

Self-Organizing Network (SON) Principles

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Venue:

IEEE 802.16m-08/040: Call for Comments and Contributions on Project 802.16m System Description Document (SDD), on the topic of “Self-Organizing Networks (SON)”.

Base Contribution:

N/A

Purpose:

To be discussed and adopted into the 802.16m SDD by TGM.

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SON Definition

- A self-organizing network is an open network that can under the control of the operator
 - control itself to resolve systematic issues of performance and availability
- Issues are systematic when they persist over time or space.

SON High Level Requirements

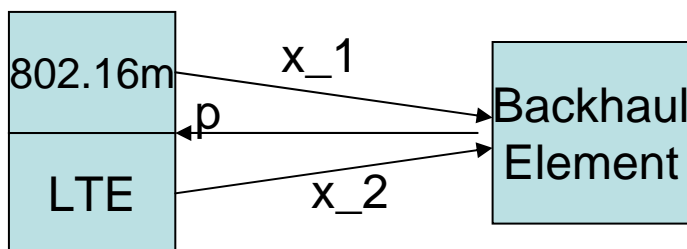
- SON solutions must be open
 - Allowing multi-vendor environment within the across RANs
- SON solutions must be inter-RAT
 - Distributed architectures
 - Message passing using universal standards (e.g. SON XML schemas)
 - Easily modifiable when old RAT is replaced with new RAT

SON Primitives

- SON primitives are elementary information types for performance and availability control
- Example Primitives
 - Price
 - Demand (Load)
 - Power
 - Time
 - ...
- Primitives are used to derive other quantities e.g. calculate derivatives with respect to other primitives etc.

Example 101

- Problem: self-optimize the UL load of two carriers sharing a backhaul link of capacity c .
 - One carrier is a 10 MHz 802.16m and the other a 20 MHz LTE-FDD.
- Primitives: Demand 1 (d_1), Demand 2 (d_2), Congestion Price (p), Demand (c)



Example 101 (cont)

- Each carrier (node) must control its own demand based on:
 - a single congestion price sent by SON
 - own latent utility (U)
 - Latent is a variable/quantity that is not revealed.
 - The value of the
- SON does not need to know each node's utility → Distributed control

Example 101 (cont)

$$\begin{aligned} & \max_{x_s} \sum_s U_s(x_s) \\ \text{subject to} & \sum_{s \in \mathcal{S}(l)} x_s \leq c_l, \quad l = 1, \dots, L \end{aligned}$$

- Primal-dual formulation of the above optimization problem leads to an equivalent problem that can be solved by the individual nodes (carriers). Indeed,

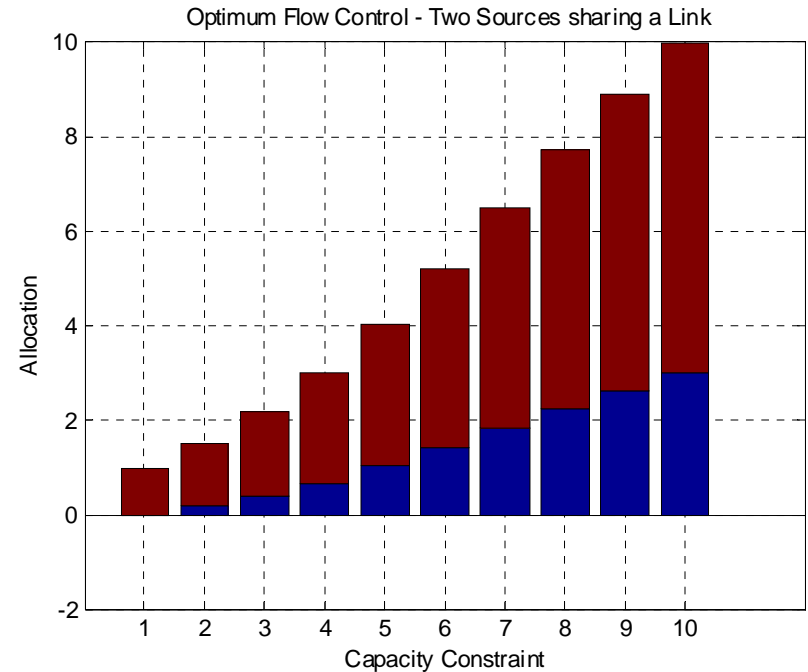
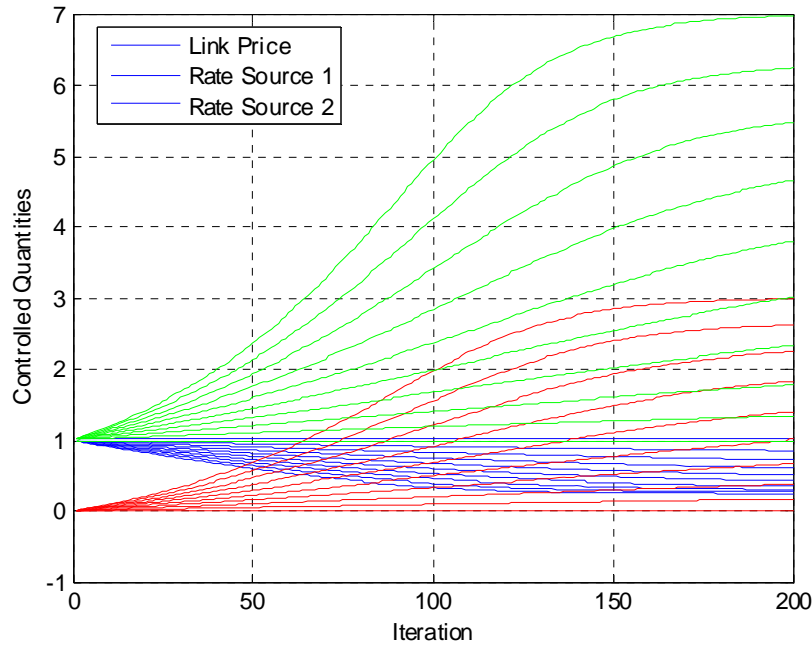
Example 101 (cont)

$$\begin{aligned} & \min_p g(p) \\ & \text{subject to } p \geq 0 \end{aligned}$$

$$\begin{aligned} g(p) &= \sup_{x_s} L(x, p) \\ &= \sum_s \max_{x_s} (U_s(x_s) - x_s p^s) + \sum_l p_l c_l \\ p^s &= \sum_{l \in L(s)} p_l. \end{aligned}$$

- If the dual-optimum price p^* is sent to the nodes, each node can calculate its optimal load (rate) without revealing its (latent) Utility.
- Arriving at the optimal p^* can be achieved iteratively.

Example 101 (cont)



- Convergence to optimal load (left)
- Optimal loads (right)

802.16m SON

- 802.16m must
 - agree on SON first principles
 - define own SON primitives
- Liaise with other SDOs to define unified methods for inter-RAT SON messaging

Proposed Text For SDD

x. SON

x.x ...