non-linear, Average of the lower index does not provide average of the higher index.
- Outage Prob. of the lower does provide Outage Prob. of the higher.



System performance can be a function of performance indexes of lower layers

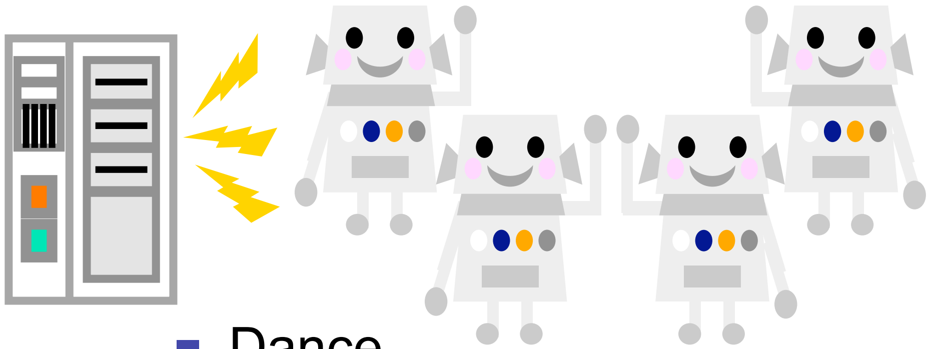






- Packet Rate and Packet Loss can be trade for.
- Minimum required performance exists for both indexes.

Common Clock for Simultaneous Move



- Dance
- Music Play
- Automation Manufacturing with multiple robots
- Fingers of a robot.

:

Not only Individual control quality (ms)

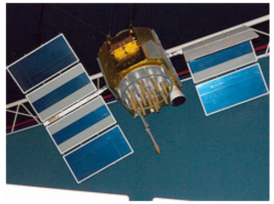
but also

Synchronization of each other (μs)

Remarks 1

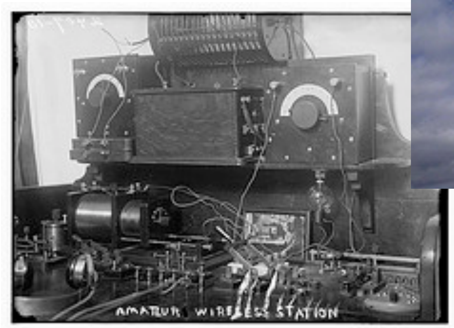
Variety of Systems

with Variety of Channels and Requirements



- Satellite
- Cellular
- W-LAN
- Body Area
- PLC
- VLC
- …

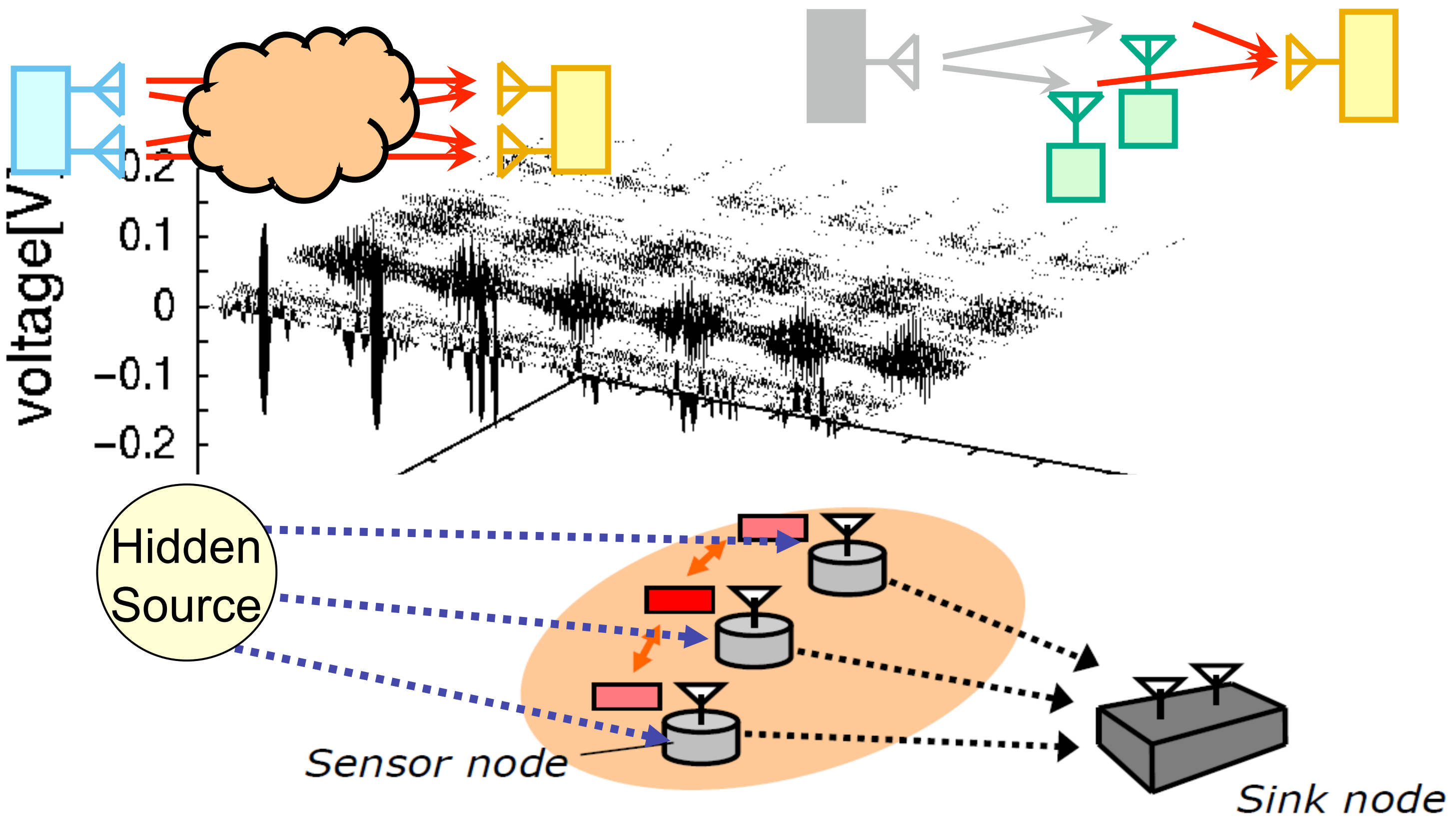
- Smart Grid
- System for Green
- Radio Control
- ITS
- Localization
- …



