Self-Organization within LTE networks:
Is this the end of network planning?

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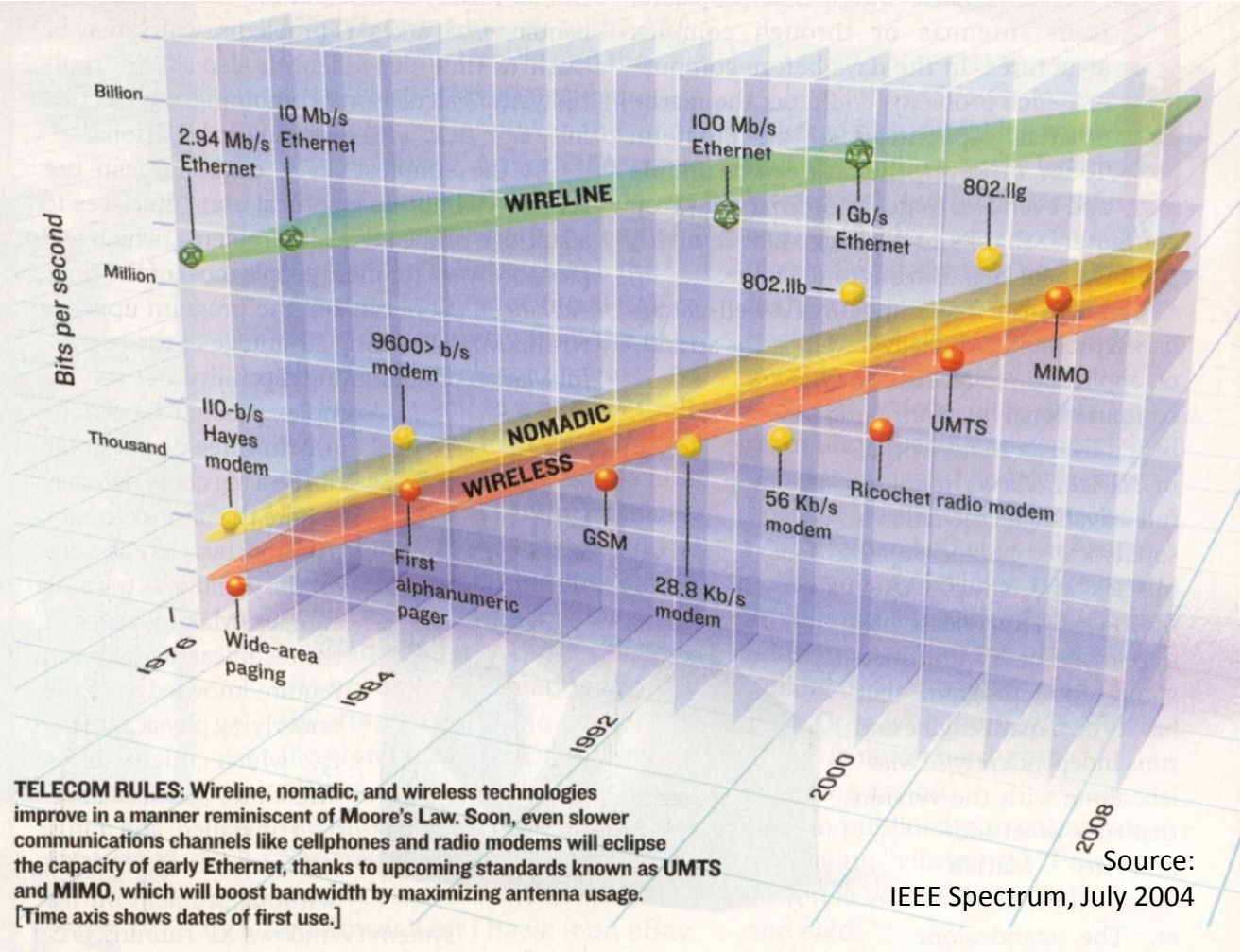
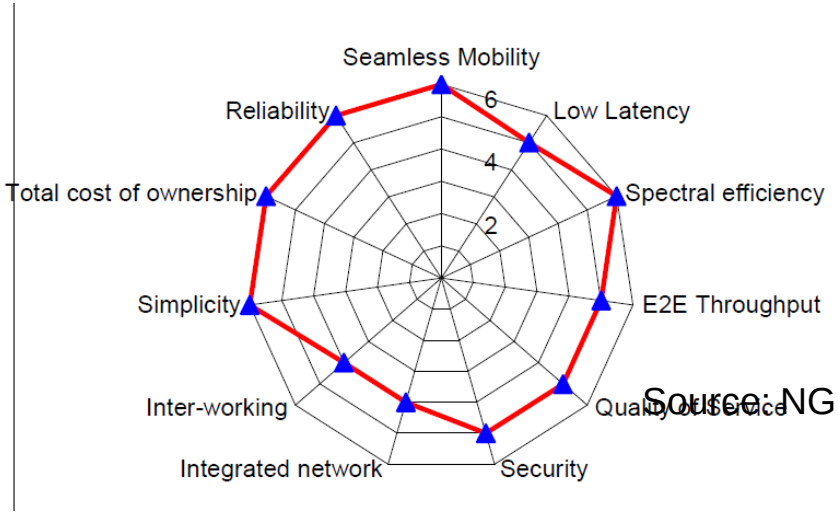


