# 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.

# 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

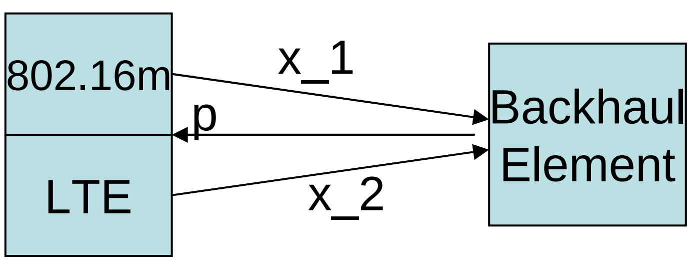
- SON solutions must be open
  - Allowing multi-vendor environment within the across RANs
- SON solutions must be inter-RAT
  - Distributed architectures
  - Message passing using universal standards (e.g. SON XML schemas)
    - Easily modifiable when old RAT is replaced with new RAT

# SON Primitives

- SON primitives are elementary information <u>types</u> for performance and availability control
- Example Primitives
  - Price
  - Demand (Load)
  - Power
  - Time
  - …
- Primitives are used to <u>derive</u> 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 (d1), Demand 2 (d2), 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)

$$\max_{x_s} \sum_s U_s(x_s)$$

$$\text{subject to} \quad \sum_{s \in S(l)} x_s \leq c_l, \quad l = 1, ..., L$$

- 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)

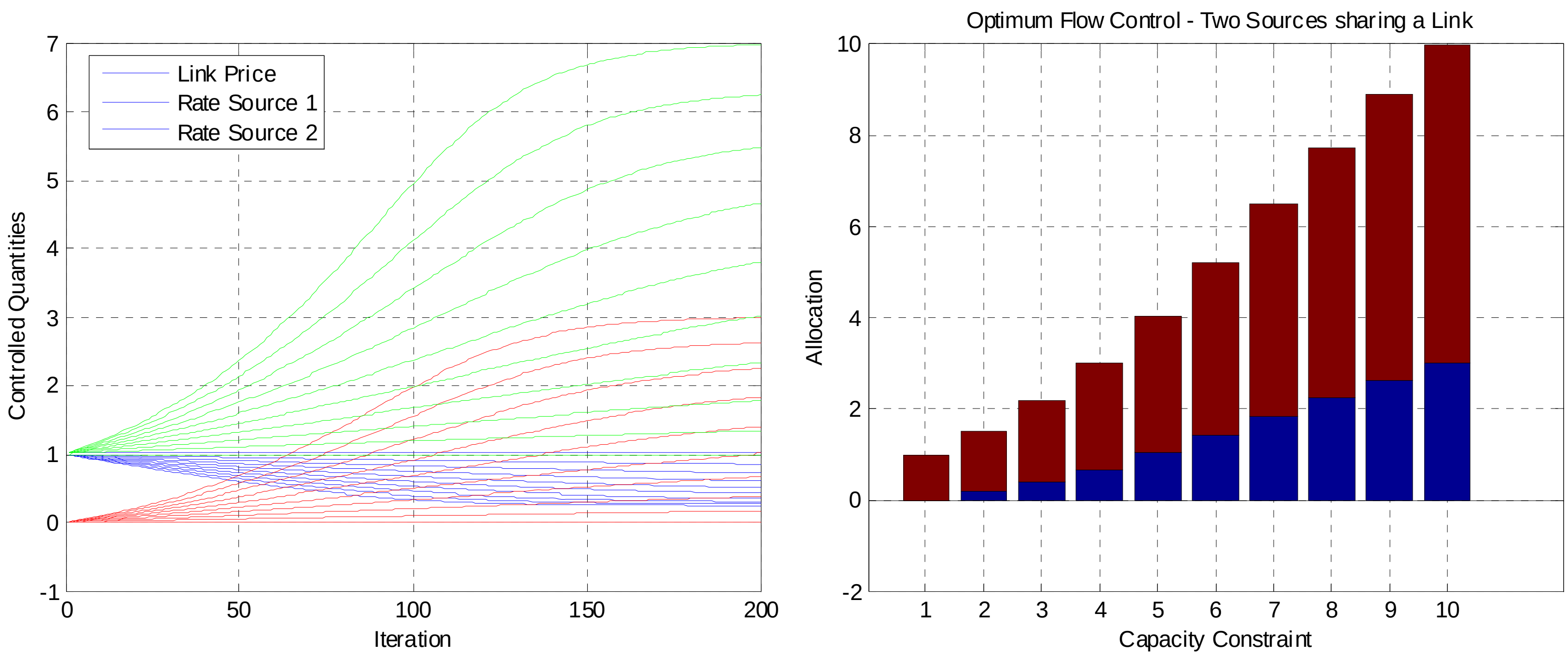
$$\min_{p} g(p)$$
$$subject\ to \quad p \geq 0$$

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

$$p^s = \textstyle\sum_{l \in L(s)} p_l.$$

- 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 …***