Remarks 2

New Channels,

and new ways to configure systems

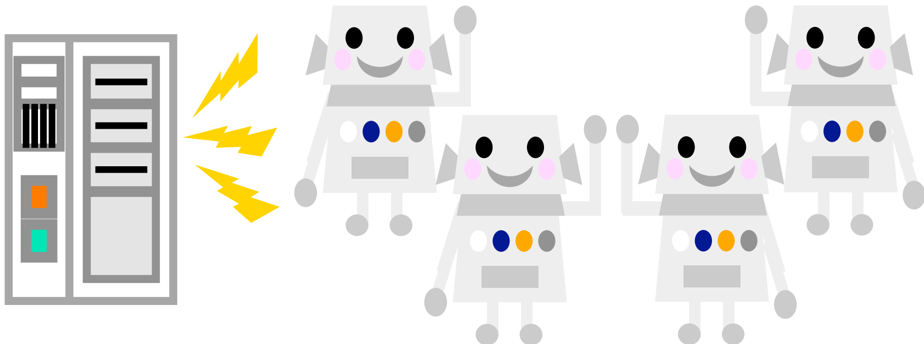


Remarks 3

New Performance Measures

- It is needs to know our customers

- wireless control is an important/interesting application.
  (also in SG)
  - data rate is relatively slow.
  - delay sensitive
  - common clock should be accurate.



Conclusion

- New systems/applications are new customers for us, communication people.
  - They provide us new interesting channels.
  - They provide us new requirements, or new viewpoints to understand wireless communication.

  - They give us not challenges but chances!

BACK UP

Nagoya University

- Established in 1939
  as the last (the 9th, after Seoul, Taipei, and Osaka)
  Imperial University
- Scale (as of May 1, 2009)
  - Staffs : 3, 204
  - Undergraduate Students: 9, 640
  - Graduate Students: 6, 049
  - Revenues : 94, 370, 000, 000 yen
  - Expenditure : 92, 912, 000, 000 yen
  - Ground Area: 3, 247, 424 m^2
  - Building Area 750, 344 m^2
  - Nobel Prize Laureates: 4

Katayama Lab.

The Only One Lab.
for Wireless Communications
in Nagoya Univ.

◆Staffs

Masaaki Katayama, Prof.

Takaya Yamazato, Prof

Kentaro Kobayashi, Assist. Prof.

Yoshihiko Kito, Technician

Aiko Ishikawa, Secretary

Eriko Shiraishi Secretary

◆Students

Ph.D. Candidates : 5

M.S. Course : 12

Undergraduates : 4

EcoTopia Science Institute

- Research Institute Established in 2004.
- Aim: Scientific studies for the realization of an environmentally harmonized sustainable society
- Faculties: about 60.
- Katayama Lab. belongs to EcoTopia Science Institute

EECS(Dept. of Electrical and Electronic Engineering and Computer Sciences)

- Katayama Lab. also belongs to EECS.
- Students of the lab. belong to EECS.

Research Projects and keywords

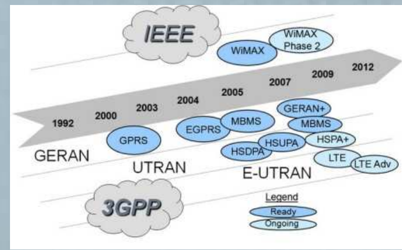
- Electric Energy EcoTopia Project
  Large-Scale Real-Time Data Gathering and Control, Collaborations with other fields
- Intelligent Transportation Systems [ITS]
  Modulation/Coding, Access Methods, Position Estimation
- Wireless Wire (Reliable Robust Radio)
  Wireless Control of Industrial Machines, Drive by Wireless, Radio Control of Robots
- Visible Light Communications
  [LED-Traffic Light Communication, Information Light House for Visually Handicapped]
  Modulation/Coding, Non-Gaussian Non-Stationary Noise
- Sensor Networks
  Cooperative Communications, Low-Power Consumptions,
  Energy Harvesting, Wireless Energy Transmission
- Power Line Communications
  Adaptive Modulation/Coding/Demodulation, Smart Grid as an application of PLC
- Reconfigurable Radio Systems
  Cognitive Radio (Dynamic Spectrum Assignment, Piggy Back Modulation), System Architecture
- New Generation Satellite Communications
  High Speed Satellite Communications, Multi-Satellite Routing, Reconfigurable Satellite,
  Satellite/Terrestrial Combined Network
- Next Generation Mobile Communications
  Advanced Modulation/Coding, Super-Speed Access, Heterogeneous Networks

Challenges in Advanced Communications and Services

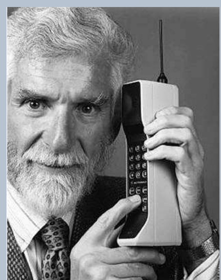
Jordi Pérez-Romero
Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

Trends of wireless communications

- Evolution of technologies towards higher bit rates (100 Mb/s, 1Gb/s) (HSPA, UTRAN-LTE, IEEE 802 family, etc.)



