

# Towards a Flexible Spectrum Market



Centre for Telecommunications Value-Chain Research

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Sarath



**Lucent Technologies**  
Bell Labs Innovations

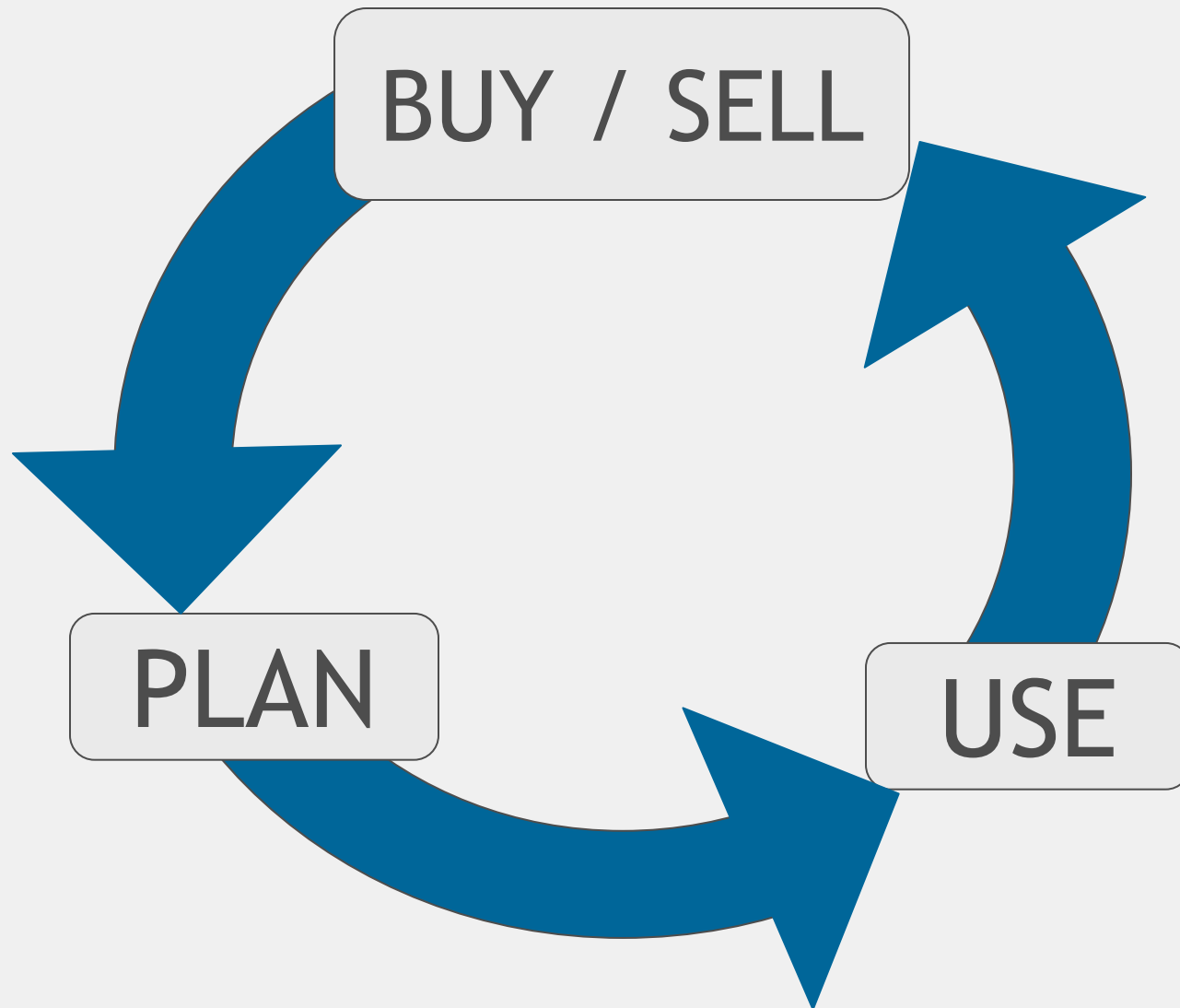


# STATIC spectrum assignment



# FLUID

## market-based spectrum assignment

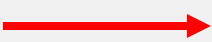


# FLUID market-based spectrum assignment

1. spectrum is the commodity (exclusive spectrum usage rights)
2. the market is a fully automated secondary market
3. spectrum is ASSIGNED not allocated
4. the technology facilitates assignment

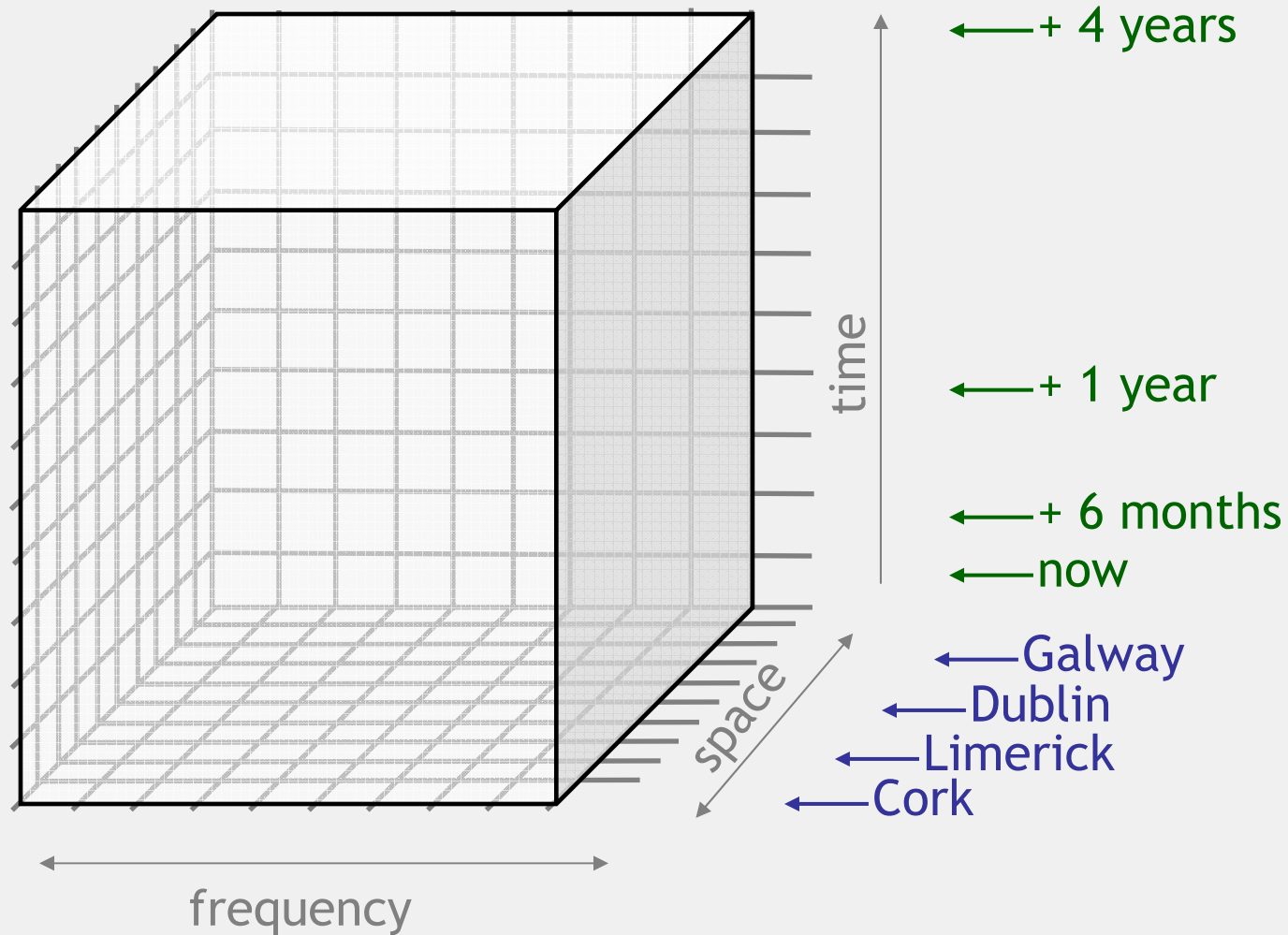
example **PLAYER** rules :

