COEXISTENCE OF MULTIPLE SECONDARY NETWORKS IN TVWS
(DISTRIBUTED BEACON APPROACH)
Date: 2010-05-18

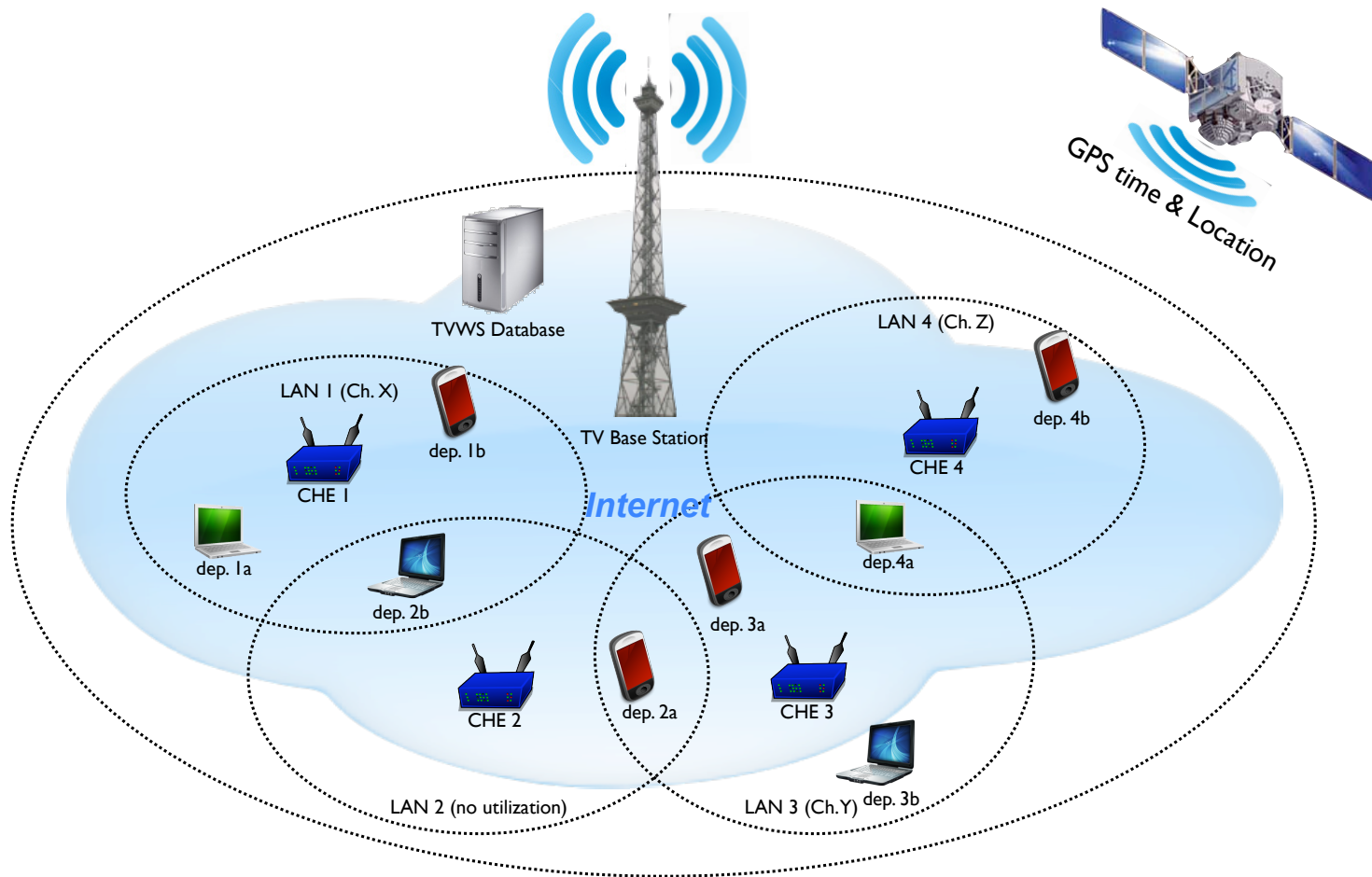## Authors:

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DISTRIBUTED BEACONS PURPOSE

■ The main purpose of TVWS Coexistence through distributed beacons approach is to allow harmless coexistence between secondary networks while offering an alternative to the method utilizing "Coexistence Discovery and Information Server".

■ The distributed nature of the approach enables structureless beacon implementation. Neither infra-structured beacon networks nor beacon operators are necessary.

