

E³ Business Modeling

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E³– SDR Forum
Joint Workshop
27 October 2008
Washington DC, USA



- **Targets**
- **Technical approach**
- **Interactions**
- **Progress**
- **Conclusions**

- Detect and analyze market and business opportunities for Cognitive Radio Systems
- Identify all involved stakeholders and their roles through a dedicated metamodel (UBM : unified business model)
- Perform quantitative and qualitative business modelling activity providing value propositions and their evaluation including analysis of transactions among business stakeholders and ecosystem transformations

□ Contextual study and inputs

- ⇒ Study impact of market, industry, regulation and standardization trends on business models for CRS
- ⇒ Gauge end users' interest in service innovations through quantitative survey and focus groups. Bridge the gap between service innovation and CR systems development.
- ⇒ Collect end users perception on enriched mobile services via focus groups
- ⇒ Carry out interviews with operators and vendors, to assess their interest in cognitive radio, and assess cognitive radio adoption (or intentions) by operators.
- ⇒ Collect feedbacks and perception of these stakeholders to develop the value propositions for E3 selected use cases

□ Update of the Unified Business Model

- ⇒ Identification of all stakeholders involved within a general meta model (Unified Business Model)
- ⇒ Report on the UBM specification and link to OMG Business Motivation Model
- ⇒ Mapping of actors/roles (from Use Cases/Scenarios) to Unified Business Model (actor, role, UBM role)

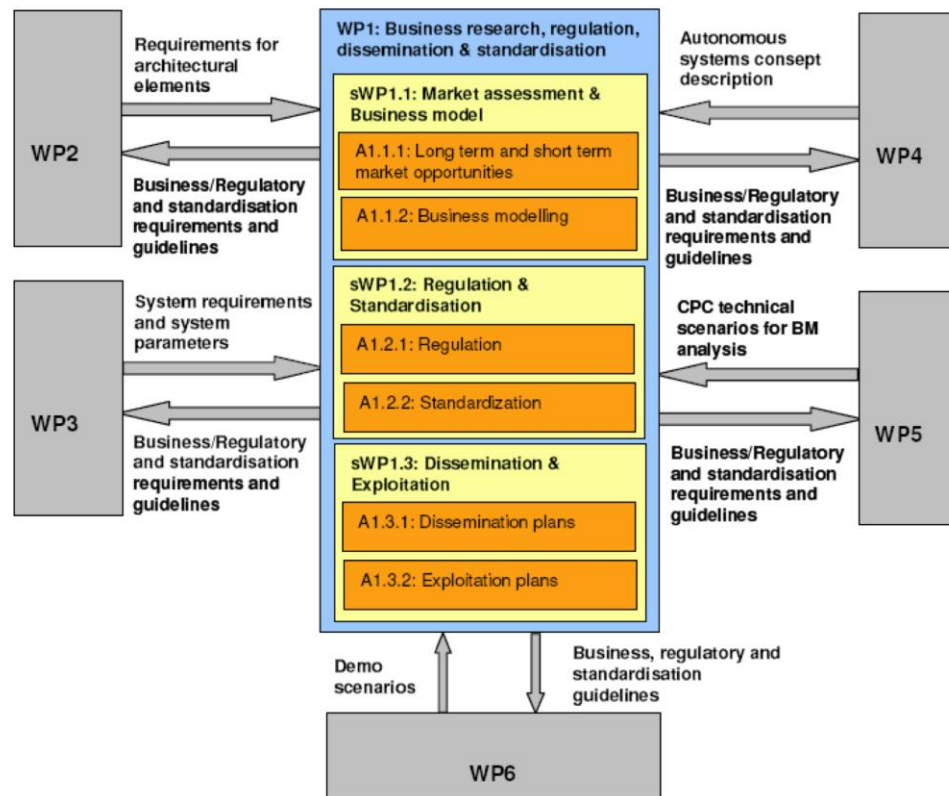
□ Qualitative analysis

- ⇒ Provide value propositions for different families of use cases (self-optimization, self-maintenance, self-reconfiguration, autonomous terminals, Flexible Spectrum Management)
- ⇒ Forecast impacts of CRS use case families on telecommunications ecosystem and perform sensitivity analysis of these impacts

□ Quantitative analysis

- ⇒ Operator centric approach: what are the costs and gains for an operator that would implement CR systems or CR functionalities?
- ⇒ Two scenarios considered : self-X functionalities and CPC adoption

- Business research and modelling work performed in parallel to the regulation / standardization work of WP1, and in parallel to technical work in the other WPs
 - ⇒ With periodic synchronization between them,
 - ⇒ With Participation of business experts to the standardization tracks (ETSI , SCC41,...)



Progress: contextual studies (1/5)

□ Market trends

- ⇒ 3 SDR products and 2 prototypes with CR capabilities analysed
- ⇒ Progress: mainly military applications and focused on spectrum management capabilities
- ⇒ Important for E3: convert the vision of CR systems for consumer markets into reality

□ Regulatory trends

- ⇒ WAPECS, Digital Dividend, Collective Use of Spectrum
- ⇒ Progress: clear trend towards “light-licensing” regimes
- ⇒ Important for E3: space for innovation → reconfigurability and interoperability capabilities

Progress: contextual studies (1/5)

□ Standardization trends

- ⇒ Study of transition from linear to multi-layered standardization process
- ⇒ Possible impact on business models for CRS (cf. qualitative studies)
- ⇒ Use case in question: Cognitive Pilot Channel
 - Following regulation/standardization in ITU-R, IEEE SCC41 and ETSI TC RRS

□ Value propositions derived from trends study

- ⇒ A gap to be filled in the consumer market
- ⇒ Efficient use of spectrum licenses
- ⇒ Reduction in license costs
- ⇒ Opportunities for spectrum trading
- ⇒ Diversification of Network Operator's service portfolio
- ⇒ Interoperability between services and networks
- ⇒ Incentives for technology developments
- ⇒ Increase of service value
- ⇒ Increase of Customer intimacy

Progress: contextual studies (3/5)

- **Two Focus Groups** with early adopters in France and Finland. Derived user expectations:
 - ⇒ Mobile world vs. Internet world
 - ⇒ Messaging services
 - ⇒ Unlimited usage
 - ⇒ Presence features and enhanced contact book
 - ⇒ Mobile quality and reliability
- **Derived requirements**
 - ✧ Capacity/availability information
 - ✧ Ability to monitor quality of service
 - ✧ Interoperability required at various levels
 - ✧ Power management and power consumption improvement, in particular at the terminal level