TELECOM RULES: Wireline, nomadic, and wireless technologies improve in a manner reminiscent of Moore's Law. Soon, even slower communications channels like cellphones and radio modems will eclipse the capacity of early Ethernet, thanks to upcoming standards known as UMTS and MIMO, which will boost bandwidth by maximizing antenna usage. [Time axis shows dates of first use.]

Source:
IEEE Spectrum, July 2004

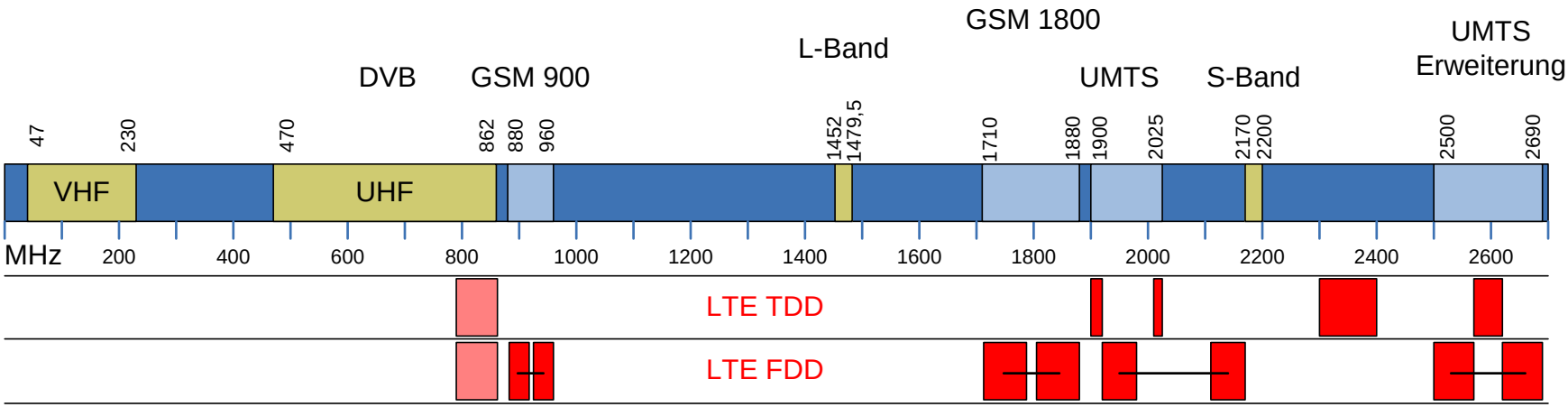
- **Improved performance**
  - Peak *data rates* of at least 100 Mbps in downlink and 50 Mbps in uplink
  - Support of huge *cell radii* (up to to 100 km, reasonable performance up to 30 km)
  - Reduced IP *latency* of at most 5 ms
  - RAN round-trip times of at most 10 ms
  - OFDMA with sub-frame length of 1ms
  - Extended support of MIMO
  - Flexible *bandwidth allocation*