COEXISTENCE SCENARIO 1 - HOMOGENEOUS

GPS time & Location

TVWS Database

LAN 4 (Ch. Z)

LAN 1 (Ch. X)

dep. 4b

dep. 1b

TV Base Station

CHE 4

CHE 1

Internet

dep. 1a

dep.4a

dep. 2b

dep. 3a

dep. 2a

CHE 2

CHE 3

LAN 2 (no utilization)

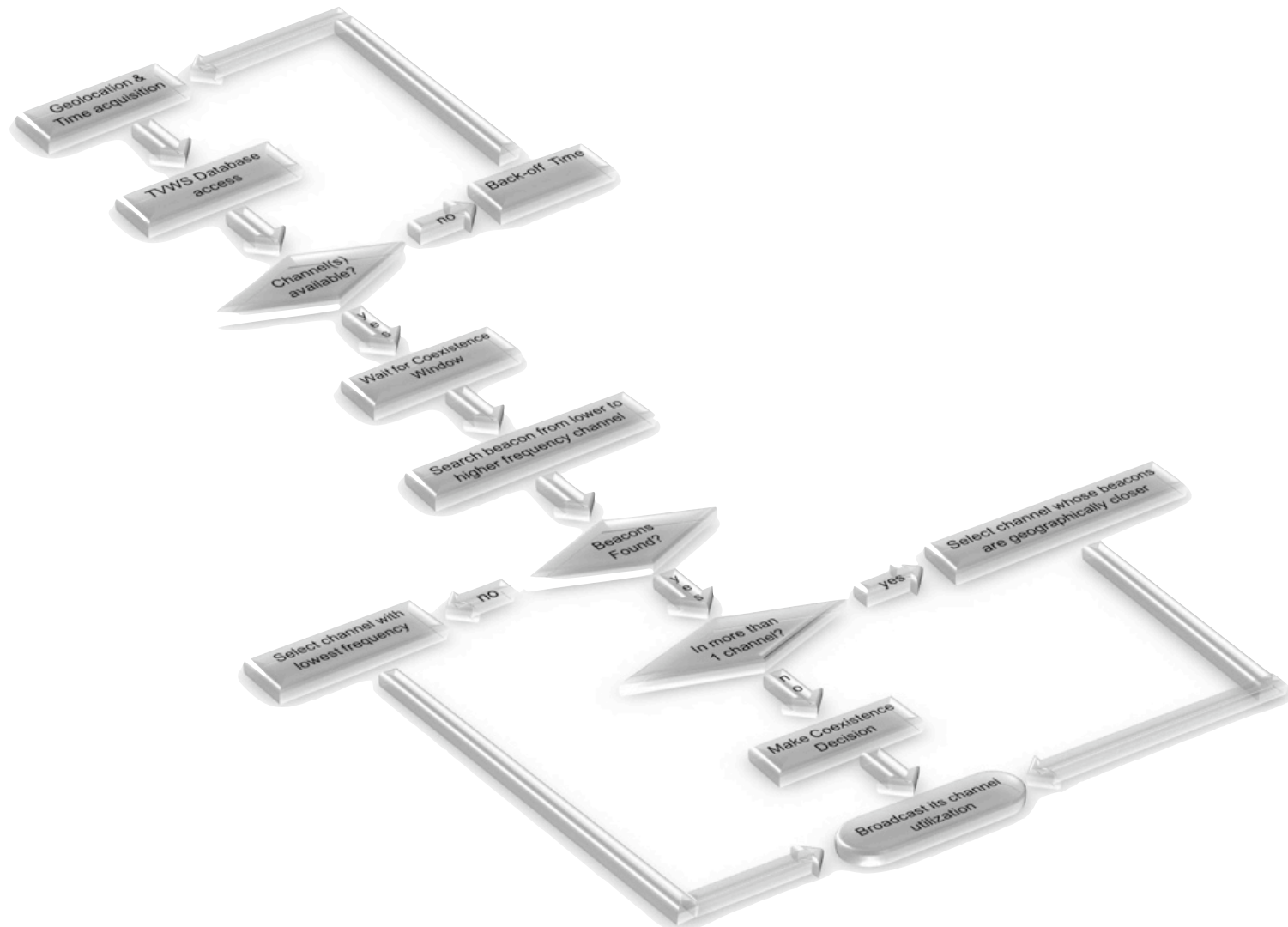LAN 3 (Ch. Y) dep. 3b

HOMOGENEOUS NETWORKS

PROCEDURE FOR COEXISTENCE BETWEEN CHEs:

1. The initiating CHE check its geo-location and its time through GPS.

2. The initiating CHE access the TVWS database to get a list of available channel(s) in its location.

3. Upon availability of TV channel(s), the initiating CHE identify the broadcast channel.

4. During the "coexistence window" , the initiating CHE receives beacons from already established CHEs, which are likely to be in its interference range, with specific information regarding geo-location, spectrum utilization, Tx power, QoS and etc.