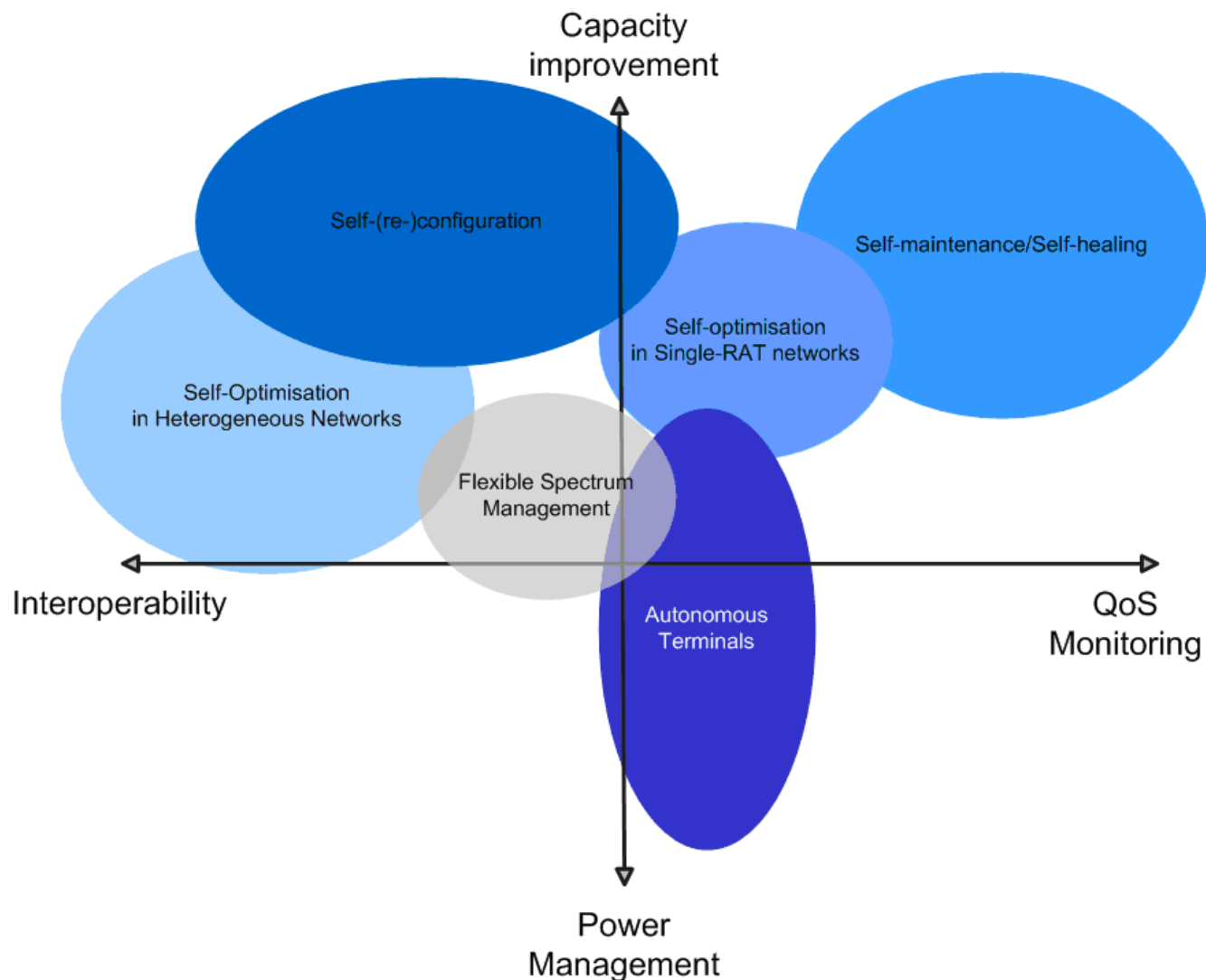


Progress: contextual studies (4/5)

E3 technical use cases families are mapped according to the services technical requirements.

In the following diagram, families of E3 technical use cases are located according to the technical requirements they address.

The size of the bubbles indicates the number of technical use cases identified for each family



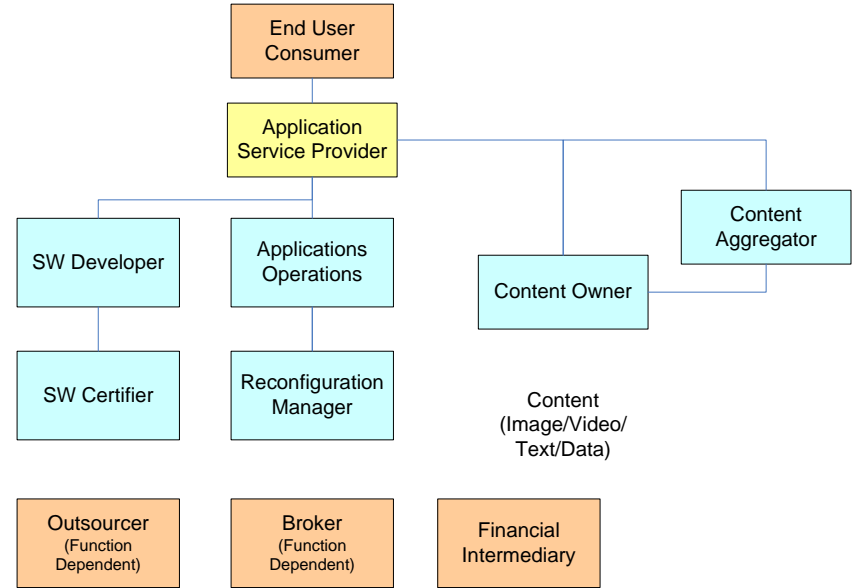
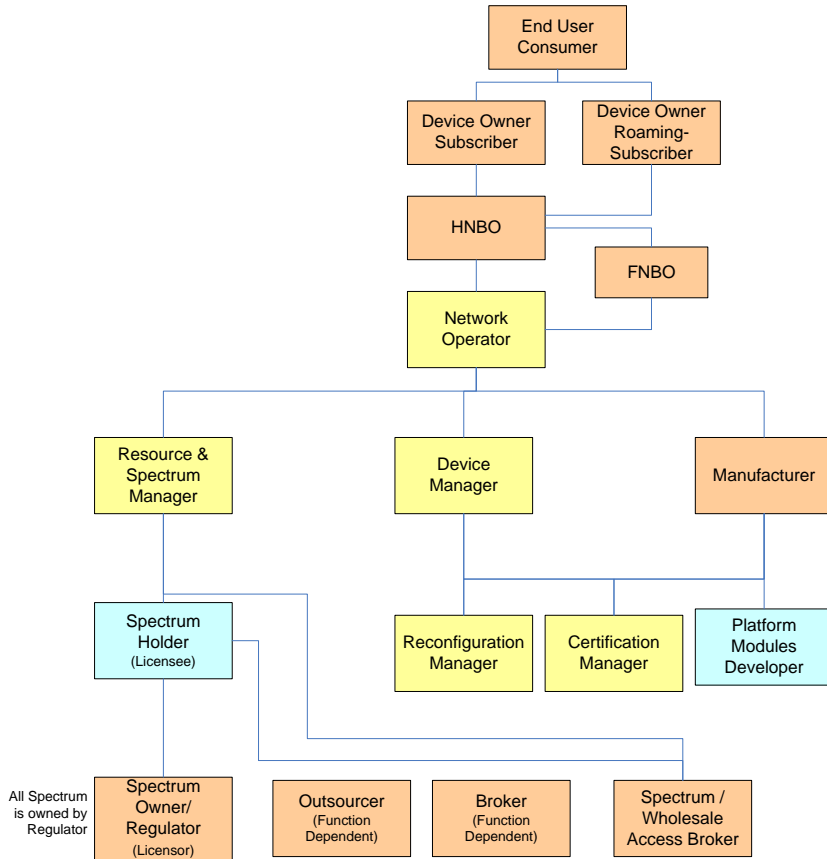
Progress: contextual studies (5/5)