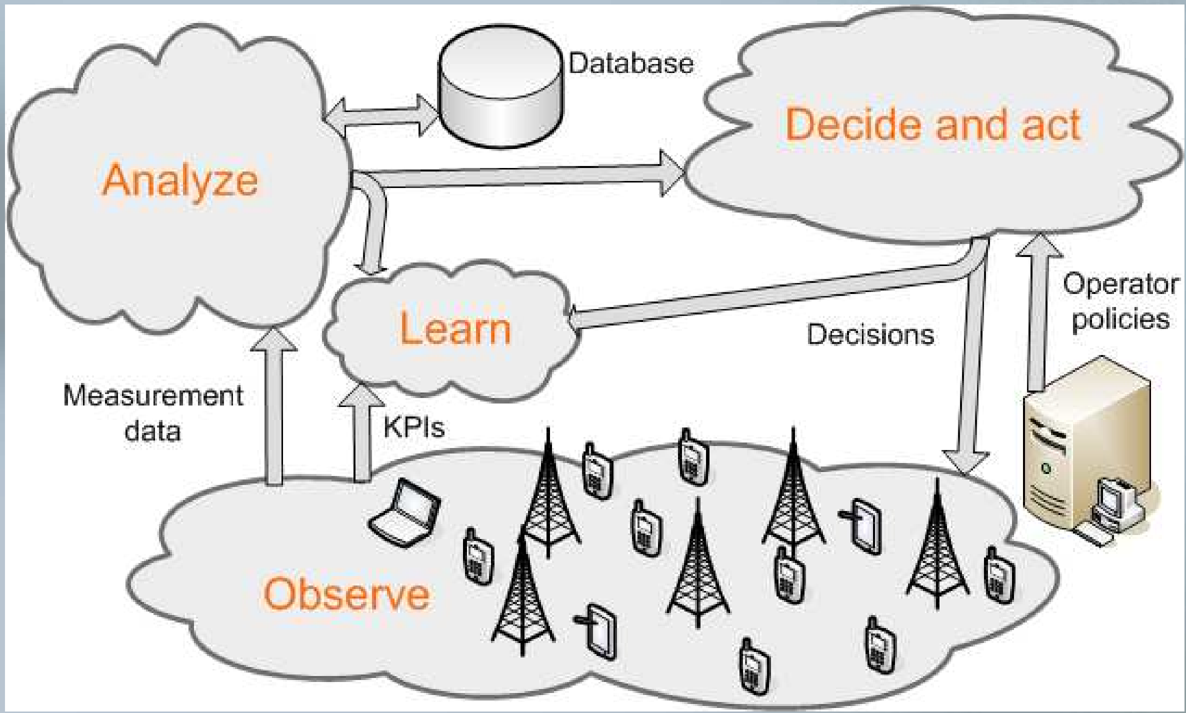
- Co-existence of multiple access technologies
- Multiple services with different QoS constraints
- Evolution of wireless devices



Evolution in the network

- Classical cellular paradigm shifts towards more complex deployments (e.g. femtocell)
- Increase in the complexity of the management and network operation
  - Automatisation of operation procedures:
    - Self-x operation (self-configuration, self-healing, etc.)

Evolution in the network



- Cognitive Network: Network with the ability to think, learn and remember in order to adapt in response to conditions or events based on the reasoning and prior acquired knowledge, with the objective of achieving some end-to-end goals

Evolution of Spectrum Management Models

- Increasing traffic demand
- Increasing bit rate services

Increasing spectrum bandwidth requirements

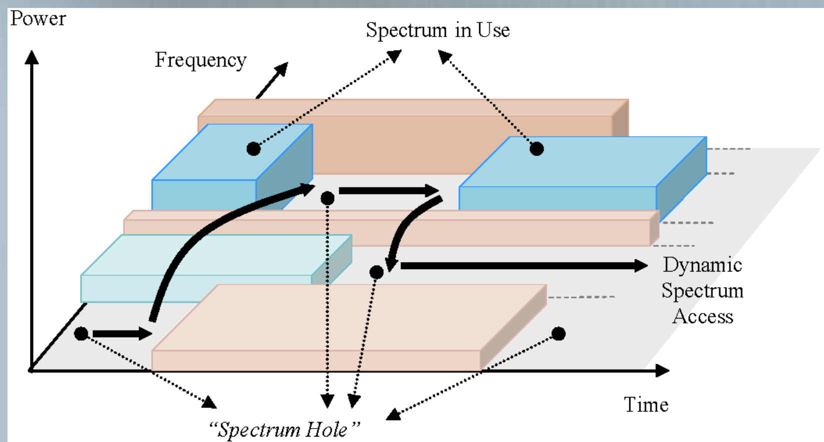
- Current models based on fixed spectrum allocation to a licensee turn to be inefficient
  - difficult and slow process to find new bands adequate for new services
  - low utilisation in many different bands