5. The initiating CHE makes a coexistence decision in autonomous manner regarding which TV channel to access (out of a subset of unoccupied channels) and how to access it.

6. The initiating CHE broadcasts its updated channel utilization (i.e, time, frequency, code).

7. The initiating CHE informs its dependent stations which TV channel they should utilize for communication.

8. The dependent stations start communication during the "communications window".

SOME PRE-DEFINED RULES TO ALL SCENARIOS

- To identify the <u>broadcast channel</u>, search for the beacon from the lowest to the highest frequency TV channel.

- If there is no <u>broadcast channel</u> (or no beacon could be found in the set of available channels), it should be selected as the lowest frequency available TV channel.

- If more than one <u>broadcast channel</u> is identified, selects the one which has beacons of CHEs in closer geographical location.

- The <u>coexistence window</u> starts every "x" seconds (GPS time) and lasts for "α" seconds.

- Randomly, selects its beacons Tx time within the <u>coexistence window</u> or utilize fixed time-slots TX for established CHEs with empty time-slots for new comers.

- The <u>coexistence window</u> should have a length that yields a predetermined low beacon collision rate, i.e., 3 CHEs -> "x" seconds; 4 CHEs -> "y" seconds).

- Dependent stations should listen for the enabling message containing their network ID in order to get information on which channel to access and how to access it.