- **Stakeholder interviews. Objectives:**
 - ⇒ Get operators' and equipment vendors' feedbacks on main value propositions developed within E3
 - ⇒ Assess the impact of Cognitive radio systems (CRS) adoption by the mobile ecosystem
- **Value propositions identified**
 - ⇒ **Operations in multi RAT environment** → Cognitive Pilot Channel
 - ⇒ **Network operations improvement:** CapEx and OpEx reductions, Radio network self management
 - ⇒ **Spectrum usage improvement and spectrum efficiency:** Secondary use of spectrum, Dynamic Spectrum allocation, Flexible spectrum management



Progress: UBM specification

The Ecosystems



- Role is exclusive to Application Service Provider Domain
- Role can exist in Separate or Same Domain as Application Service Provider
- Role can be in Separate Business Domain

- Role is exclusive to Network Operator Domain
- Role can exist in Separate and Same Domain as Network Operator
- Role can be in Separate Business Domain

- An ecosystem incorporates the involved roles and the established relationships
- A Network Ecosystem includes all the roles that are active within a network service provision environment
- An Application Ecosystem includes all the roles that are active within an application service provision environment



Progress: UBM specification

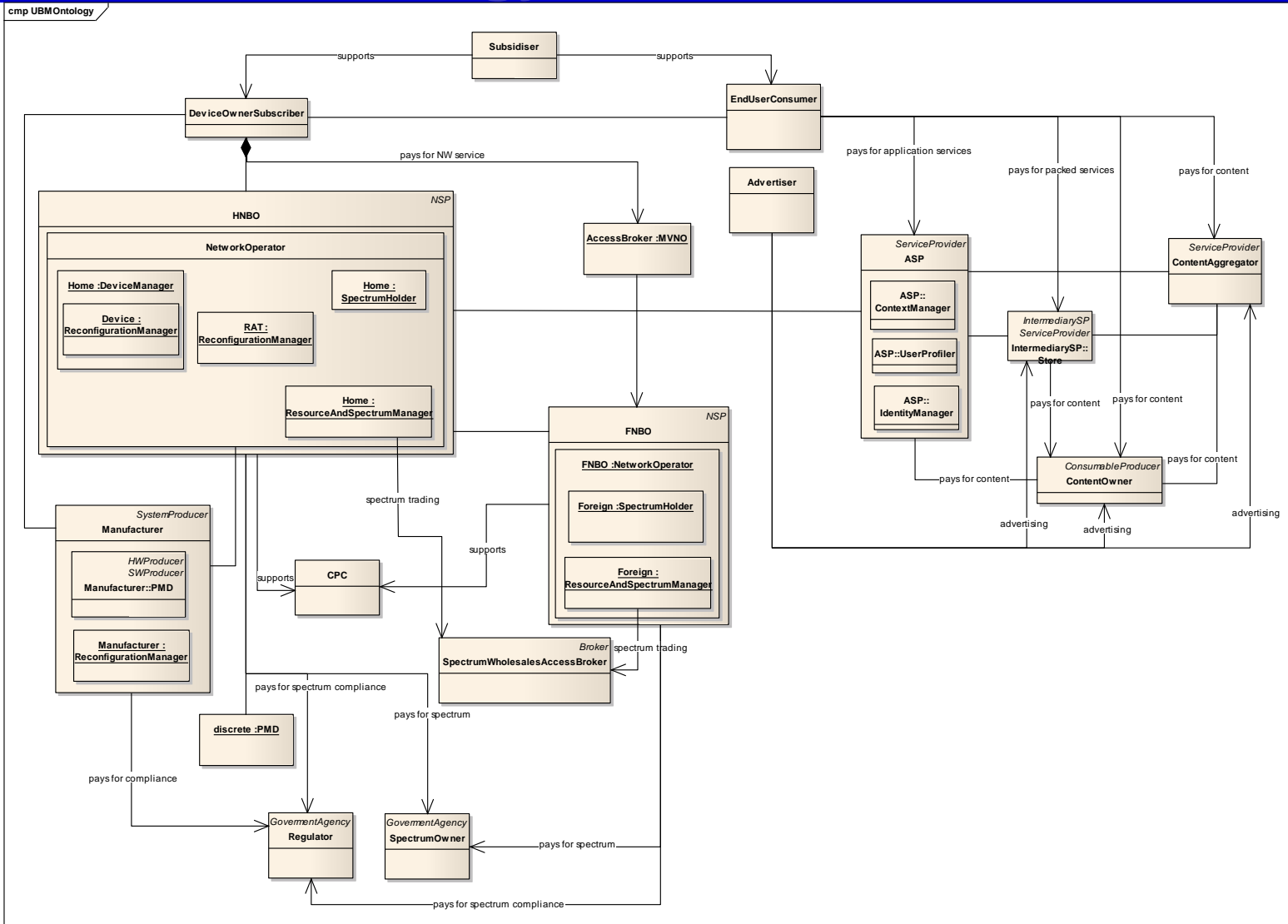
UBM Ontology in UML 2.0 notation

- UBM ontology integrates
 - ⇒ The involved roles and the level of abstraction (discrete/embedded)
 - ⇒ The top-down revenue flows
 - ⇒ The identified inter-roles transactions
- UML 2.0 is used to formalize UBM and modularize with business archetypes towards encouraging reuse and ease of use of the UBM reference model.
- The UML view of the UBM ontology is based on component model
 - ⇒ UML 2.0 Component diagrams illustrate the components that compose a system or an enterprise including the interrelationships, interactions and public interfaces.
 - ⇒ A Component diagram is developed on a higher level of abstraction compared to a Class diagram.
 - ⇒ Specifically, the notion of a Structured Classifier has been utilised to model the notion of the BSAP Discrete roles and also the embedded roles.
 - ⇒ A Structured Classifier is defined, in whole or in part, in terms of the number of the contained instances. Such instances are either owned or referenced by the structured classifier.