Source: NGMN

- **Reduced network complexity**
  - *IP based* core network
  - Fewer network element types

- **Cheaper to deploy and to maintain**
  - OPEX reductions, e.g., by means of ***self-organising networks (SON)***
  - Reduced power consumption

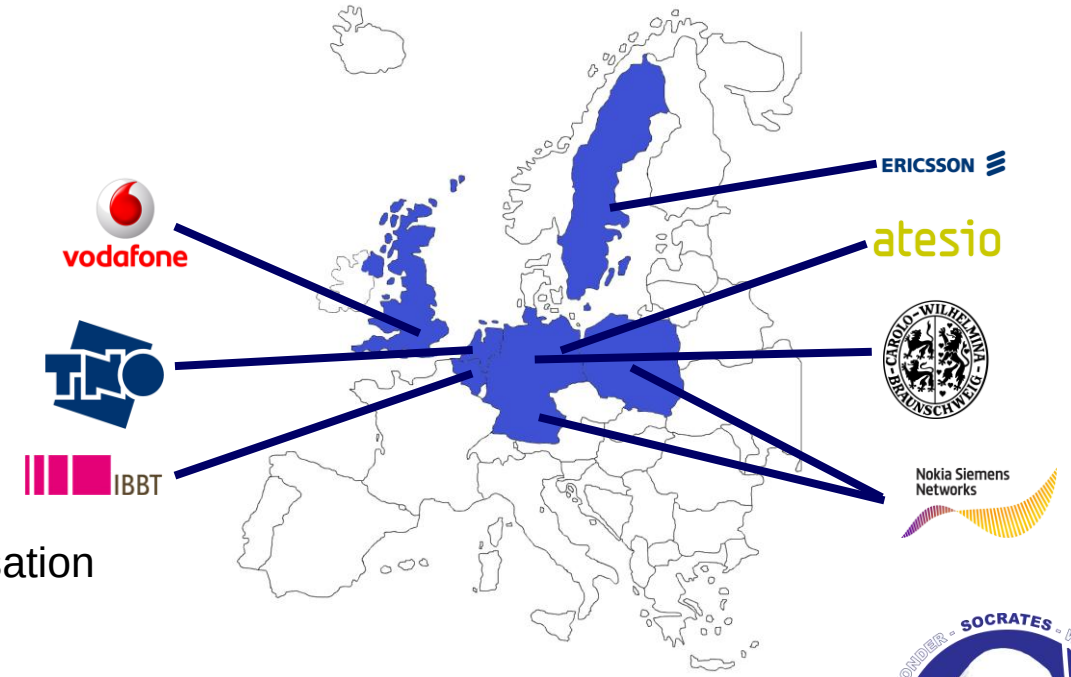


- Large, but scattered spectrum available
  - Flexible migration from existing technologies to LTE
  - High flexibility in spectrum usage required: 1.4, 3, 5, 10, 15, 20 MHz
- Low frequencies allow good areal coverage
- High frequencies offer sufficient bandwidth for high data-rate services
- FDD/TDD bands available

FP7-Project Socrates

- Overview
  - Self-Optimisation and self-ConfiguRATion in wirelEss networkS
  - Technological focus: 3GPP E-UTRAN (LTE)
  - 3-year duration: from 01/01/2008 until 31/12/2010
  - Effort: 378 person months, € 4.980.433

- Objectives
  - Novel concepts, methods & algorithms for *effective self-organisation*
  - Assessment of *operational impact*
  - Validation & demonstration
  - Influence 3GPP standardisation & NGMN activities



