COST-TERRA

COST Action IC0905 TERRA

Regulation for innovation:

"Pluralistic Licensing using Cognitive Radio Mechanisms"

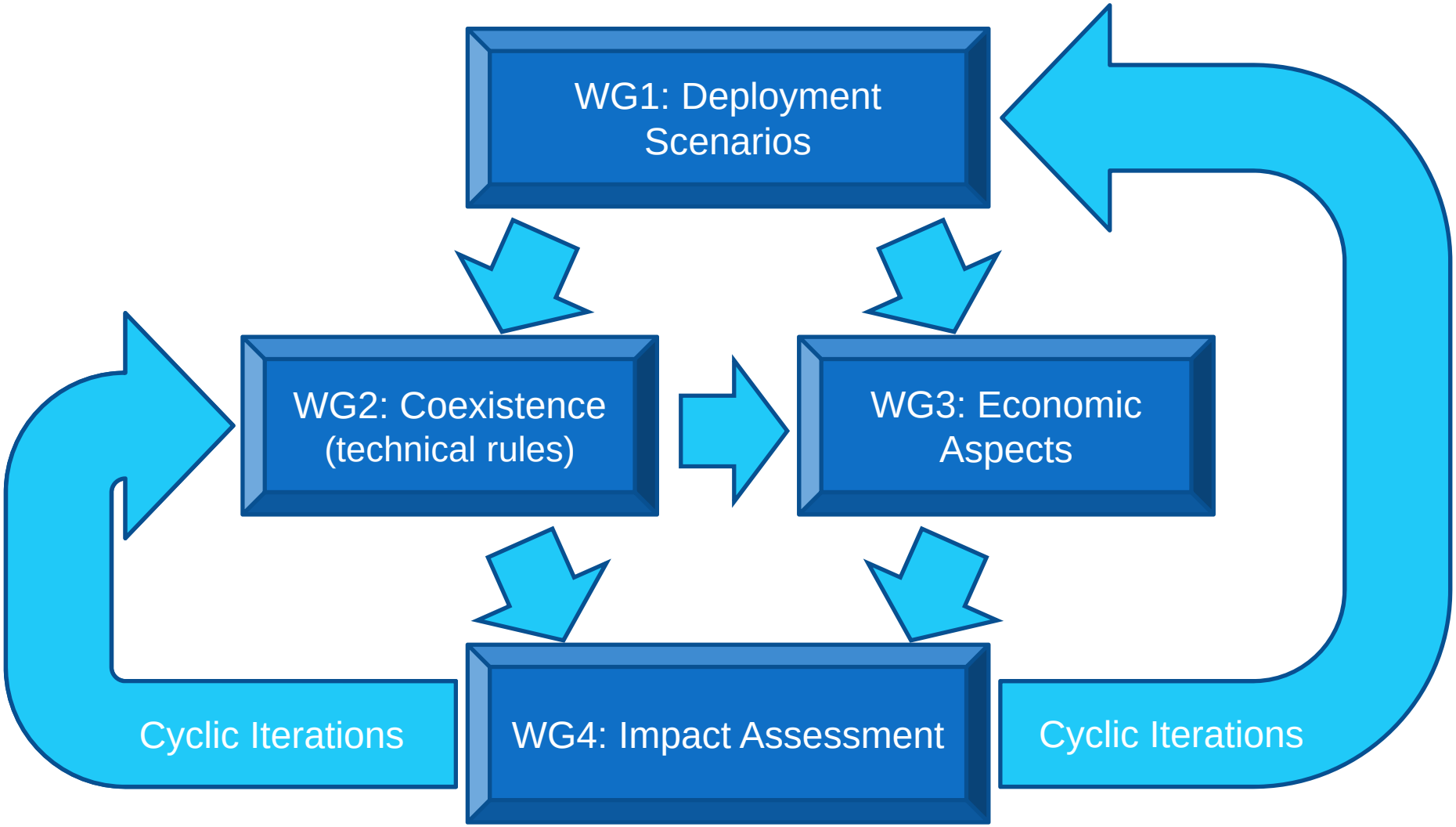
Oliver Holland, Keith Nolan, Marja Matinmikko, Arturas Medeisis, Luca De Nardis, plus others in COST-TERRA