Progress: UBM specification

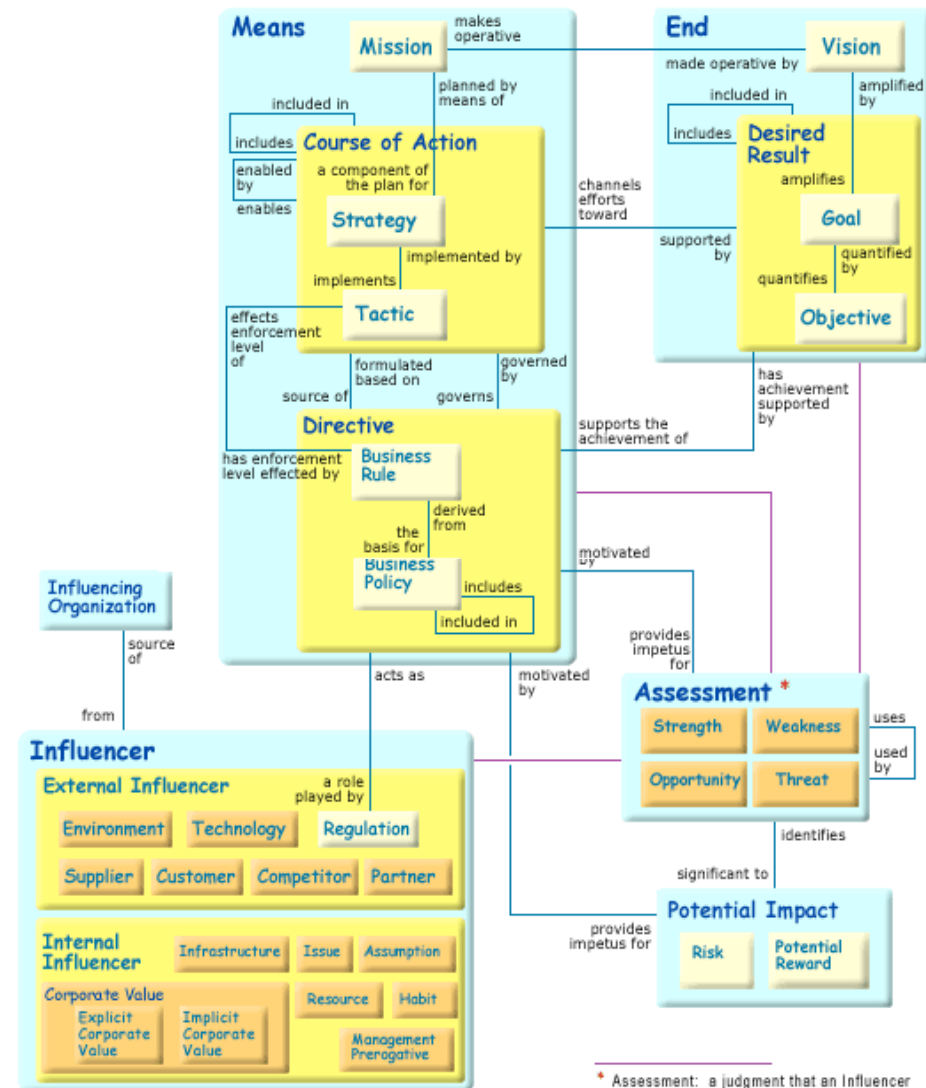
UBM Ontology in UML 2.0 notation



Progress: UBM Specification

OMG Business Motivation Model - BMM

- The Business Motivation Model (BMM) provides a scheme or structure for developing, communicating, and managing business plans in an organized manner.
- This includes the elements of business plans, the factors that influence such plans development and their interrelations.
- Ends – Means – Influencers. Continuous procedures of gradual abstraction form the concepts and the relations that exist within the aforementioned areas.
- End
 - ⇒ Vision
 - Desired Result
 - Goal
 - Objective
- Means
 - ⇒ Mission
 - Course of Action
 - Strategy
 - Tactic
 - Directive
 - Business Rule
 - Business Policy
- Influencers
 - ⇒ External Influencer: Environment, technology, ...
 - ⇒ Internal Influencer: Infrastructure, Corporate Value, ...





Progress: UBM Specification

OMG BMM and BSAP UBM - The Enterprise Model

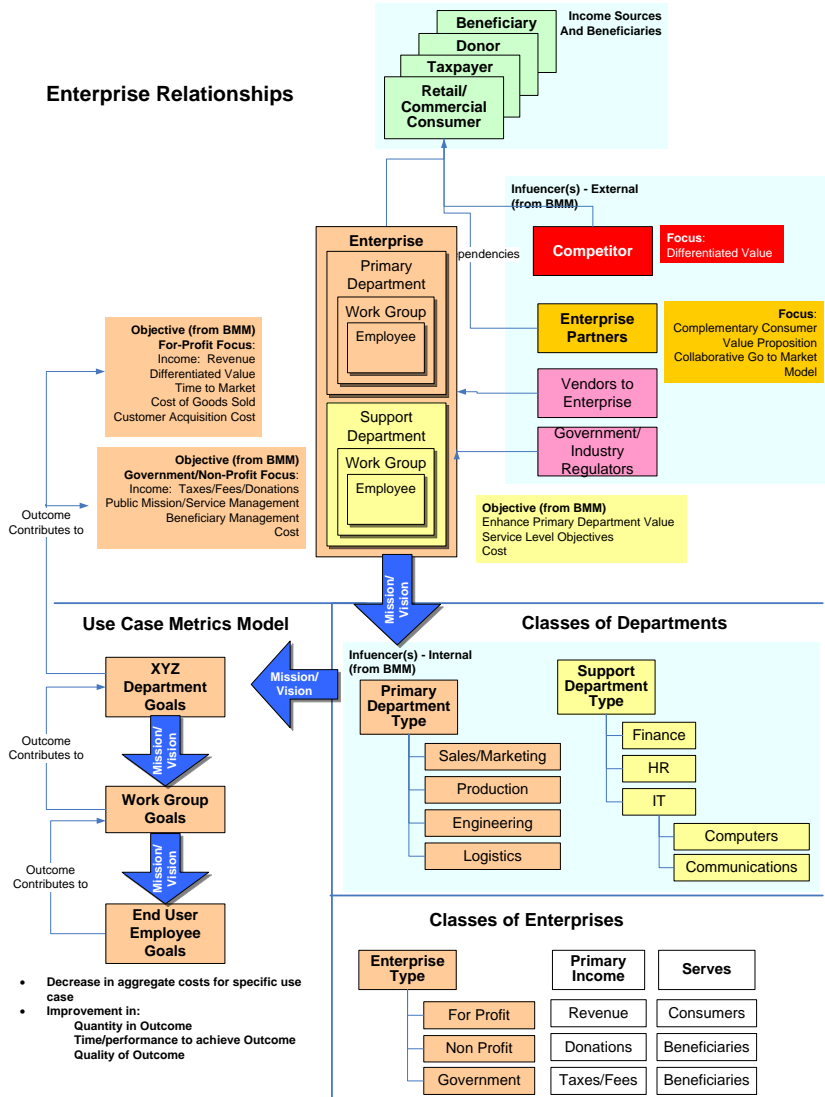
- BMM: how to achieve visior through mission according to the Enterprise de-composition
- UBM-based EM: who to work or mission for achieving visior according to the Enterprise de-composition