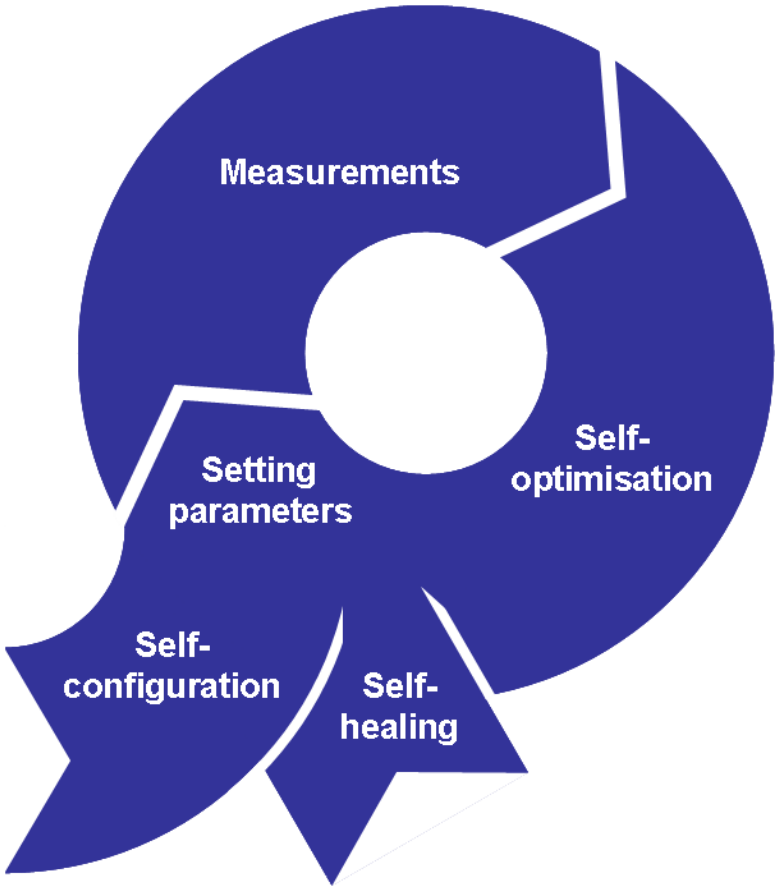
Self-Organisation in the LTE Radio Network

- *Basis*
  Continuous monitoring and measuring within the operational radio network as embedded functionality

- *Self-optimisation*
  Autonomous optimisation of radio network performance

- *Self-configuration*
  (Largely) Automatic configuration of new network elements

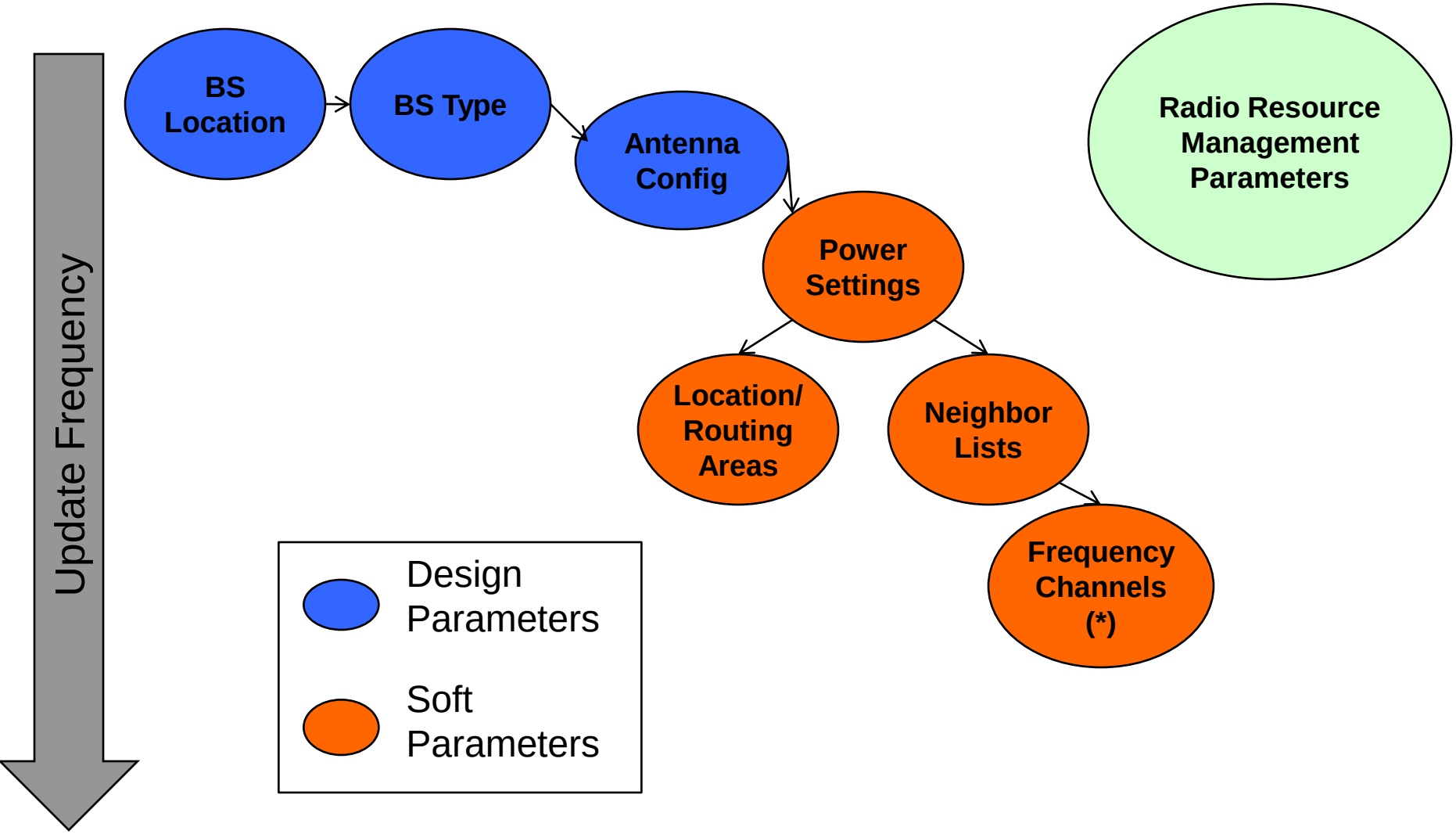
- *Self-healing*
  Autonomous (temporary) adaption of the network configuration in reaction to element failures (compensation)



