

# Self-Management Hybrid Wireless Networks Using Autonomic Computing Principles

## M-Zones Research Programme

Chong Shen, Dr. Dirk Pesch and Dr. James Irvine  
 {cshen, dpesch, j.m.irvine}@ieee.org  
 Centre for Adaptive Wireless,  
 Cork Institute of Ireland, IE



# Objective & Aims

Map Autonomic Computing principles to Hybrid Network's Radio Resource Management and Routing

Aim 1: Investigate benefits of Hybrid Networks with fixed infrastructures (Dedicated Routers)

Aim 2: Using Autonomic Computing principles and elaborating systems self-management polices

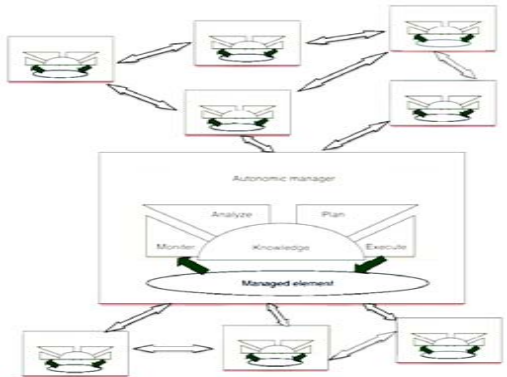
Aim 3: Provide a general structure with the help of Artificial Intelligence techs. such as NN, Fuzzy Logic, and genetic

# Autonomic Computing

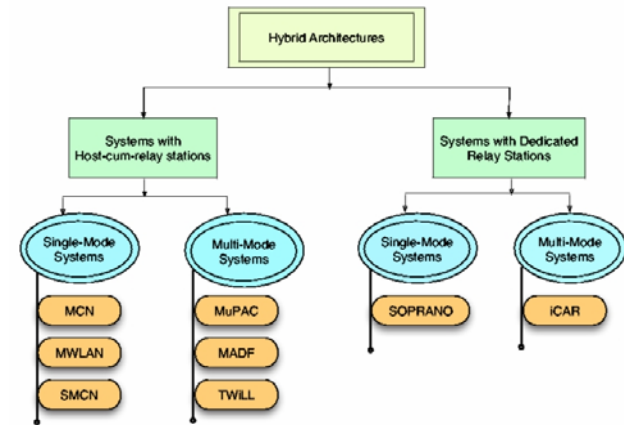
IBM Autonomic architecture is composed of interactive collections of autonomic elements

AEs manage both external and internal behavior according to established policies.

AEs enable self-optimizing, self-protecting, self-configuration and self-healing in AC based systems



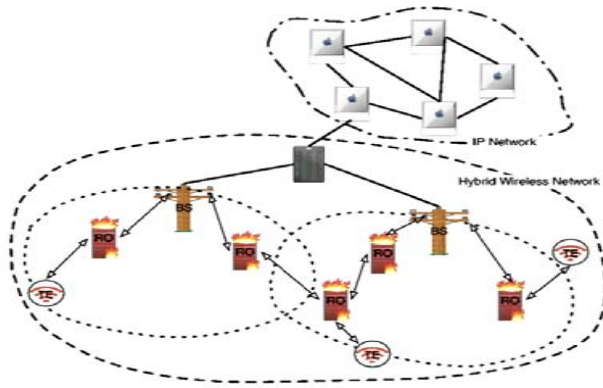
# Hybrid Networks



Hybrid Architectures are classified as systems with dedicated relay stations and systems with host-cum-relay stations (mobile multi-hop relay). Because the cost of reconfiguration and recalculation in mobile multi-hop relay are high and unacceptable. Therefore, dedicated relay stations structures are recommended in our research.



# Hybrid Networks



An increasingly large amount of base sites that share spectrum with mobiles which becomes unmanageable with a centralized management approach. Therefore, focusing on *Autonomic Computing* based self-management can lead to new solutions to overcome the management problem.