⇒ Enterprise

- Primary Department
 - Work Group
 - Employee
- Support Department
 - Work Group
 - Employee

⇒ Classes of Departments

⇒ Classes of Enterprises



Beneficiaries are a type of Commercial Consumer who are entitled to but do not necessarily pay for services which are allocated based on the Enterprise's criteria.



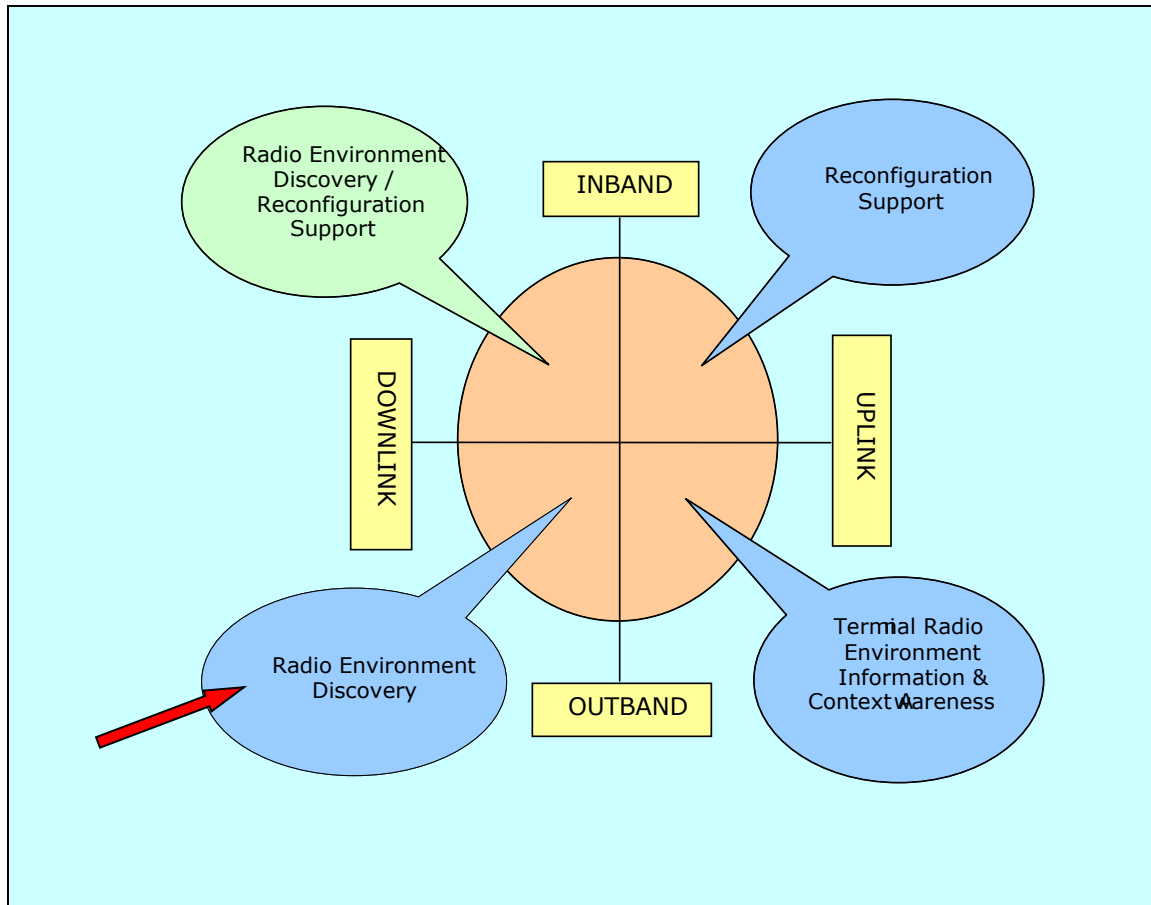
Progress: UBM Specification Elaboration within E3 scope

- ❑ Mapping between actors as identified within technical use cases and system scenarios and the well-established UBM roles
- ❑ Keep UBM aligned to Responsibility Chain concept
- ❑ Outcomes
 - ⇒ UBM roles semantics refinement
 - HNBO: Network Service provision, Decision on benchmark values
 - HNO: Policy Setting, multiple RATs operation, ...
 - Device Mgr: Policy acquisition, context information derivation
 - Infrastructure Mgr: Network monitoring and optimisation, ...
 - Reconfiguration Mgr: performance management, KPI measurements, ...
 - ⇒ Potential emergence of new roles
 - ⇒ Refinement of business interrelations

Actor	Role	UBM Role
NO	Network Service Provision	HNBO
	Decision on threshold and benchmark values.	HNBO
	Network monitoring and optimization.	Infrastructure Mgr
	Network Performance analysis	Reconfiguration Mgr
	Operating of multiple RATs in overlapping areas	HNO
	Traffic monitoring of different RATs.	HNO
	Reconfiguration actions management.	Reconfiguration Mgr
	Setting Constraints/Policies.	HNO
	Activation/configuration the functionality according to own strategy/policy.	HNO
	Evaluation of the correct reliability of the imposed DSM algorithms by regulator/meta-operator	HNO