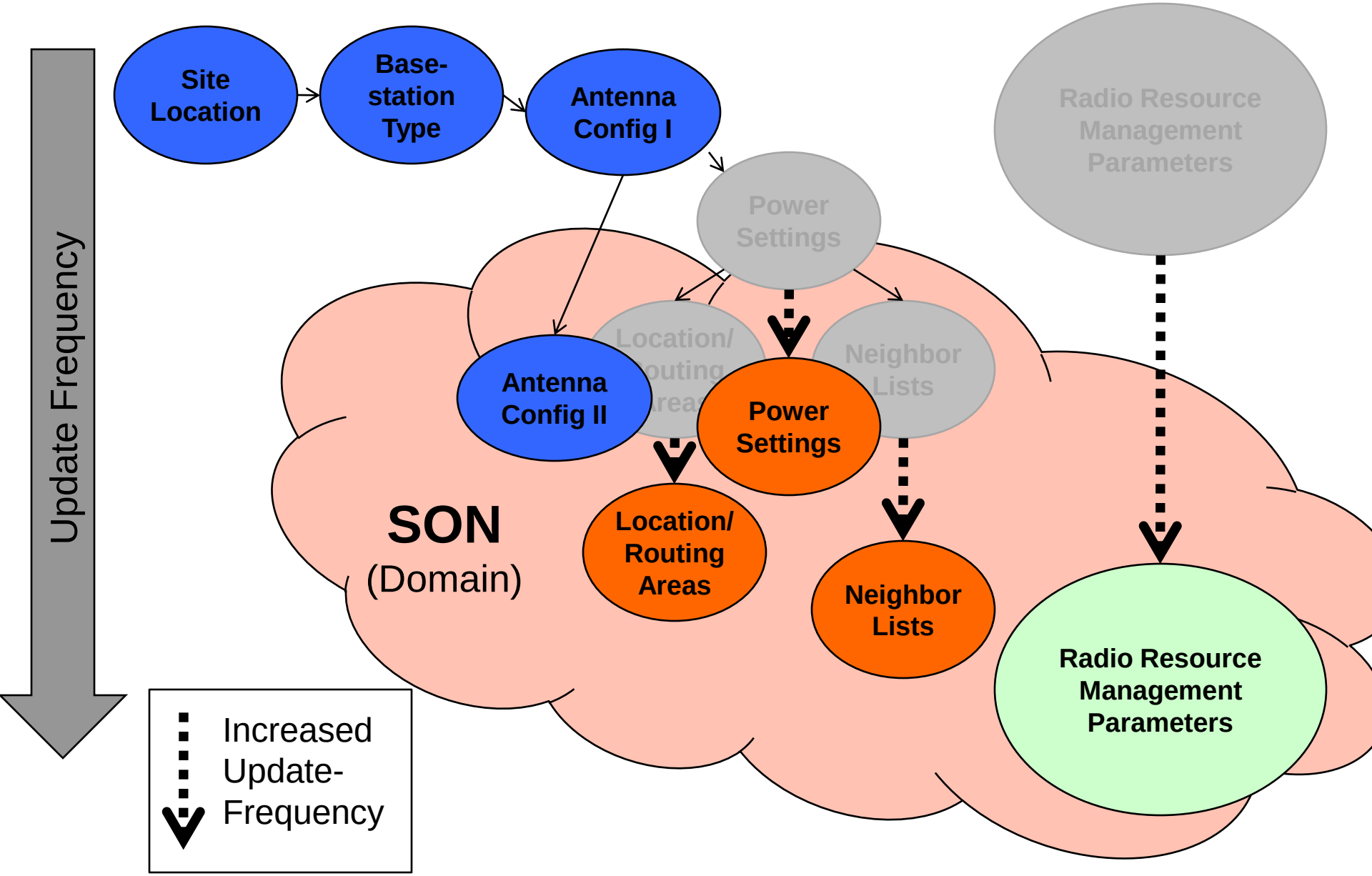
SOCRATES USE CASES

Self-optimisation	Handover parameter optimisation
	Load balancing
	Packet scheduling optimisation
	Admission control optimisation
	Interference coordination
	HeNB handover optimisation
	HeNB interference and cov. optimisation
Self-configuration	Automatic generation of initial params
Self-healing	Cell outage management

Traditional Planning Parameters and Frequency of Updates



(*) Only applicable to some technologies (i.e. GSM)



- State-of-the-art Planning Approach:
  - 80% / 20% principle: 80% effect by optimizing 20% of (relevant) parameters

- **SON** will:
  - Enable the optimization of some of the current planning parameters and in particular **additional parameters**
  - Increase the **update frequency** of planning parameters under control
  - Allow the optimization of **RRM parameters** that were static before

- **SON will not** optimize most of the relevant **network design** parameters:
  - Site (base station) location
  - Antenna parameters:
    sectorization, height, type, azimuth, (mechanical) tilt
  - SON has only limited compensation possibilities: e.g. tilt and beam-forming

- **Multi-Technology Networks**
  - LTE will co-exist with GSM and UMTS networks
  - GSM and UMTS networks to be planned traditionally
  - In addition to intra-system parameters:
    Inter-system parameters to be planned (e.g. traffic/handover control)

- **Frequency Allocation**
  - Multiple frequency bands available
    (GSM, UMTS, and new frequency bands)