Introducing COST-TERRA

About COST-TERRA

- COST = European **CO**operation in **S**cience and **T**echnology
  - A European inter-governmental framework to promote international networking for R&D and standardisation, managed by the European Science Foundation
- COST action IC0905 "TERRA": "***T**echno-**E**conomic **R**egulatory framework for **R**adio spectrum **A**ccess for Cognitive Radio/Software Defined Radio*"
- Is an independent think-tank with broadly open participation from academia, industry and regulators
- General aim is to bring together technical and economic experts to spearhead a regulatory breakthrough for European development of CR/SDR

About COST-TERRA



Proposal from COST-TERRA: Pluralistic Licensing using Cognitive Radio Mechanisms

The Past: License Exempt

- Pros
  - A hot-bed of innovation in wireless field
  - An entry point for "free" wireless services
  - Created plethora of novel applications and wireless uses
  - Led to the development of popular standards such as WiFi, Bluetooth and ZigBee
  - Spill-over of related innovation to other bands
  - Rich eco-system
- Cons
  - Built on one caveat – limited (low) transmit power
  - Interference/coexistence concerns

The Past: Licensed

- Pros
  - Have allowed reliable services
    - Near-ubiquitous voice connectivity in public land mobile
    - Early data services
    - High-quality broadcast services
    - Guaranteed clean spectrum for critical services
- Cons
  - There are efficiency concerns of such bands
    - Parallel need for more spectrum; mobile data growth

The Present: Stalled Innovation

- Opportunistic/dynamic spectrum access (OSA/DSA), enabled by cognitive radio key impetus of wireless research & innovation
- Barriers
  - Extremely onerous technical requirements to protect incumbents
  - Nascent markets
  - Geolocation database access challenges
  - Lack of appropriate spectrum
  - Resistance of incumbents due to "fairness factor"
  - Severe and yet to be defined certification requirements
  - Difficulty to scale from test & trial licensing incentives (low cost) to commercial deployment (extremely high cost)
    - Costs – e.g. nationwide, long-term licence
    - Deployment band & conditions of usage are usually different than the wireless test & trial scheme used to test the new technology/service

Going into the Future: Data Growth

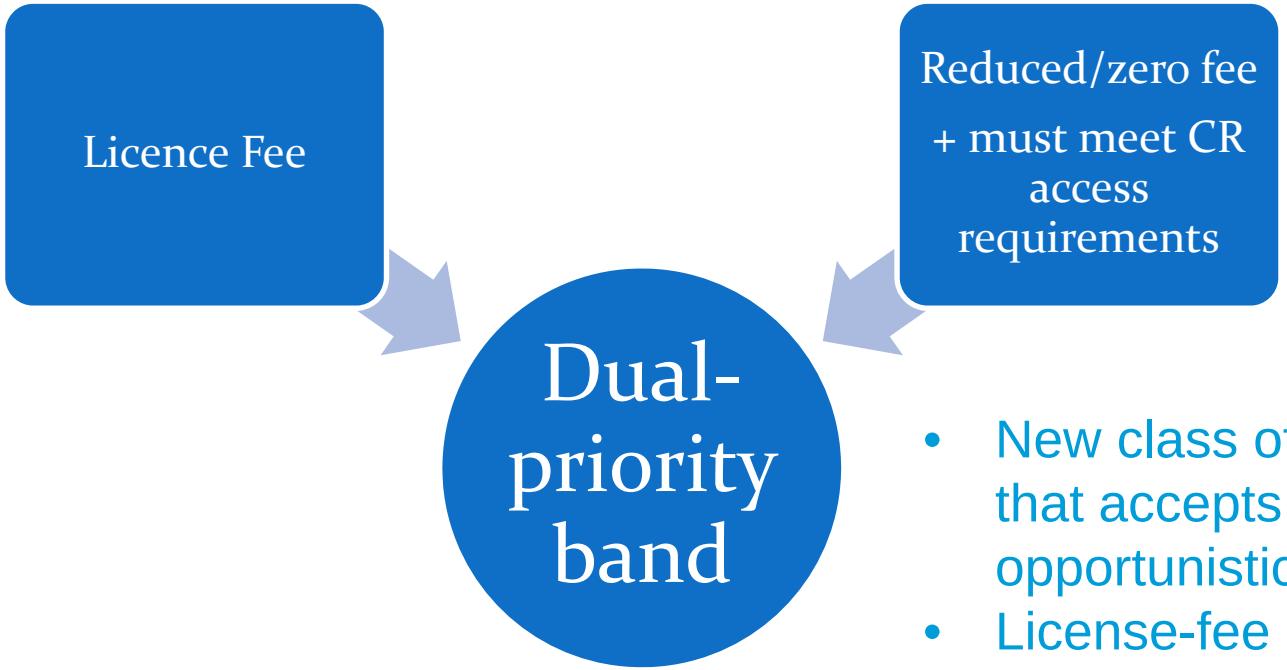
- The mobile/wireless telecommunication market expected to continue growing extremely rapidly in the next decade [1]
  - QoS is critical in certain mobile/wireless applications and is difficult to guarantee without dedicated spectrum
- The increasing data rate demand will result in ***increasing spectrum demand*** for mobile/wireless services, also sufficient amount of spectrum is needed ***to ensure fair competition***
  - Current auctioning mechanisms favour existing strong players that can afford to bid for the limited number of licenses available not giving new entrants a look-in