  …

Trend towards the introduction of more flexibility in the spectrum management

Evolution of Spectrum Management Models

- Spectrum refarming
  - Technology neutral bands
- Flexible channelisation
- Cognitive Radio and Dynamic Spectrum Access
  - Enabling the operation of unlicensed devices (secondary users) over licensed bandwidths, provided that no interference is caused to licensees (primary users)



Evolution of Spectrum Management Models

- Challenges for Dynamic Spectrum Access
  - Spectrum Awareness: Identification of the spectrum usage in a given area, and the adequate bands for transmission
    - Sensing techniques
    - Use of databases
    - Radio Environment Map
    - Appropriate signaling mechanisms (e.g. Cognitive Pilot Channel)
  - Spectrum Sharing:
    - Power allocation to avoid interference to primary users
    - MAC protocol to coordinate access among secondary users
    - Spectrum handover: Identify the appearance of a primary user, vacate the used channel and continue communication in another one

Thank you for your attention !

Panel:

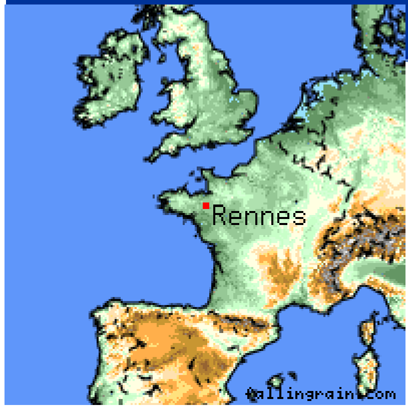
Challenges in Advanced Communications and Services:

« Cognitive Radio & Energy consumption»

Amor Nafkha

SUPELEC/IETR, Rennes, France

Signal, Communication and Embedded Electronics



Signal, Communication & Embedded Electronics team

Signal Processing View:

MIMO systems *(detection, turbo detection, etc….)*

Cognitive Radio *(PAPR, decision making, spectrum sensing, Multi-layers sensors, etc…)*

HW/SW Implementation View:

Reconfigurable Computing *(Partial FPGA reconfiguration, Common Operators: Cordic, FFT, LFSR)*

Reconfiguration Management

Global systems View

Context & motivation

- The most important challenges of the 21th century is how to reduce the Information and Communication Technologies (ICT) carbon footprint.
- ICT carbon footprint is comparable to the world-wide CO_2 emissions by airplanes or one quarter of the world-wide CO_2 emissions by cars [1].
- *How to reduce ICT carbon footprint ?*

[1] http://www.cwc.oulu.fi/workshops/W-Green2008.pdf

Signal Processing side

- Computational efficient algorithm: new algorithms should take into account power consumption constraints (static and dynamic power).

- Put off unused or unnecessary functions: If channel impulse response is good then put off the equalizer function

- Optimization of the transmitted power by beamforming: Smart antennas → The transmitted power is optimized.

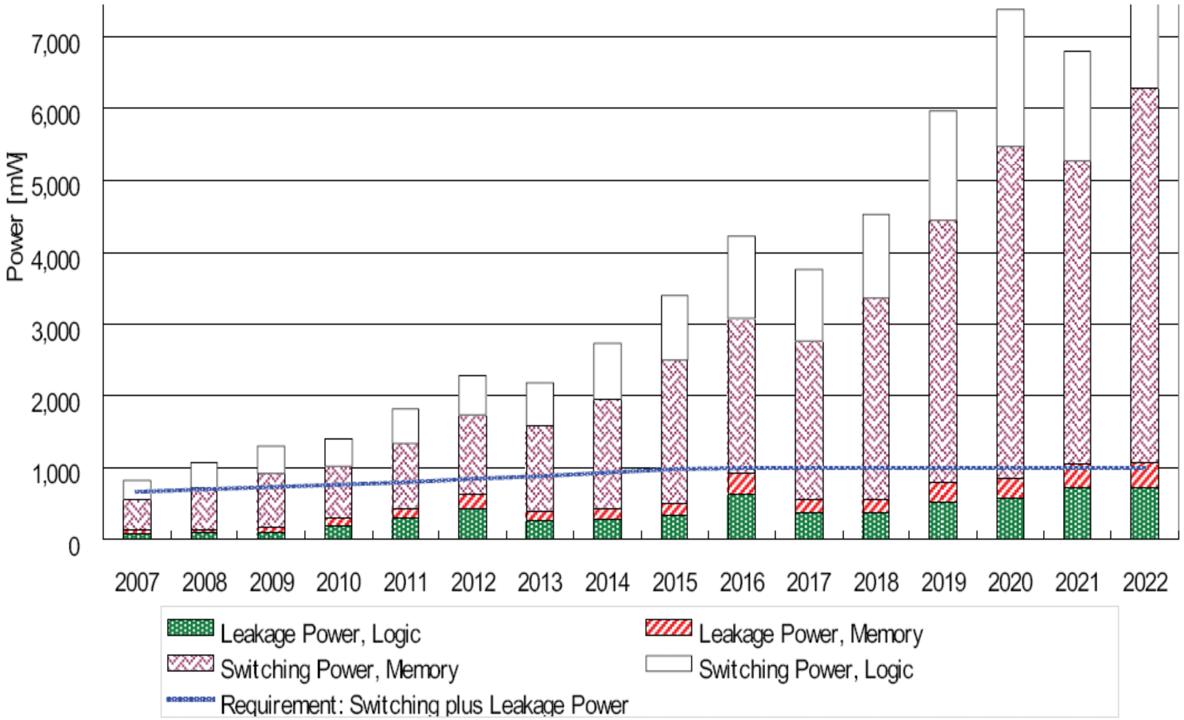
- Optimization of the transmitted power at the High Power Amplifier (HPA) → using Power to Average Power Reduction.