- buyers must be users, not hoarders
- sellers can only be government designated entities
- buyers can / cannot become sellers

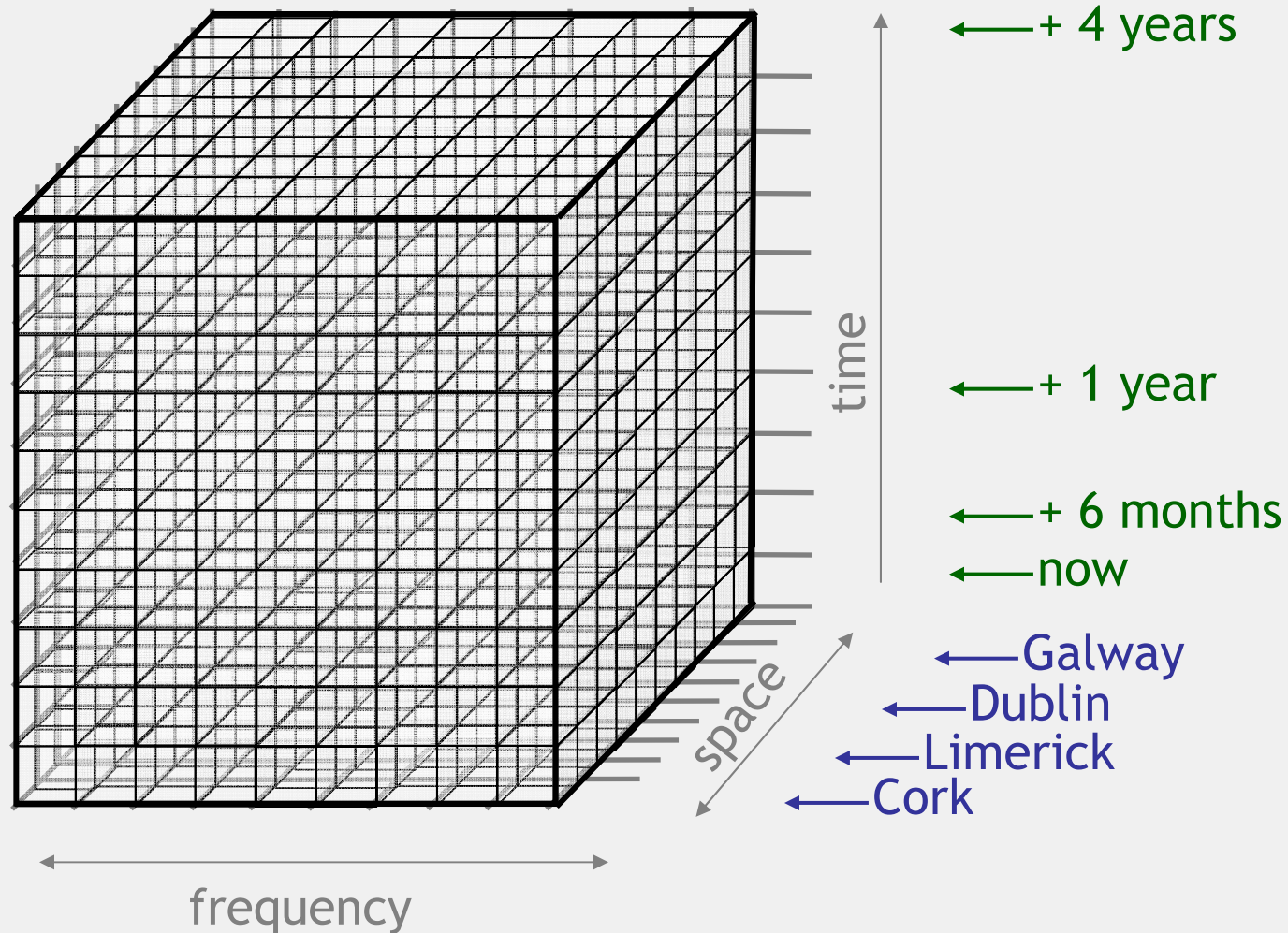
- definitions can change over time
- mobile operator  municipal network / campus networks



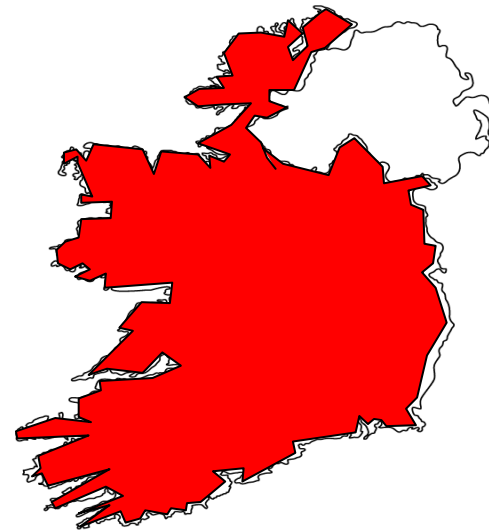
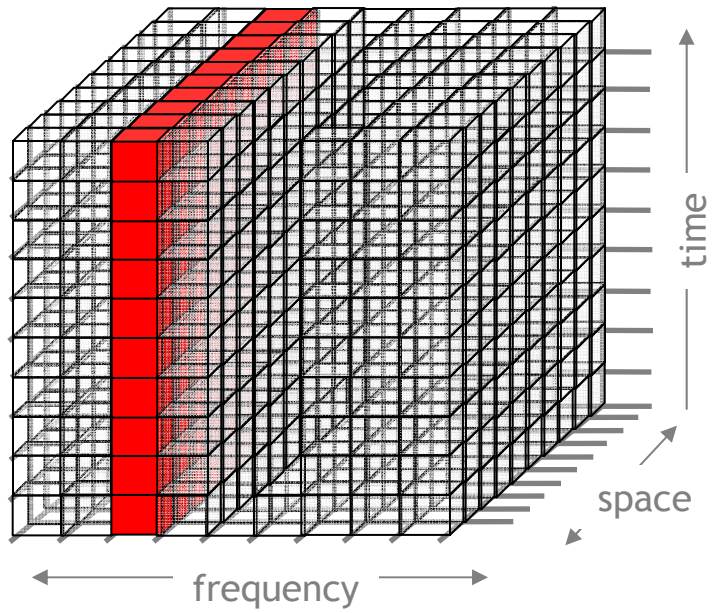
# radio spectrum usage continuum