[1] ITU-R Report M.2243. Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications. 2011.

The Future: Vision

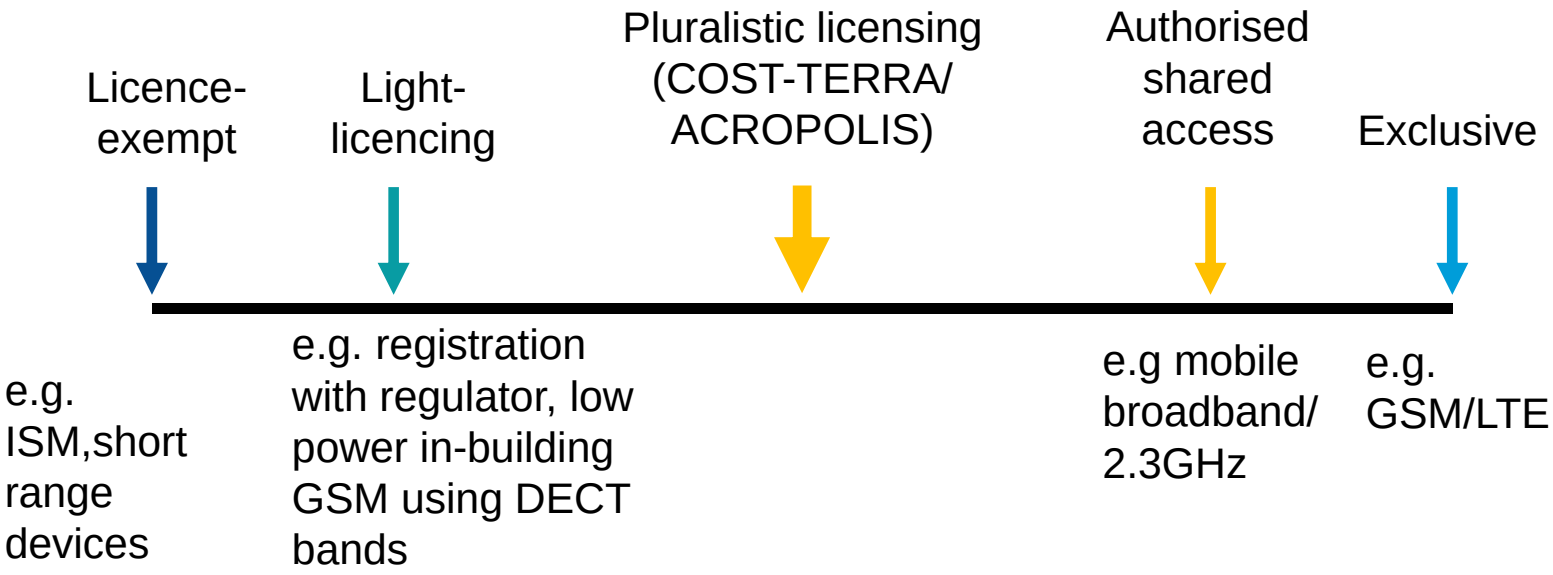
- New type of pluralistic licensing exploiting cognitive radio mechanisms in designated bands
  - Coexistent licensed with license-exempt using 'cognitive mechanisms'
  - Propose new class of primary which implicitly accepts opportunistic access when obtaining license
    - Allows those to pay for quality who wish to, while also allowing lower-quality opportunistic access for those that can't pay
  - Facilitates innovative wireless services scaling up more efficiently
    - No upfront licence costs if 'cognitive mechanisms' are used
    - Progressive deployment of primary is possible through a payment scheme similar to "light licensing"
    - Might scale up to multiple spectrum segments (can be aggregated)
  - Opportunistic access elements presents vast improvement in spectrum efficiency compared with pure centralised management
  - Built-in primary robustness also vastly improves efficiency