- Maximum likelihood detector (good channel → ZF detector)

Embedded Electronics side

- Reconfigurable equipments → No Velcro architecture, recycling of the equipments.

- Reduce Static and dynamic energy consumption:



- ITRS forecast for SoC system

Power consumption

- Reducing Power consumption:

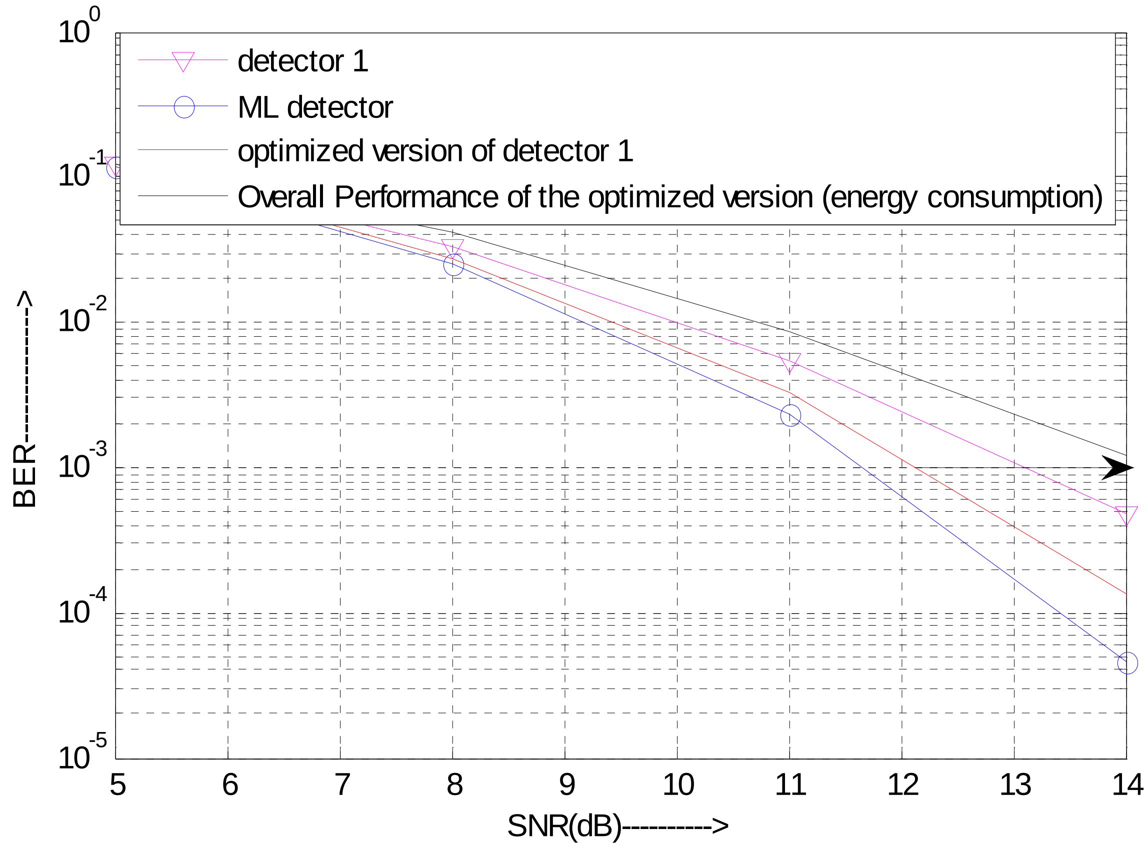
$$\mathbf{P}_{total} = \mathbf{P}_{static} + \mathbf{P}_{dynamic}$$

$$\mathbf{P}_{dynamic} = \alpha \cdot C \cdot \mathbf{V}_{dd}^{2} \cdot f \qquad \mathbf{P}_{static} = \mathbf{V}_{dd} \cdot \mathbf{I}_{leakage}$$

Level	Dynamic Power			Static Power
System	Reduce the value of loop, pipeline.			Delete unused units
Structural	Parallel	Simplicity	P. Reconfiguration	Size efficient
Physical	Gated Clock	DVFS, Vdd reduction	Capacitance , activity reduction	Power Gating , Low Vdd, etc.