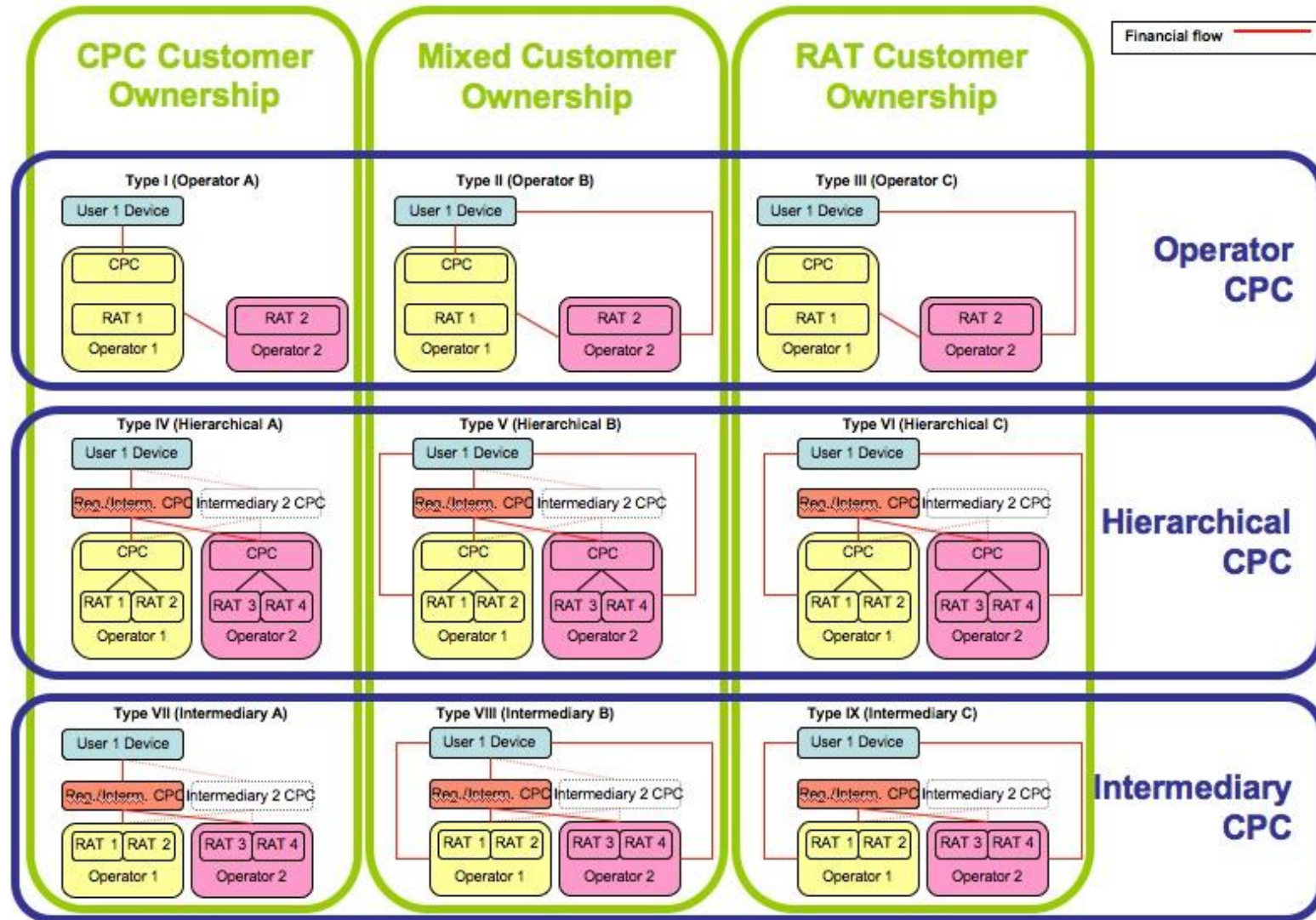
- ❑ Value propositions derived from technical use cases
- ❑ Outcome: link the UBM framework to the initiation of quantitative analysis through identifying also the involved UBM roles and the corresponding value

Value Proposition Aspects	Involved Players' benefits
<ul style="list-style-type: none"> ❑ Optimal radio and system resource management to ensure network efficiency, ❑ Dynamic spectrum access in a secondary manner and a light regulation ecosystem, ❑ Increased overall capacity through the efficient resource management, ❑ Fault management, ❑ Load optimisation, ❑ Resources sharing, ❑ Optimal service provisioning to users in heterogeneous environment, ❑ Reduced bandwidth and power consumption on UE side, ❑ Automatic test of new services, ❑ Assurance of coverage and QoS. ❑ Enhanced service provision through ad-hoc networks. 	<ul style="list-style-type: none"> ❑ Agreements and fees among the involved players (NOs, Regulator, Spectrum Owners and Broker) for optimal radio resource management ❑ OpEx reduction and centralised control by supplying BSs with self-healing capabilities ❑ OpEx reduction for NOs through optimal spectrum utilisation, as well as SLAs opportunities for spectrum rental among NOs ❑ Subscription and charging to Users for service and content provision cases and the better QoS ❑ New income from enhanced capacity resulting to an increased number of users being served and better user experience ❑ Ensuring the best, highly personalised service provision ❑ Ensuring the “always-best-connected” value to those users that need such a capability and are willing to pay for this, (e.g. save money in cases of bad connectivity, time critical tasks, and efficient remote (co-)working) ❑ Guaranteed service provision through NO's before-deployment test and evaluation of services provided by other service providers ❑ Reduced bandwidth and power consumption on UE side ❑ Potential reduced cost for service provision through ad-hoc network formation.

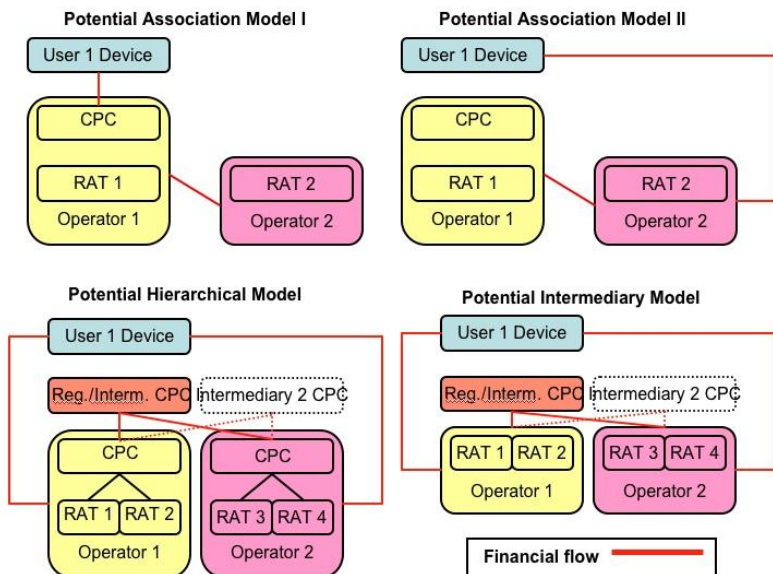


Scenario 1: CPC

- ⇒ Radio environment discovery
- ⇒ Data broadcasting
- ⇒ Outband/downlink
- ⇒ Multi-operator CPC context
- ⇒ Reuse of existing GSM infrastructure
- ⇒ No specific hardware needed (use of GSM channel)
- ⇒ 200 kHz channel (With spectrum efficiency of 1 bit/Hz/s)
- ⇒ Data base with networks information (Coverage of different RATs: GSM, UMTS, LTE, WLANs..)