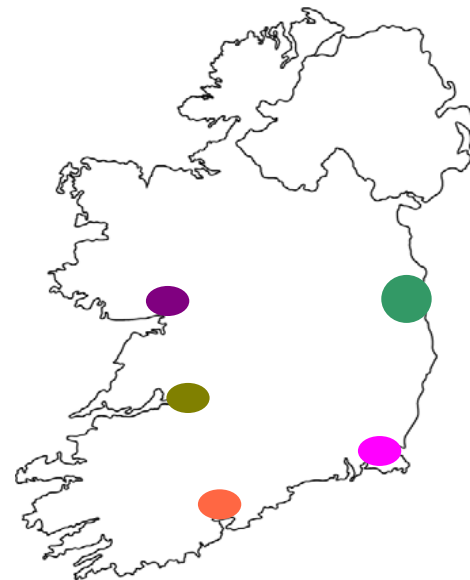
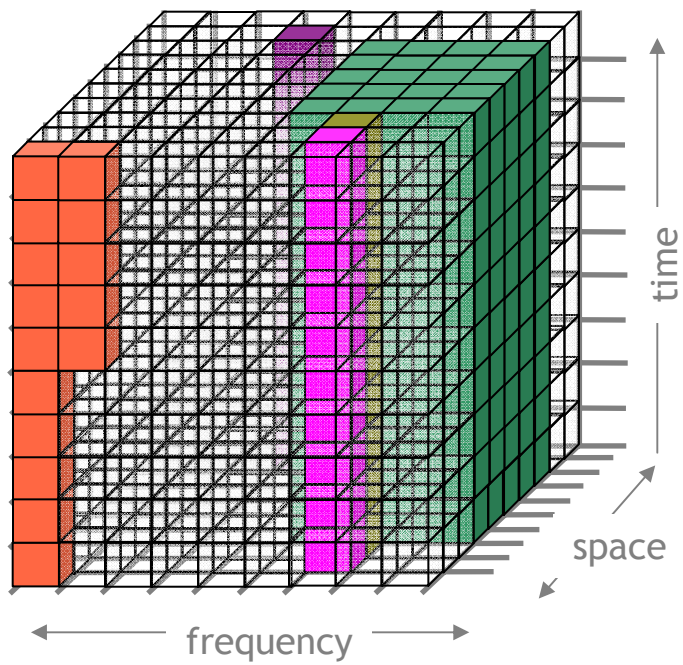
# radio spectrum usage continuum