DVFS: Dynamic Voltage Frequency Scaling

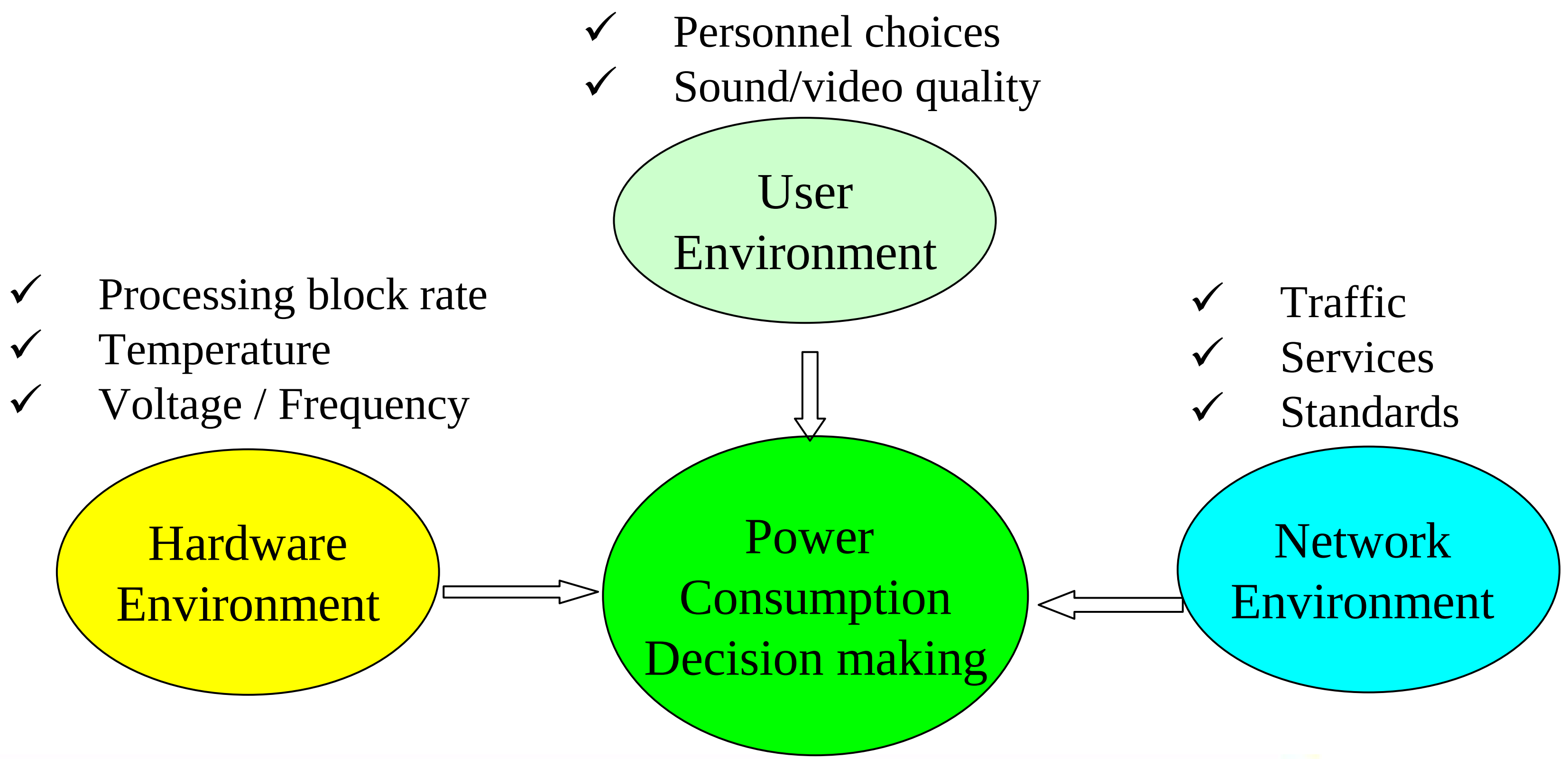
- Bit error rate example



Need to have a global view to reduce system energy consumption

Future trends

- **Decision making engine to reduce system energy consumption :**



Thank you for your attention

SEN communication Challenges

Guillermo Ravera
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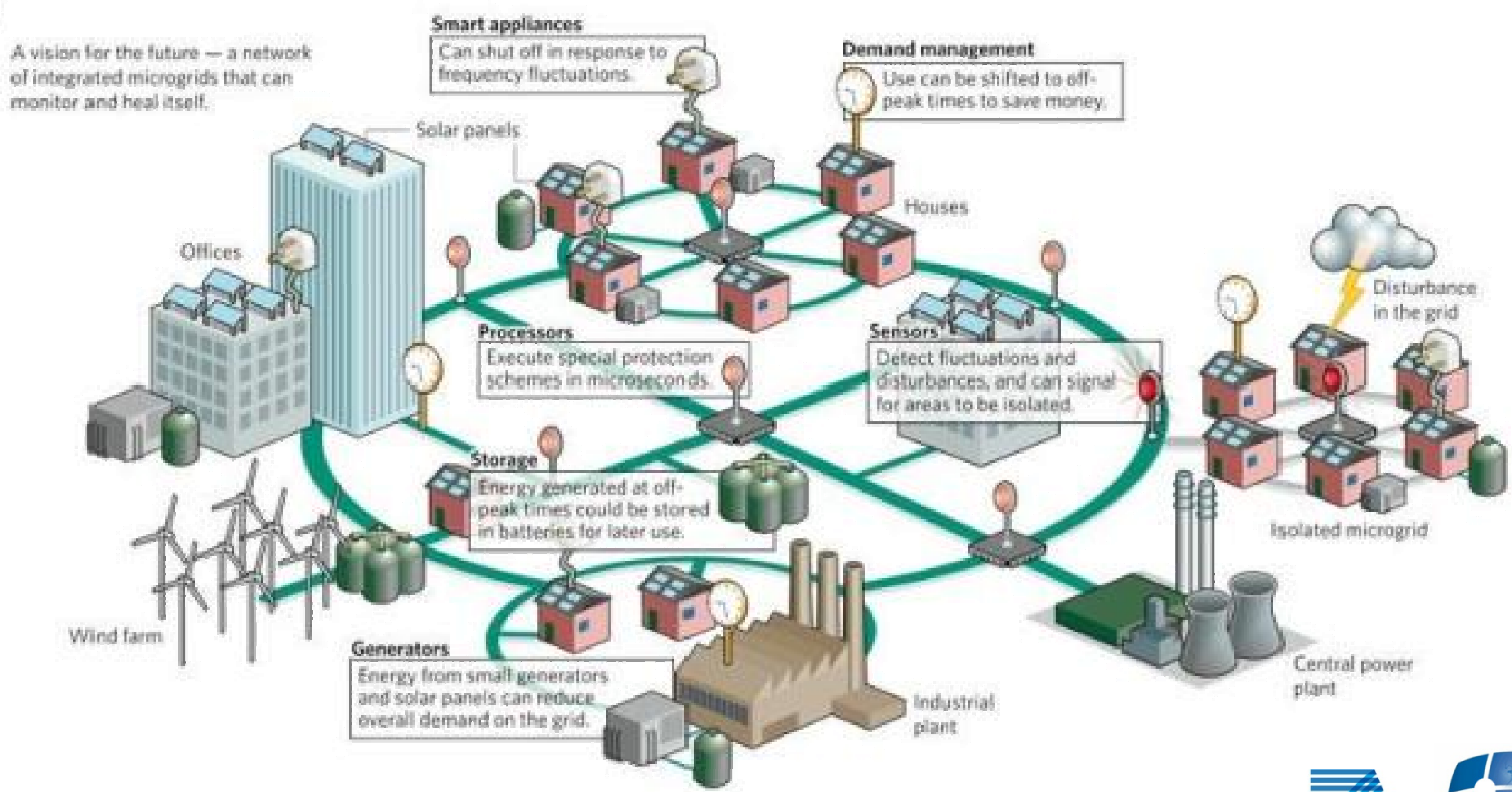
Barcelona, Spain
gjravera@salle.url.edu

