Identifying the problem

Scenario to be solved

- relay, cooperative, ad-hoc wireless communications
  - no centralized authority
- many nodes and many terminals with high area density
  - dense interfering environment
- performance criteria
  - throughput, energy/spectrum efficiency, reliability, latency

Classical solution — problems

- interference = major problem
  - interference limited system
- orthogonal resource slicing reduces throughput
- complicated routing signaling overhead & latency
DIWINE Core Concept — Virtual Cloud Relay

Core concept elements

- dense massively air-interacting (relay) nodes in the self-contained cloud
- dense interaction is advantage, interference not avoided but exploited
- stochastically defined intra-cloud structure and connectivity
- terminals PHY/MAC interface to the cloud is simple and uniform
Progress beyond State-of-the-Art

Reserch and Technical Novelty

- Wireless cloud serves as virtual relay to the simple and uniform terminals
  - cloud is self-contained entity with distributed internal processing
  - cloud does not reveal its internal structure/PHY to the terminals

- Wireless Network Coding paradigm inside the stochastically defined cloud
  - transformed data are flooded through the cloud (no routing of individual data)
  - multi-hop stochastically defined networks are exploited in the cloud
  - compare: current WNC requires
    - full knowledge of the end-to-end connectivity structure at all nodes
    - all nodes with individually crafted processing
    - “hand-made” design for very small number of interacting nodes

- Cloud relays/nodes are dense
  - massively parallel signal interactions
  - imperfect/unreliable knowledge of the interacting signal structure and topology
  - interference alignment and interference neutralization
### Utility Targets (UT)

Measurable and evaluable project achievements

- **UT1**  Spectrum and energy efficiency, data throughput
- **UT2**  Robustness, diversity, reliability and weak system state information impacts
- **UT3**  Latency, connectivity and signaling overhead
- **UT4**  Distributed self-adaptation (response time, side information, overhead)
- **UT5**  Dense interfering nodes issues (exploitation of friendly interference)
- **UT6**  Topology specific functionality
- **UT7**  Intra-node and intra-cloud inference and processing (contents processing)

UT1-4 mostly quantitative, UT5-7 mostly qualitative or capability addressing
DIWINE research is generic and applicable in wide range of scenarios

**Proof-of-concept core application cases**

- **System-Level-Simulation** — *Advanced Cloud Scenarios*
  - “glue” between the theory and practical verification
  - allows advanced scenarios

- **HW demonstrator #1** — *Smart Meter Network*
  - natural environment for demonstrating DIWINE concepts
    - cloud virtual self-contained relay
    - distributive processing
  - direct impact on energy and resource savings
  - direct connection to “Smart Cities” platform

- **HW demonstrator #2** — *Critical Industrial Monitoring and Control*
  - verifies DIWINE concepts in terms of
    - robustness
    - critical reliability/latency
  - first project to demonstrate cloud principles in critical industrial scenarios