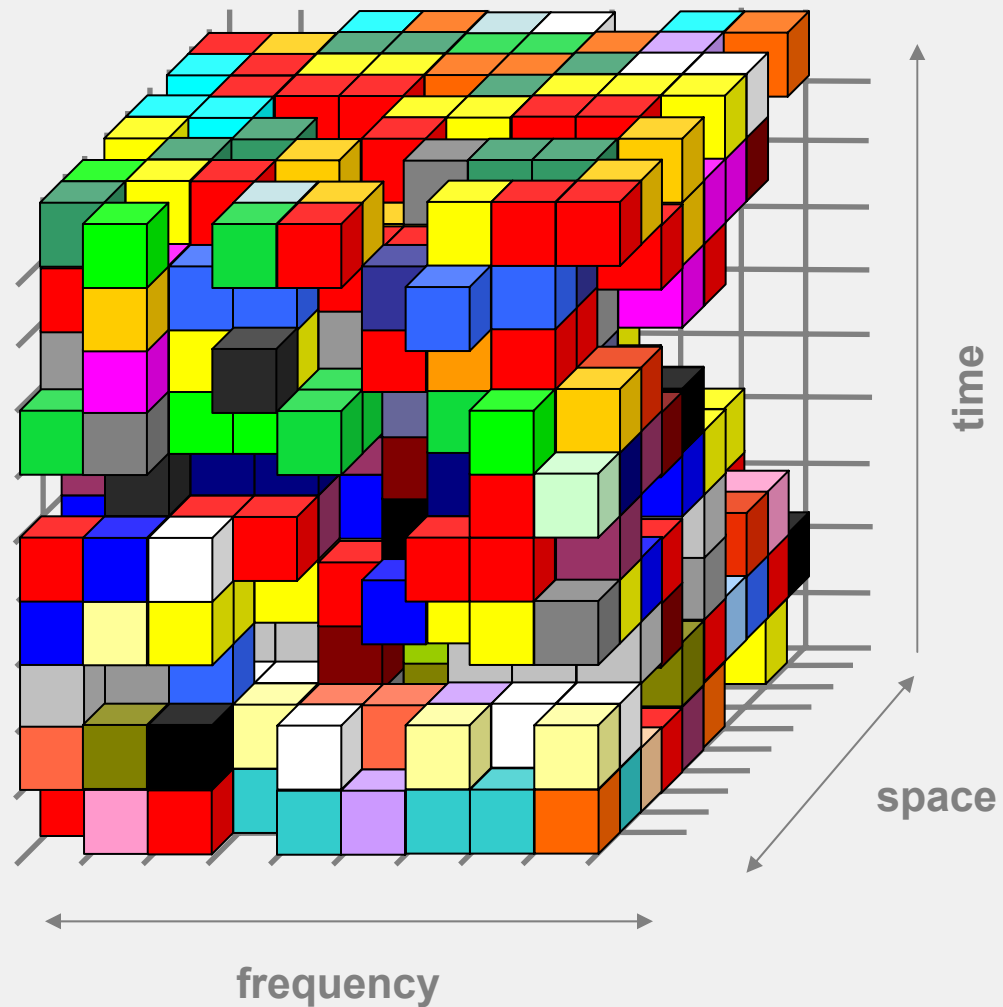
GSM/  
UMTS



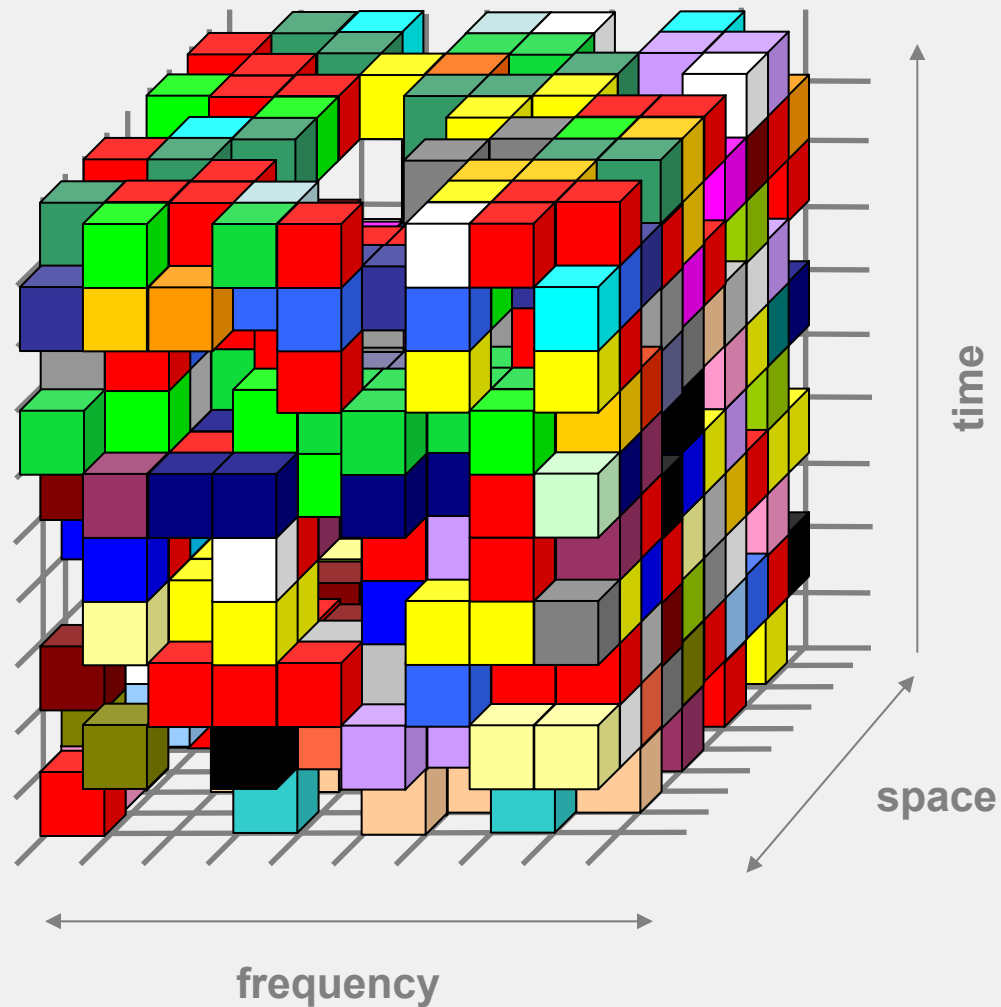
WiMAX



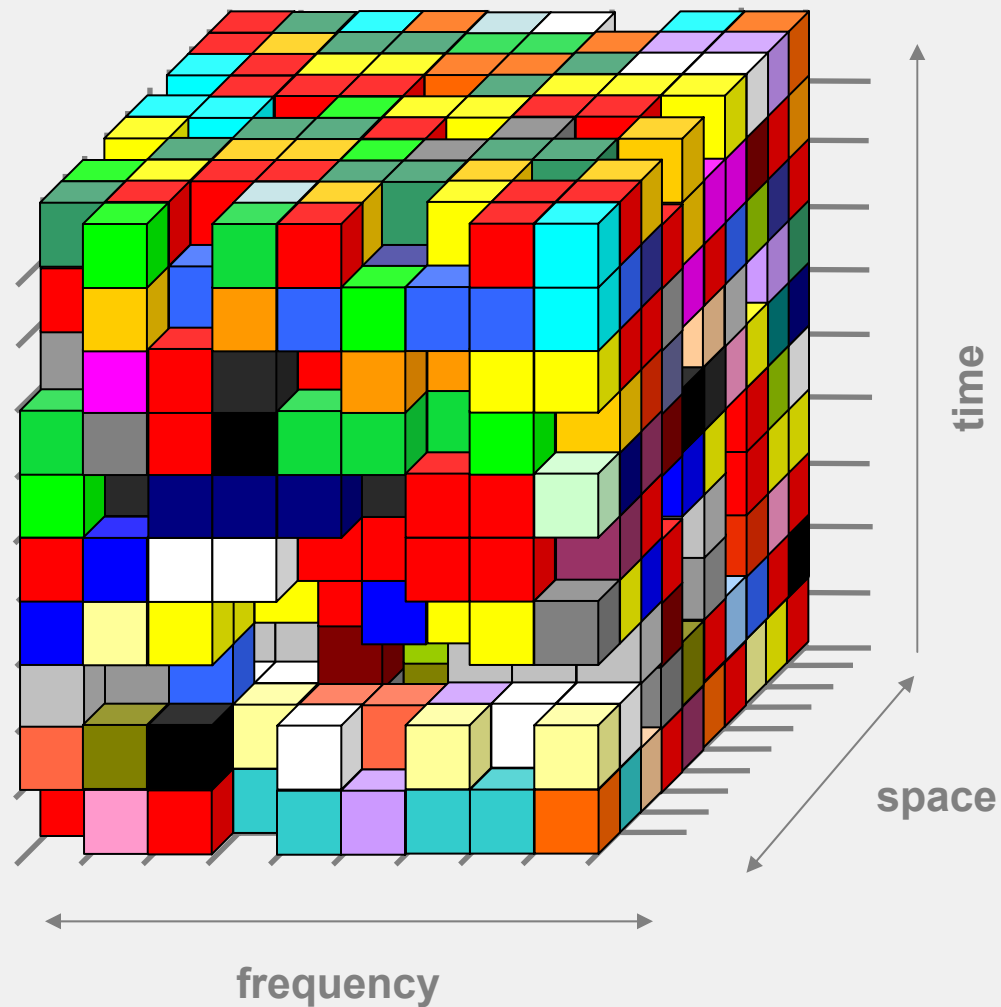
# fluid market-based assignments



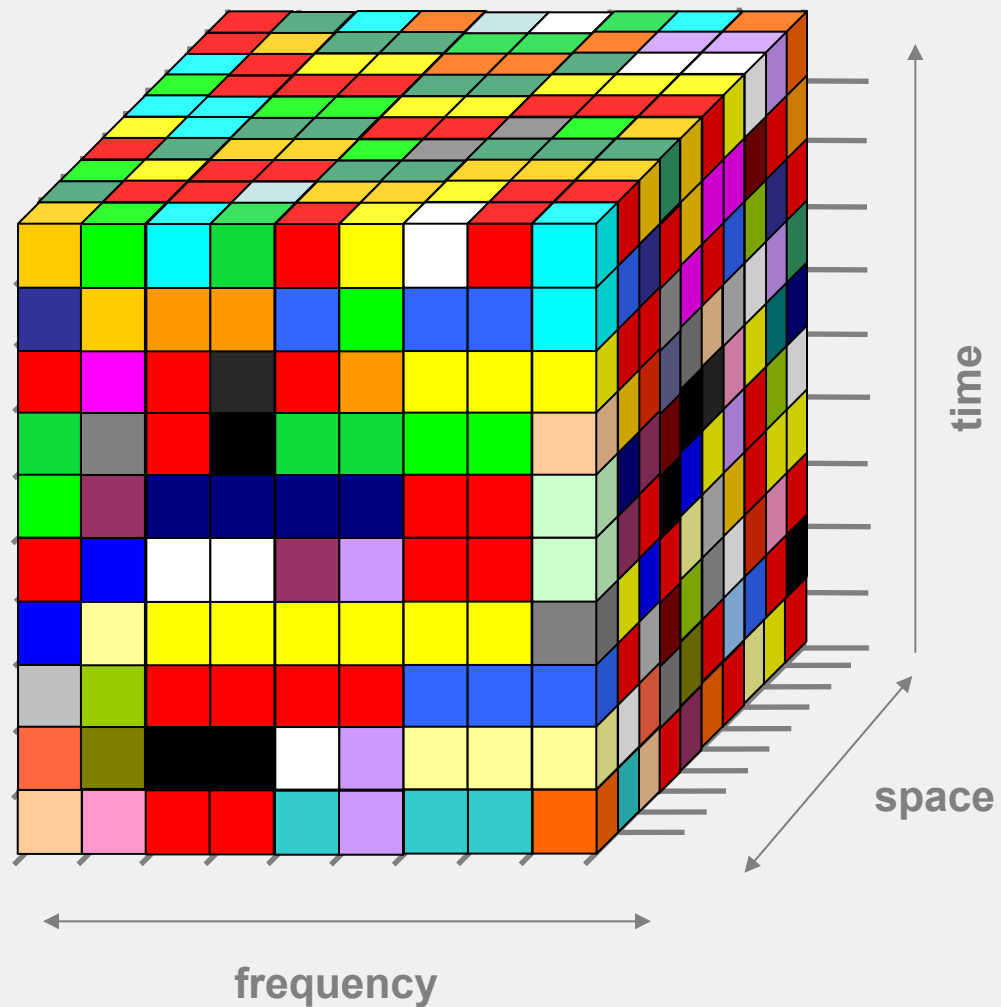
# fluid market-based assignments

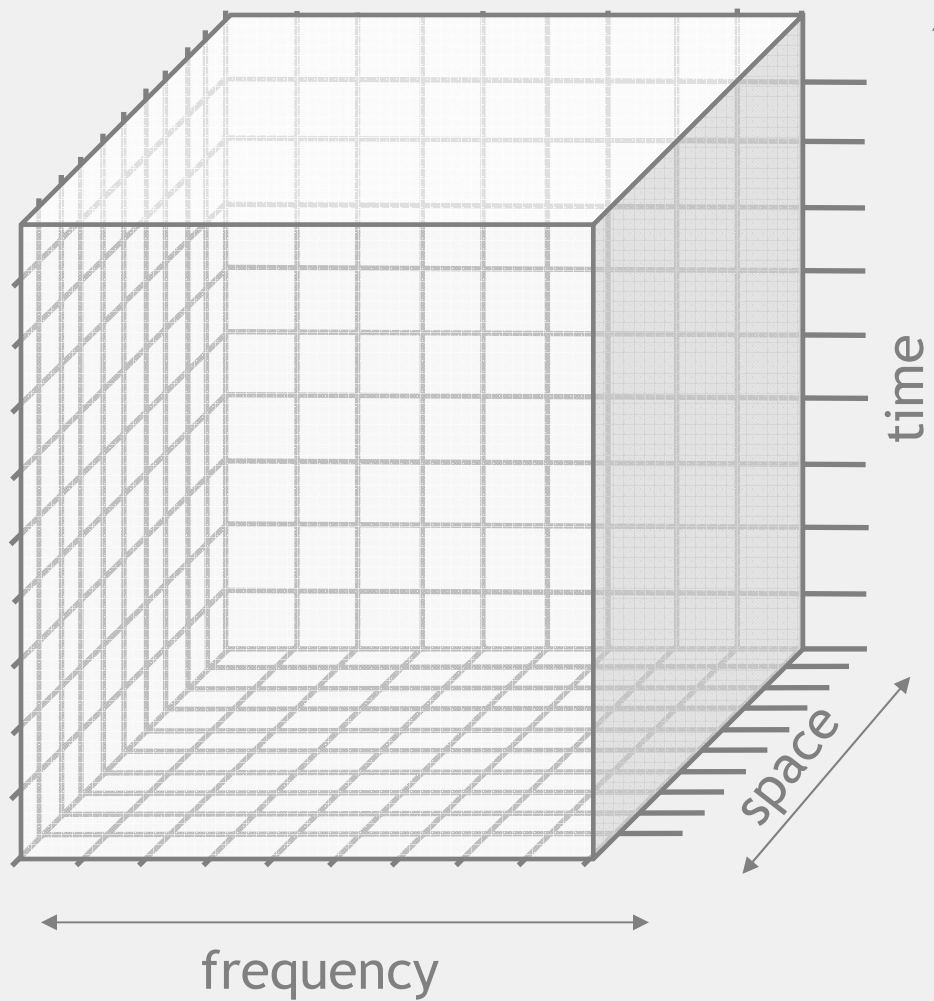


# fluid market-based assignments



# fluid market-based assignments





← + 4 years

← + 1 year

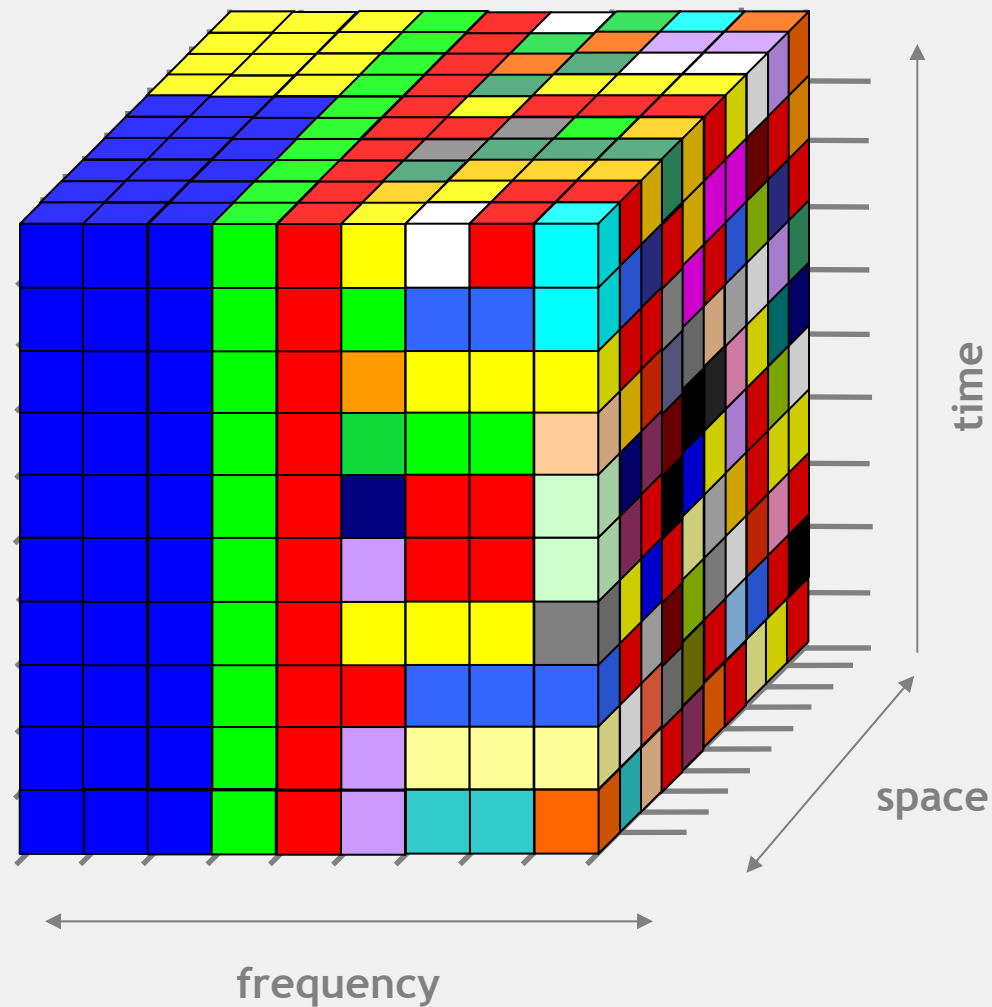
← + 6 months

← now

**SPOT**

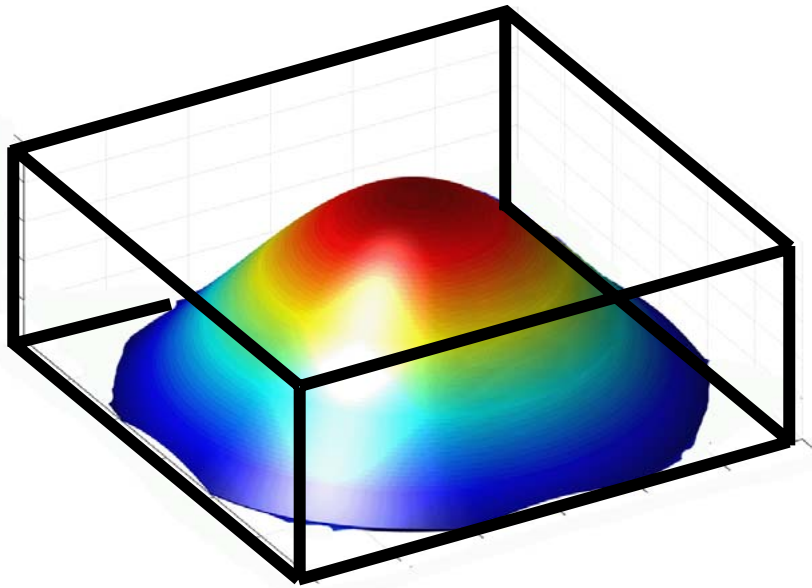