I	II	III	IV	V	VI	VII	VIII	IX
1. Control & Revenue Balance								
1.1. Alignment Gateway ~ Asset								
High 2	High 2	High 2	Med 1	Med 1	Med 1	Low 0	Low 0	Low 0
1.2. Alignment Value ~ Asset								
High 2	High 2	High 2	Low 0	Med 1	High 2	Low 0	Med 1	High 2
2. User Value								
2.1. Billing Complexity								
Low 2	High 0	Low 2	Low 2	High 0	Low 2	Low 2	High 0	Low 2
2.1. Service Diversity								
Low 0	Low 0	Low 0	Med 1	Med 1	Med 1	High 2	High 2	High 2
Total								
6	4	6	4	3	6	4	3	6



Revenue sharing models analysis

- Pure association models feasible (I and III)
- Hierarchical and intermediary models with RAT CO feasible (VI and IX)
- CPC = thin intermediary, possibly run by consortium or regulator
- Costs borne by operators, justified by cost savings for underlying RATs and new services
- Mixed CO and CPC CO, multiple independent CPC scenarios less likely

General conclusions

- Limited possibility for standalone CPC
- Primary aims: reduce harmonization and implementation complexity, gain stakeholder support
- Little opportunity for competitive, cross-operator CPC market
- More chances for association or consortium platforms
- RATs remain core asset → core source of revenue

Further steps in CPC case

□ A. CPC business analysis

- ⇒ Draw up limited set of technical assumptions
- ⇒ Derive limited set of business/regulatory assumptions
 - Which fundamental factors will change?
 - How do these changes impact, on a more detailed level, the operations of key actors: HNBO, FNBO and possible CPC operator (side actors: consumer and manufacturer)
- ⇒ Identify possible inputs to verify/falsify assumptions (internal/external)
- ⇒ Illustrate with UBM
- ⇒ Feed back to more detailed technical picture of CPC

□ B. CPC standardization analysis

- ⇒ Follow-up technical development of CPC in standardization and regulation bodies
- ⇒ Feed developments into
 - Technical assumptions
 - Business/regulatory assumptions
- ⇒ Update business analysis
- ⇒ Possibly feed back results (specifically wrt design choices ↔ business assumptions) to body/bodies

□ Other possible scenario candidates:

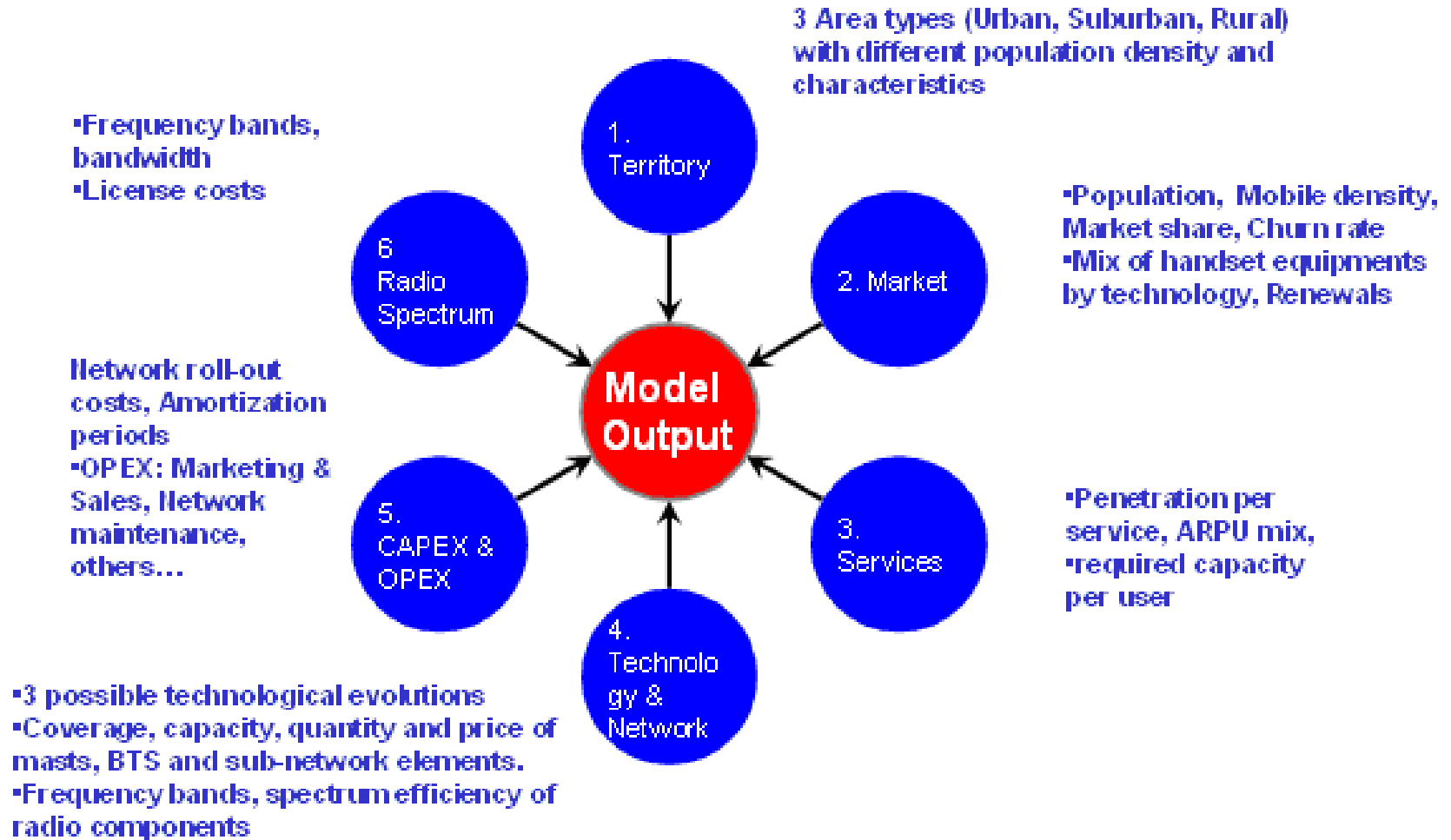
- ⇒ Increased amounts of licensed spectrum available
- ⇒ Market mechanisms for spectrum
- ⇒ Collective use of spectrum
- ⇒ Massive inclusion of self-x capabilities