BS stands for base station, RO stands for dedicated relay station and TE stands for mobile terminal. An IP network can be incorporated to hybrid network through proper gateway



# Self-Management

Our focus

**Self-configuration** involves automatic incorporation of new components and automatic component adjustment to new conditions. Example: Automatic Routing and Cell Breathing

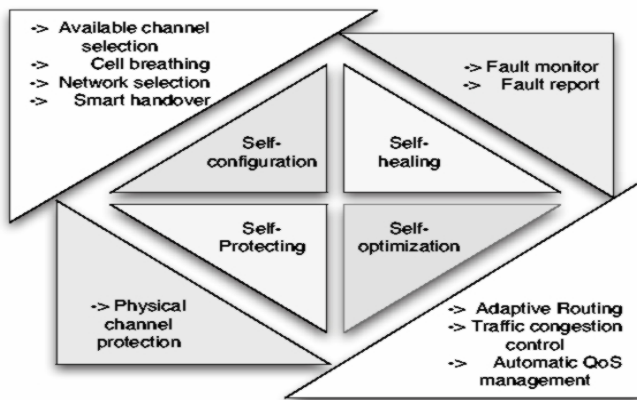
**Self-optimization** is achieved through AI base techniques, a method to do this is to explore, learn and exploit, such as a self-learning circle. Example: Routing Optimization

**Self-healing** from bugs and failures can be accomplished using components for detection, diagnosis and repair.

**Self-protecting** prevents large-scale correlated attacks or cascading failures from permanently damaging valuable information



# Map AC principles

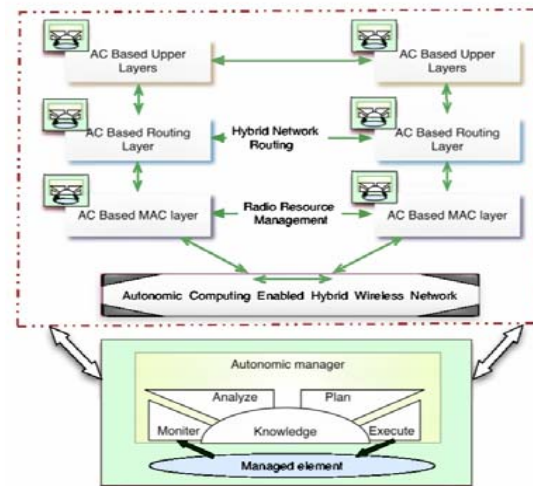


Autonomic Computing principles are mapped to hybrid networks for the benefit of better configuration and optimization and less re-topology-change and re-calculation



# Using AC Principles

AC based hybrid network structure



Routing layer and Radio Resource Management in MAC Layer are given special focus in our research



# Self-Management Policies

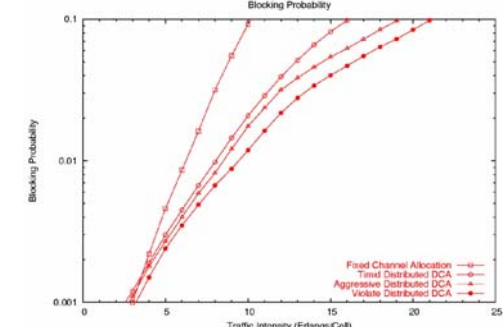
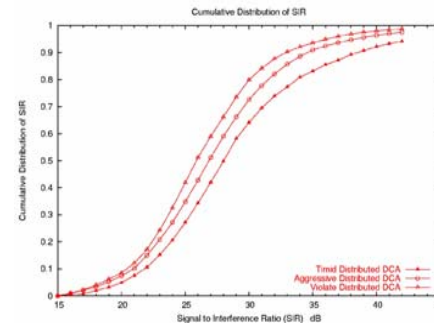
Highest Level	Utility Function Policies	Example: Upper_Limit = 15 (Assign numerical value)
Middle Level	Goal Policies	Example: Base_Station_Capacity must not exceed Upper_Limit
Lowest Level	Action Policies	Example: IF Base_Station_Capacity > Upper_Limit (Condition) Then Using_RelayStation_Nearby (Action)

Based on previous experience of the hybrid wireless system we can design a Neural Network to train adaptive policies to achieve self-management.

Three policies examples: Utility, Goal and Action policies respectively



# Distributed DCA in Mac Layer



Distributed channel allocation facilitates self-configuration at the MAC layer, where channel assignment decisions are made by individual base stations.



# Conclusions

In this paper, the concept of self-management for hybrid wireless networks based on autonomic computing principles is discussed.

We outlined the AC background and its requirements for self-configuration and self-optimization are discussed.

TDD-CDMA based cellular network with a relay station architecture as the test bed of our AC based study as it lends itself to self-management.