**FUTURES**

# varying granularity of assignment aggregations

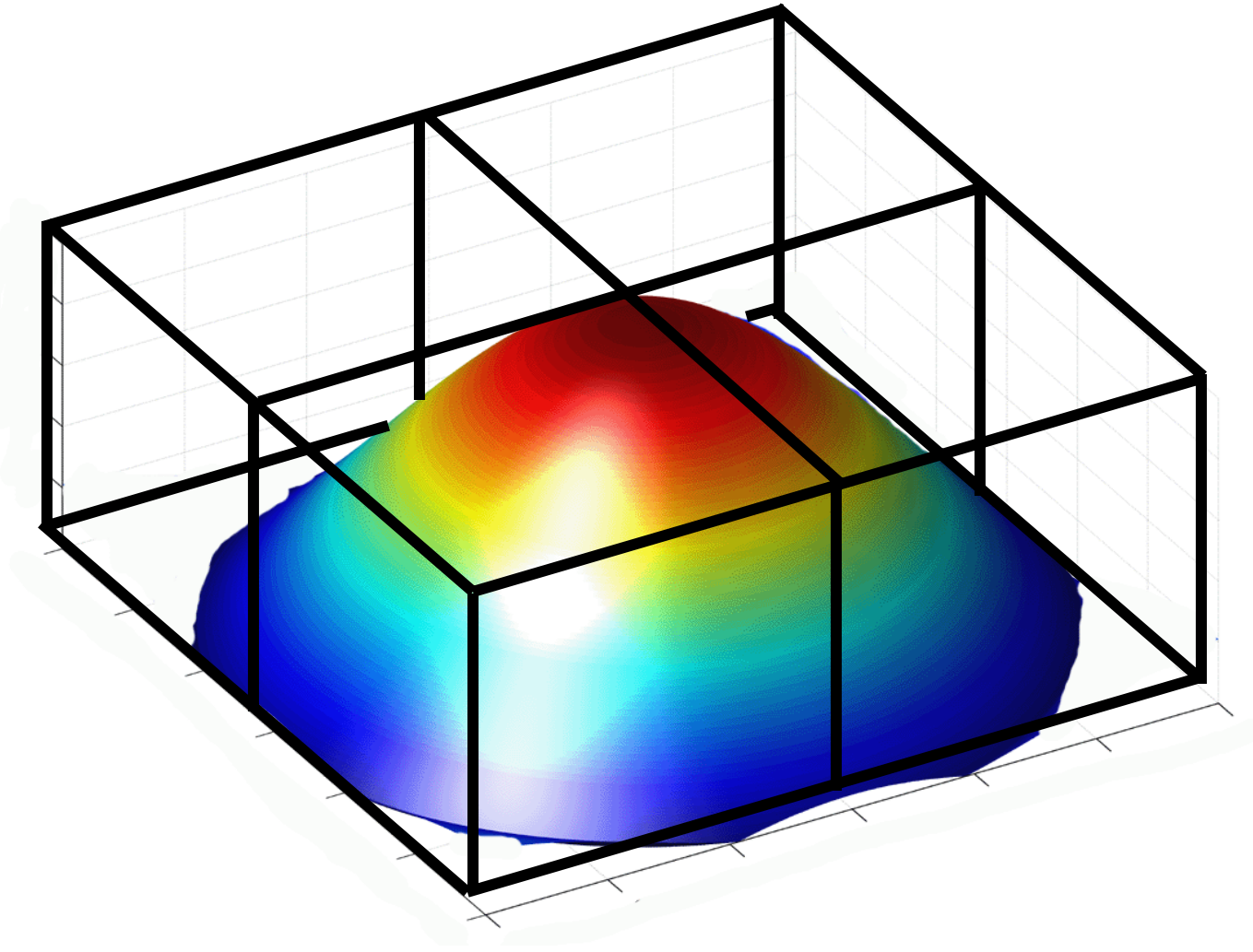




setting the boundaries



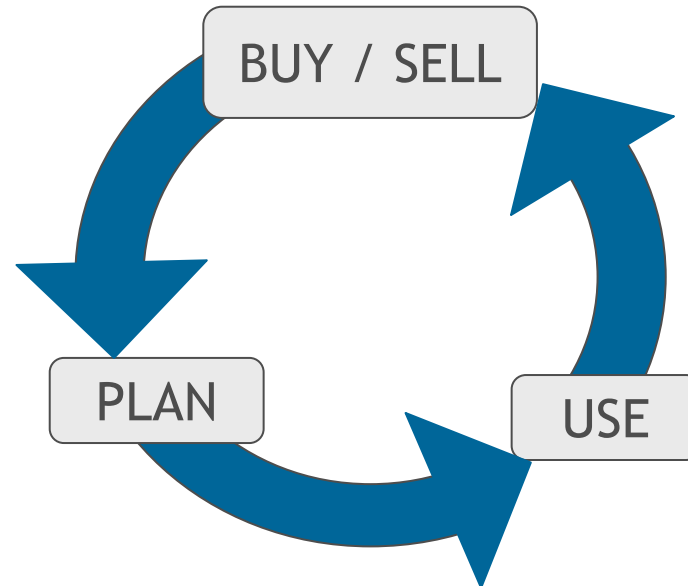
combinations





technology

automated trading floor  
automated buyer/seller/broker/clearing house agents  
associated payment & security



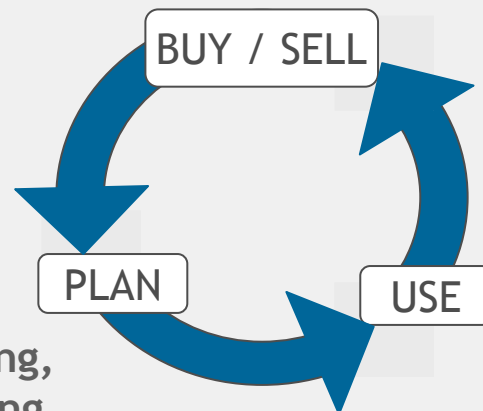
self-organising, self-configuring,  
self-planning, cognitive  
networks  
distributed and disaggregated  
decision-making  
distributed optimisation

**NETWORK**

frequency agile & reconfigurable  