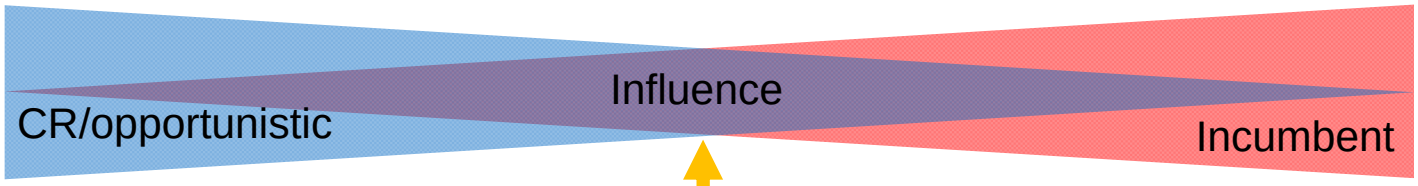
Licensing Concept



- New class of license, that accepts opportunistic access
- License-fee paying users have priority in spectrum access mechanism

Licensing Concept



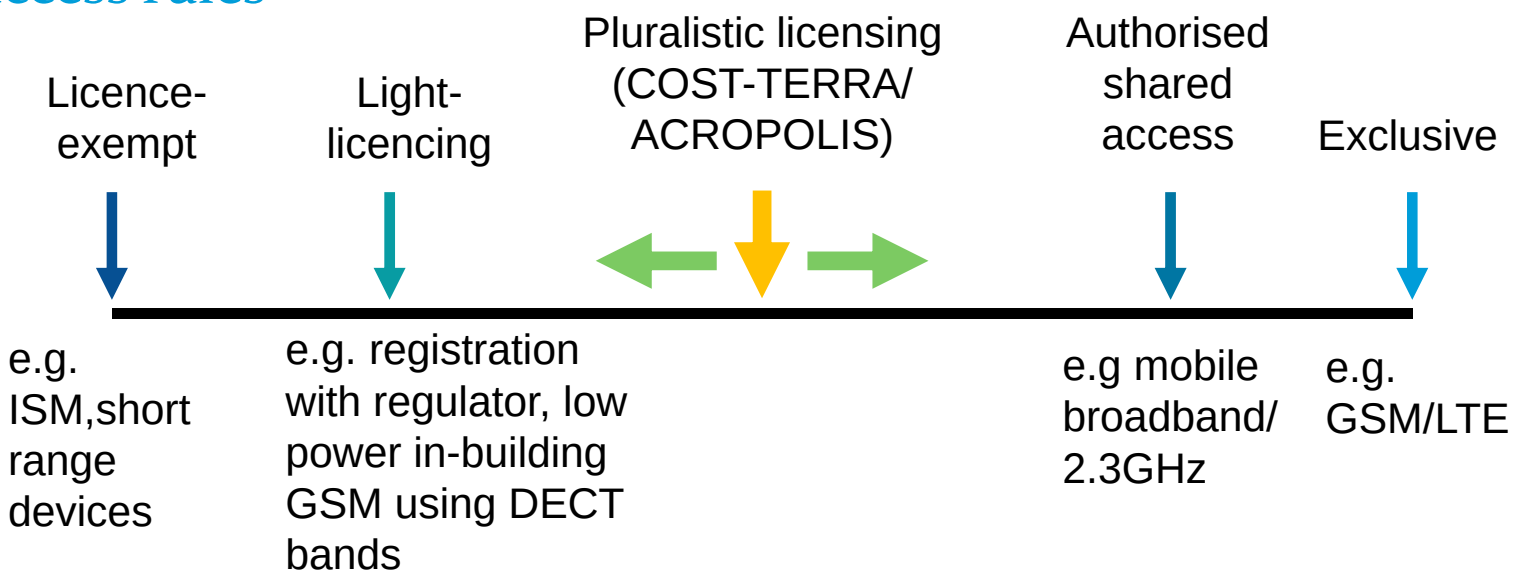


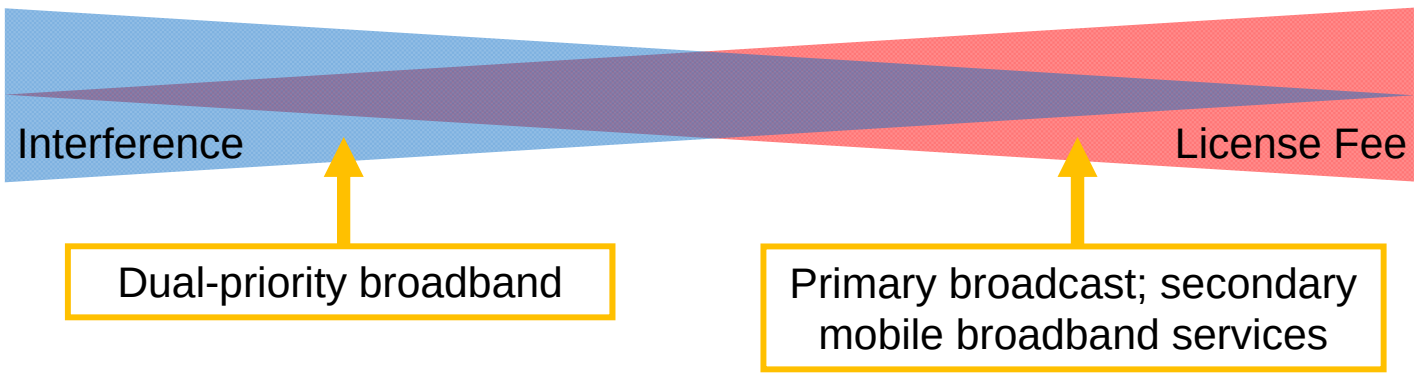
Equilibrium

CR/opportunistic and incumbents have equal rights
Dual entry approach – value for both incumbents & new tech scaling up

Licensing Concept

- Interference vs. license fee trade-off for different primary/secondary application combinations and required access rules





Suggested Work for CEPT-ECC FM

- Scheme is applicable to a wide range of commercially-attractive spectrum segments
  - Inferred from market / spectrum characteristics
- Identify possible candidate bands and "composite applications"
  - Examples of composite application(s):
    - Dual-priority broadband
    - Primary broadcast vs. secondary mobile broadband services
    - Etc…

Suggested Work for CEPT-ECC SE

- Requirements and fine tuning for identified bands and composite applications
  1. Secondary access technical conditions
  2. Primary access performance expectations
  3. Coexistence of primary systems, e.g., resource allocation, contention mechanisms, pricing (latter likely non-SE consideration)
  4. Coexistence of secondary systems (e.g., the politeness expectations among the low-priority access)

That's all folks!

oliver.holland@kcl.ac.uk
www.ollyinteractive.com

Acknowledgments

- This work has been prepared in the framework of COST IC0905 "TERRA", supported by the ICT-ACROPOLIS Network of Excellence, FP7 project number 257626, and CTVR
- Special thanks to the contributors to this presentation and concept: Oliver Holland, Keith Nolan, Arturas Medeisis, Luca De Nardis, Marja Matinmikko, John Sydor, Simon Delaere (list not exhaustive)

- For more information on COST Action IC0905 TERRA, please visit: www.cost-terra.org
- For more information on ICT-ACROPOLIS, please visit: www.ict-acropolis.eu