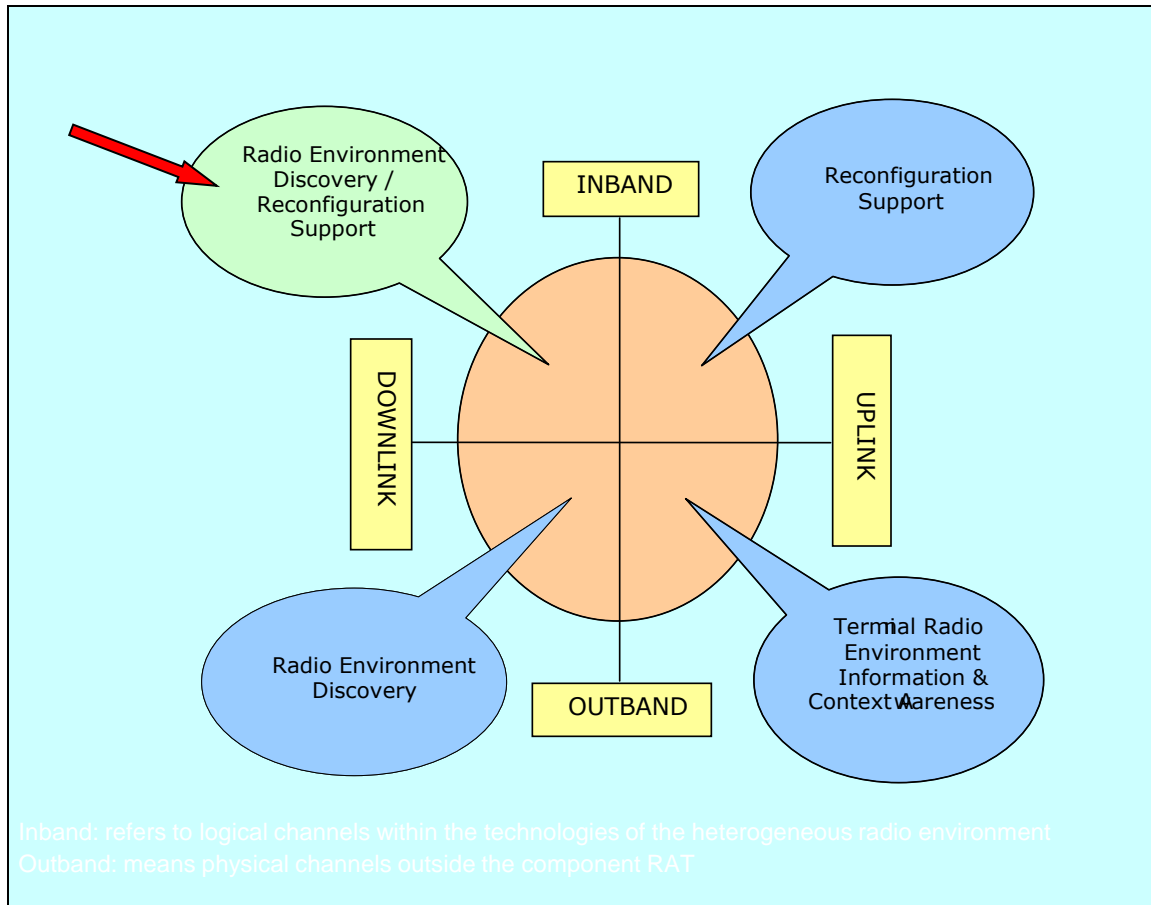
□ Methodology:

- ⇒ Draw up limited set of assumptions (key changes)
- ⇒ Identify possible inputs to verify/falsify assumptions
- ⇒ Illustrate with UBM and other representations
- ⇒ Link to E3 use cases

Progress: quantitative studies (1/7)

- Objective: assess the impact of adoption of cognitive radio elements on Mobile Network Operators' economics.
 - ✎ Quantitative Progress should be targeted, not only potential savings at the CapEx and OpEx levels especially but also potential revenue gains
- Main relations within specific categories of variables have been built:
 - ✎ Six categories of variables: territory, market, services, technologies and network, CapEx and OpEx, radio spectrum
 - ✎ Relations between categories of variables have been formed
 - ✎ Validation of cost model framework and of main assumptions by running the model without CR elements





Scenario 1: CPC

- ⇒ Radio environment discovery / Reconfiguration support
- ⇒ Data broadcasting
- ⇒ Inband / downlink only
- ⇒ CPC operated in the operator's domain
- ⇒ Reuse of existing GSM infrastructure
- ⇒ No specific hardware needed (use of GSM channel)
- ⇒ 200 kHz channel (With spectrum efficiency of 1 bit/Hz/s)
- ⇒ Data base with networks information (Coverage of different RATs: GSM, UMTS, LTE, WLANs..)

Progress: quantitative studies (4/7)

□ CPC implementation:

- ⇒ Reuse of existing infrastructure: no equipment CapEx required
- ⇒ Limited amount of spectrum needed but regional harmonization is required for outband CPC and would facilitate inband CPC adoption.

□ CPC benefits

- ⇒ Allow a terminal to select a network in an environment where several technologies are available
- ⇒ Updated connectivity information
- ⇒ Power saving at the terminal level
- ⇒ Facilitate frequency bands refarming
- ⇒ International roaming enabler
- ⇒ Key enabler for future dynamic spectrum access context
- ⇒ If one considers potential uplink capabilities, there are additional gains:
 - Cellular based location information,
 - Support of reconfiguration management between network and terminals,
 - Further radio enablers developments

Fitting the CPC scenario into the cost model

□ Potential cost:

- ∞ Operational costs related to software updates in GSM base stations
- ∞ Cost of GSM spectrum used
- ∞ Cost of building and operating the data base containing network information

□ Preliminary potential gains identified:

∞ Qualitative:

- ∞ Improvement of operations in multi RAT environments
- ∞ Improved QoS for end users
- ∞ Reduced time to market for innovative services

∞ Quantitative:

- ∞ Capacity gains on cellular networks due to transfer offload to WLAN networks when possible: Cost per Mbit lower on WLAN networks than on cellular networks.
- ∞ Reduced churn rate and increased market share (due to improved QoS and reduced time to market) → higher revenues.

Scenario 2: Network self planning and self optimization

□ Objective: to assess the gains of self planning and self optimization functionalities at the network level for functionalities developed within E3

□ Scenario:

- ⇒ Self planning and self optimization functionalities developed within E3
- ⇒ Adoption of self planning and self optimization functionalities for future standard (not deployed in GSM and UMTS networks) → functionalities integrated in the standard from scratch.
- ⇒ Vendor independent standardized interfaces

□ Definition of operators' use cases for self planning and self optimization functionalities

Fitting the self-x scenario into the cost model

- Potential cost
 - Increased CapEx
- Preliminary potential gains identified
 - ⇒ Qualitative
 - ⇒ Improve network performance: Handover, optimization, reduced outage, improved resource usage
 - ⇒ Quantitative
 - ⇒ OpEx savings
 - ⇒ Quantitative assessment requires inputs from operators:
 - ⇒ Frequency of each use case in current network planning and optimization operations
 - ⇒ Duration of manual operations for each use case
 - ⇒ Cost of operational staff



Conclusions