handsets,  
cognitive radios,  
sensing technologies

**NODE**

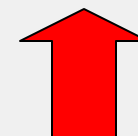
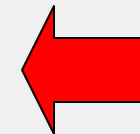
automated trading floor  
automated buyer/seller/broker/clearing house agents  
associated payment & security



self-organising,  
self-configuring,  
self-planning,  
cognitive  
networks  
distributed and  
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**NETWORK**

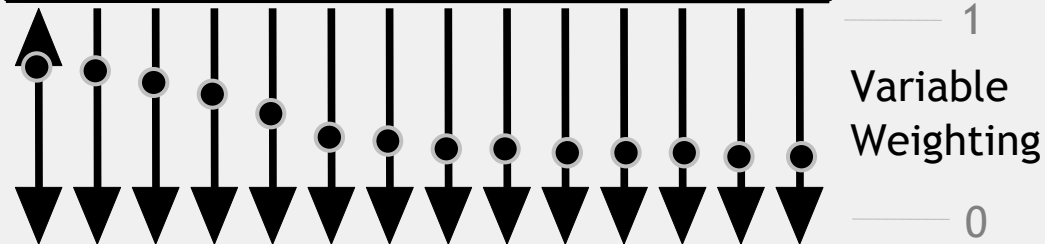
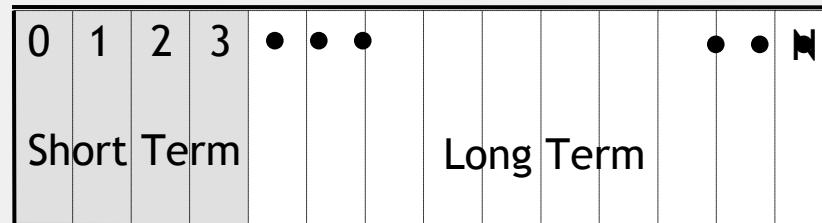
frequency agile & reconfigurable  