SEN



SEVENTH FRAMEWORK PROGRAMME

INTEGRIS

SEN communications

- The SENs topology (long-distance partial mesh) will be a future challenge for engineering
- It requires communication seamlessly between technologies (NPLC,BPL , WSN, UMTS, RFID, ADSL…)
- The different services run over the SEN (voltage control, substation monitoring, …) and the future services (load shedding, PEV or renewable integration) have to be transported across an heterogeneous network
- Elements like security, QoS and routing have to be defined to work without knowledge of the underlying technology

SEVENTH FRAMEWORK PROGRAMME

INTEGRIS

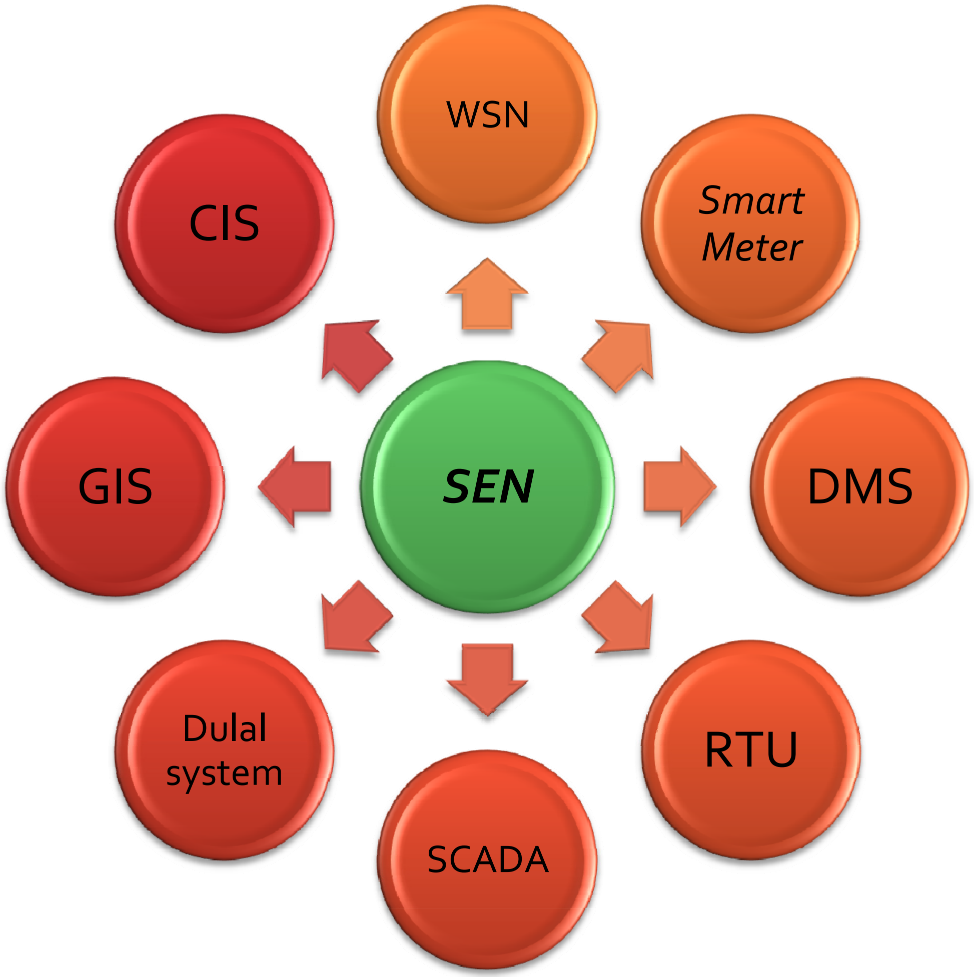
SEN challenges

- The SENs open the door to the internet of things where the communication network brings the possibility to hear the electric network
- The number of communicated elements can range from ten to hundreds all of them with difference communication requirements
- The architecture of this network have to be flexible to evolve and adapt to new technologies and protocols.

