A Self-Organizing SDN Architecture for Mobile Tactical Edge Networks

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Bringing SDN to the Mobile Tactical Edge

SDN benefits:

- Global network view and centralized control
- Optimal and flexible routing

Challenges in highly dynamic networks:

- High overhead and slow network reconfiguration
- Heavy reliance on the remote SDN controller

Overview

A hierarchical architecture with two novel features.

- *Dynamical network partitions in a self-organizing manner;*
- *Temporary local controller assigned with control functionalities.*

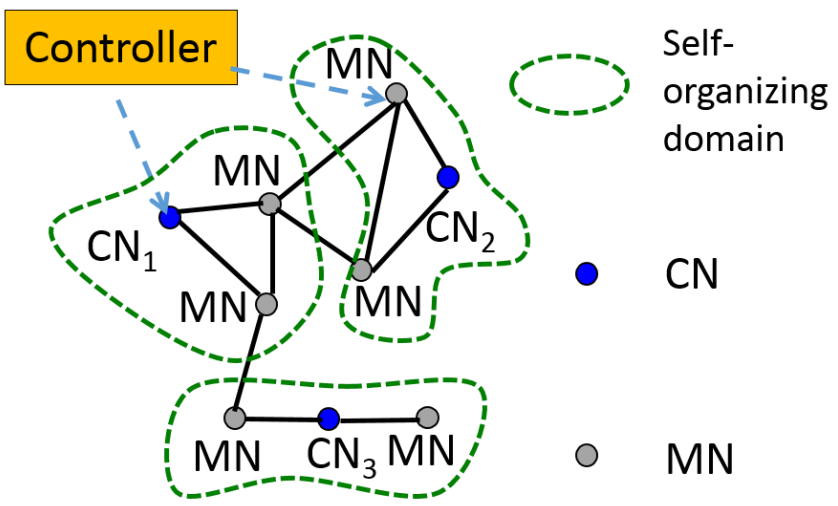

Figure 1: Illustration of a network with 3 self-organizing domains.

Network components:

- CN (Controller Node): the temporary local controller in each domain
- MN (Member Node) : the controllable mobile asset, such as UAVs, robots, vehicles
- Controller: the central logic controller

Protocol

Neighborhood Discovery

Broadcasting a HELLO message contains:

- *ID*: the belonging ID
- CN_p: the potential CN
- $\{MN_p\}$: the potential MNs
- *MNCP*: the maximum number of coexisting peers by joining CN_p with a given average control plane bandwidth ---- *reflect the control plane cost*

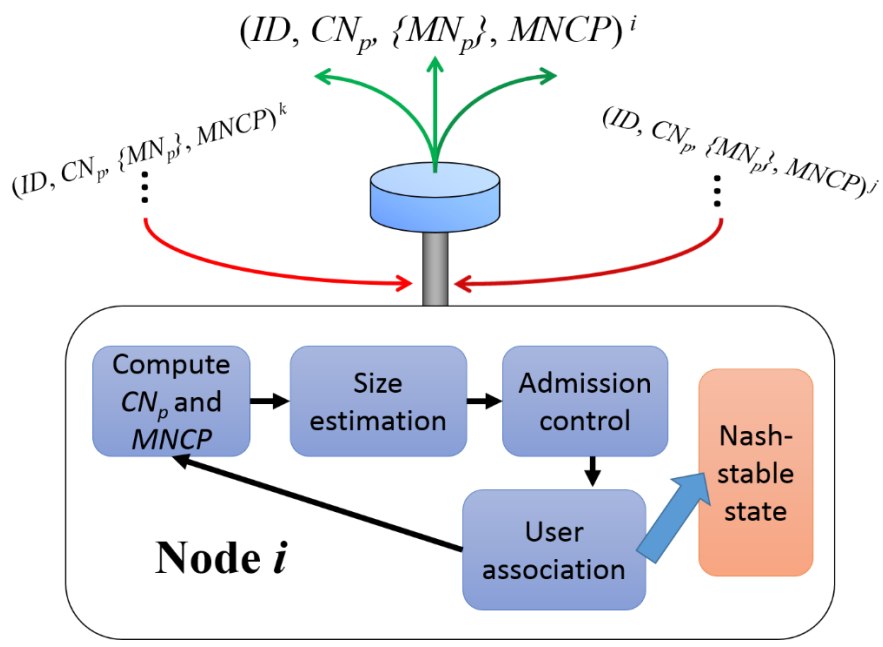

Figure 2: Illustration of the neighborhood discovery and the algorithm.

Distributed Game-theoretic Algorithm

Our idea is to *formulate the dynamic partitioning as a hedonic coalition game based on MNCP.*

- A local optimal solution to minimizing the control plane cost
- *All players can converge to a Nash-stable state* with the domain size k^{NS}.

$$k^{NS} = \inf_k k < MNCP_i \qquad \forall i = 1, 2, ..., k.$$

Abstraction of Dynamics

- User handoff;
- Controller substitution.