handsets,  
cognitive radios,  
sensing technologies

**NODE**



**BEHAVIOURS/  
POLICIES**

Knowledge Representation Delay-Line  
{Memory: Market-Place Observations}



**BUY /  
SELL**

**Decision-Making,  
Reasoning & Learning**

**STRATEGY**

System  
Constraints

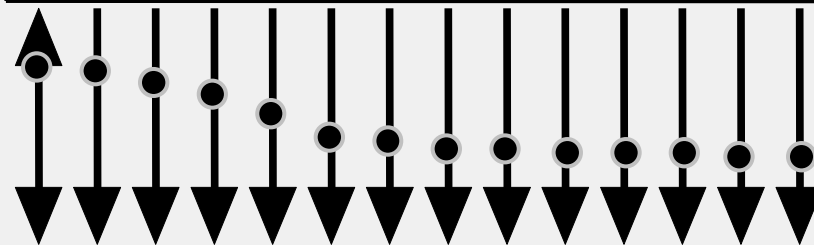
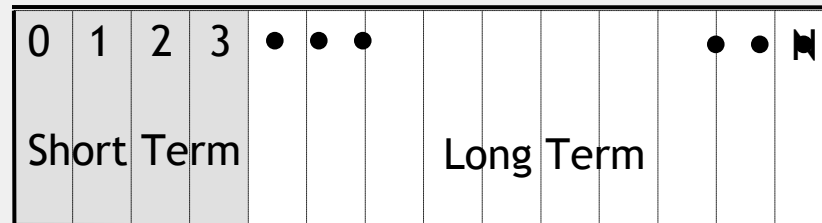
Etiquettes

**Identity**

Regulatory  
Policy

Constraints

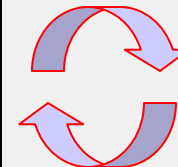
Knowledge Representation Delay-Line  
{Memory: Market-Place Observations}