SEVENTH FRAMEWORK PROGRAMME

INTEGRIS

SEN elements



SEVENTH FRAMEWORK PROGRAMME

INTEGRIS

Panel-Discussion: Challenges in Advanced Communications and Services

Michael Massoth
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Sixth Advanced International Conference on Telecommunications
Barcelona, Spain, 12.05.2010

h_da
HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES

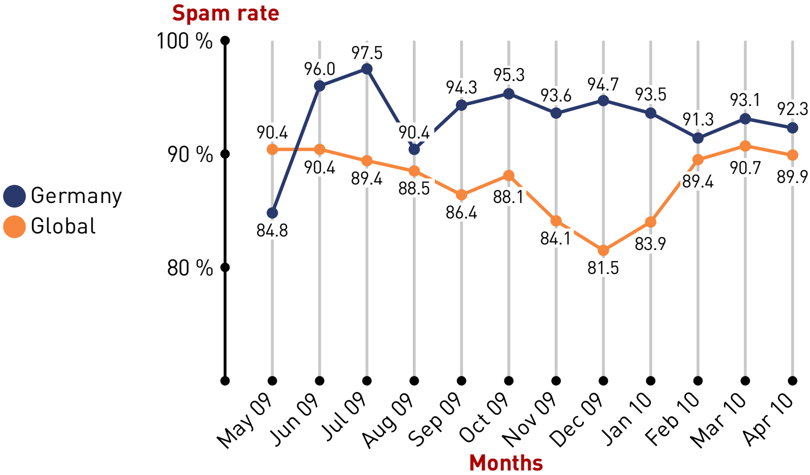
Worldwide Development of Markets

- Number of residential, small- or home office **VoIP subscribers** grew in 2009 to **132 million** [Infonetics Research, 04/2010].
- Total number of **mobile VoIP users** will be reach **288 million** by end of 2013 [In-Stat, 03/2010].
- **IP Multimedia Subsystem equipment** is forecast to grow to **US$ 1,44 billion** in 2014 [Infonetics Research, 03/2010].

Security Situation

- Attackers generated up to 6 gigabyte traffic to launch a **SIP brute force attack** originating in the Amazon Elastic Cloud Computing Platform [TecChannel, 04/2010].
- **98.5 % of e-mails** received in Germany in 2008 were **spam** [BSI, 01/2009].
- The annual spam in 2008 lead to a **power consumption of 33 billion kilowatt hours**, that corresponds to the electricity used in 2.4 million homes in the USA [McAfee, 04/2009].

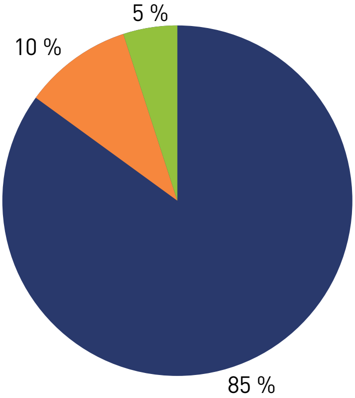
E-Mail Spam Rate in the Last 12 Month



[MessageLabs, 04/2010]

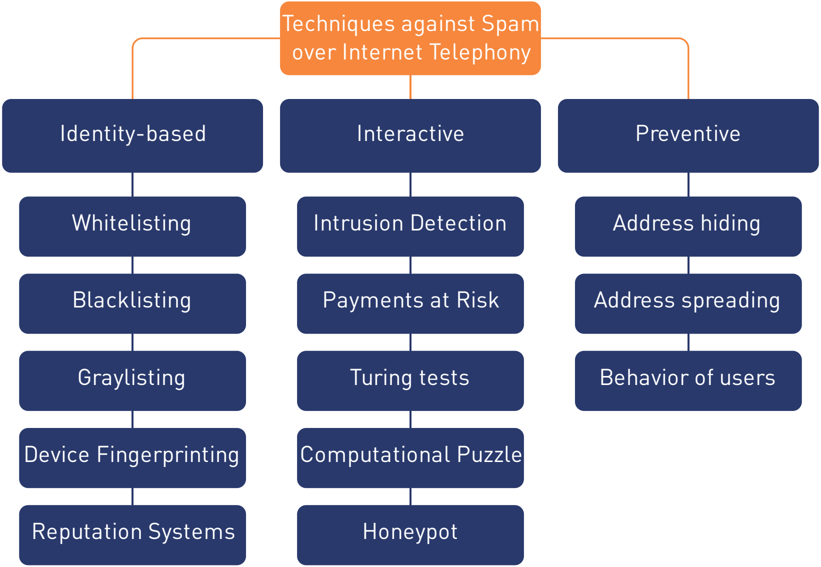
Economic Damage Caused by E-Mail Spam

- User productivity cost
- Help desk cost
- Soft- and hardwarecost



[Ferris Research, 01/2009]

Techniques Against Spam over Internet Telephony



Challenges: Risks and Opportunities

Risks

SIP and VoIP security threats and vulnerabilities, like e.g., spam over internet telephony (**SPIT**), denial of service (**DoS**), **brute force** and VoIP **toll fraud attacks**.

Opportunities

288 million mobile VoIP users by end of 2013 - will transform the future of wireless voice communication.