  - Technologies compete for available frequencies
  - Deployment strategies to be developed
  - Impact on parameter planning

- **Energy Saving**
  - Energy saving strategies one of main upcoming challenges
  - Network planning has to be take account of energy saving strategies
    (e.g. capacity and coverage layers)

- **Home eNodeB / Femto Cells**
  - Small indoor cells are expected to be integral part of LTE network deployment
  - Installed at customer premises, only under limited control of operator
  - Hardly to be considered in planning
  - But, depending on deployment strategy: Impact might need to be taken into account

- **Non-Stationary Network Configuration**
  - Vital terminology in current network planning:
    - *"One (or The) network configuration"* (optimized for busy hour traffic)
  - New technology development (e.g. SON) will increase frequency of parameter updates
  - Network configuration constantly changing ("floating")

- Self-organising networks (SON) can be expected to exploit additional network capacity and quality
  - In particular more efficient Radio Resource Management (RRM)

- Network design parameters most relevant for network quality and efficiency are mainly not in SON domain
  (i.e. antenna location, sectorization, type, direction)

  ➔Main planning challenges are only partially handled by SON

- With introduction LTE: drastic increase in radio network complexity
  - Already today:
    Complexity can hardly be handled by manual planning

  ➔More automation required

  ➔Change in planning paradigm