**BUY**

**Decision-Making,  
Reasoning & Learning**

**STRATEGY**



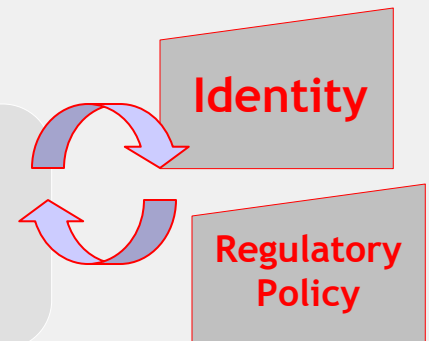
System  
Constraints

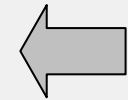
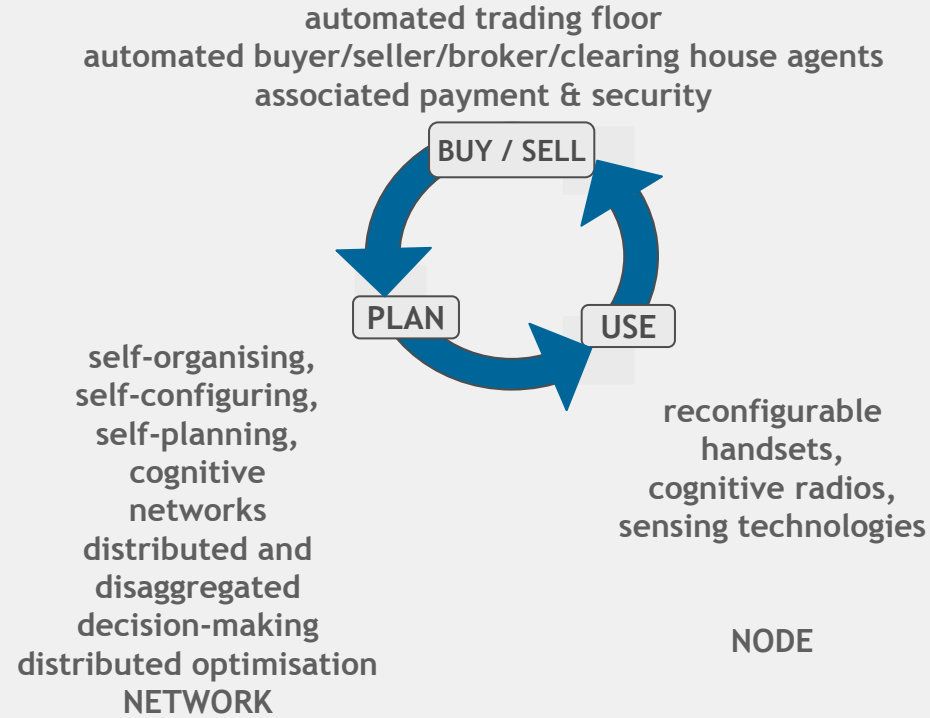
Etiquettes

Identity

Regulatory  
Policy

Constraints





BEHAVIOURS/  
POLICIES



TEST / CERTIFICATION







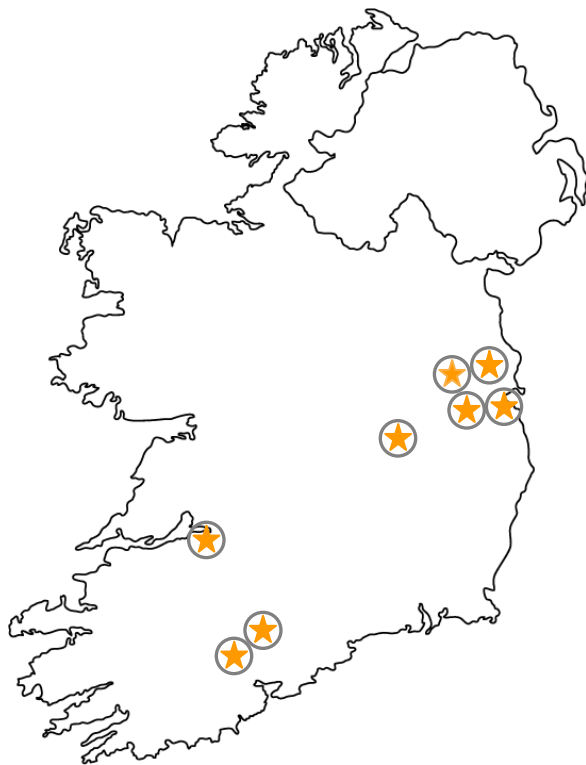
growth

overlay: opportunistic use

market-based primary assignment

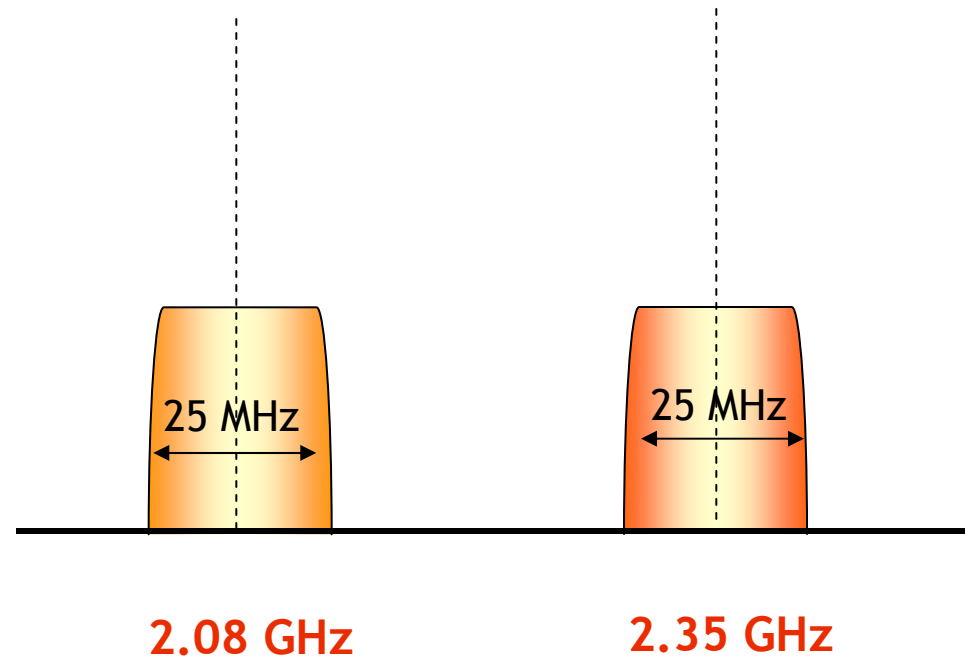
underlay: easement use

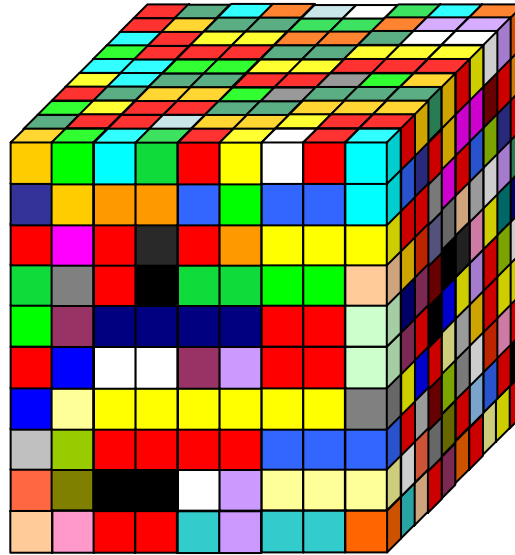
# ComReg Test License Scheme



Transmit Sites

CTVR BANDS





[www.ctvr.ie](http://www.ctvr.ie) | [www.emergingnetworks.info](http://www.emergingnetworks.info)

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# Centre for Telecommunications Value-Chain Research

*CTVR will establish an international leadership position in **industry-guided** research that **redefines** key elements of **telecommunications systems**, architectures and networks and the value chains used to design, build, market and service them. It will leverage this leadership position to contribute to the scientific, commercial and educational infrastructure of Ireland.*

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