FLOW CHART - HOMOGENEOUS NETWORKS
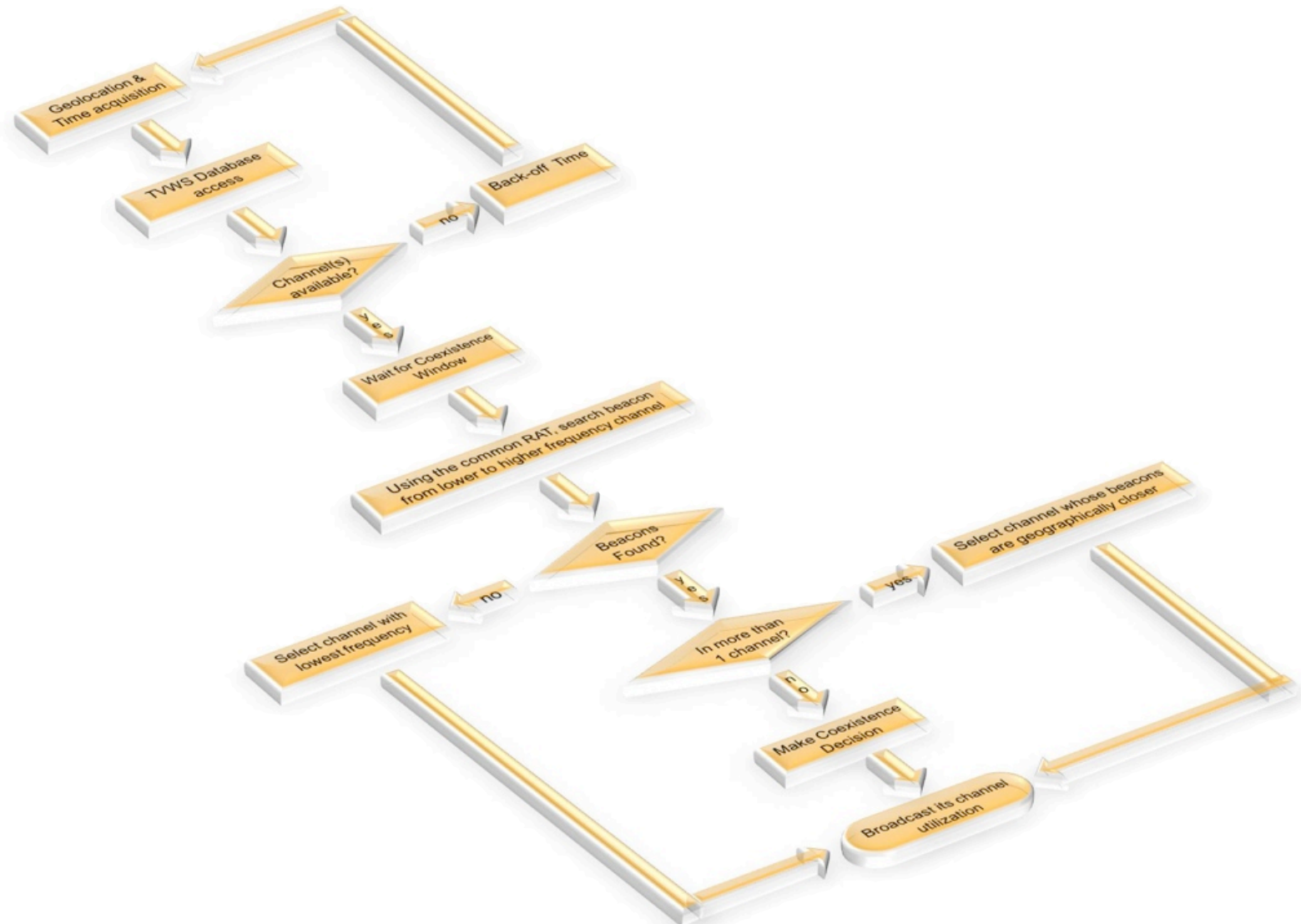
COEXISTENCE SCENARIO 2 - HETEROGENEOUS (A)
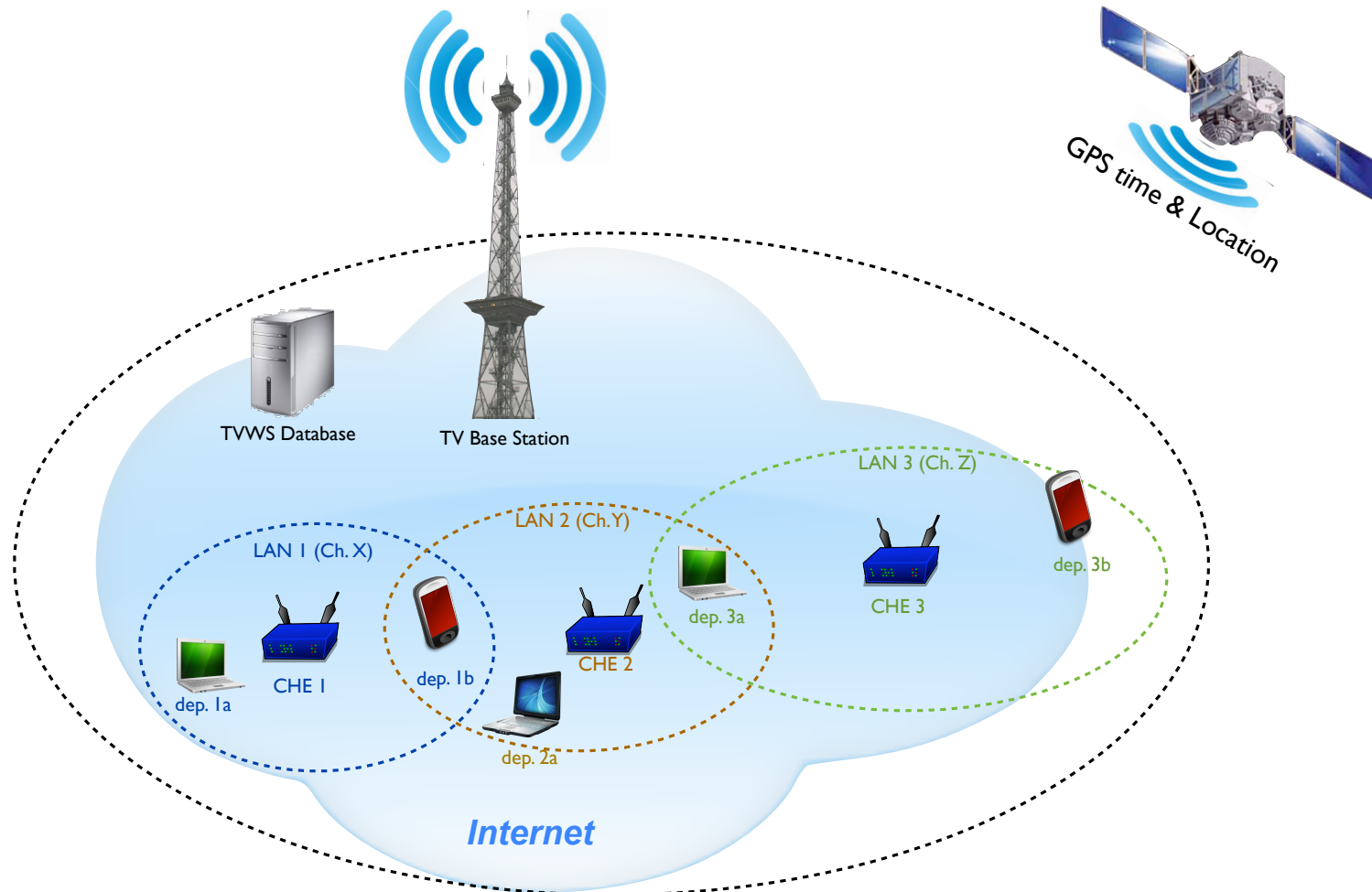
HETEROGENEOUS NETWORKS (A)
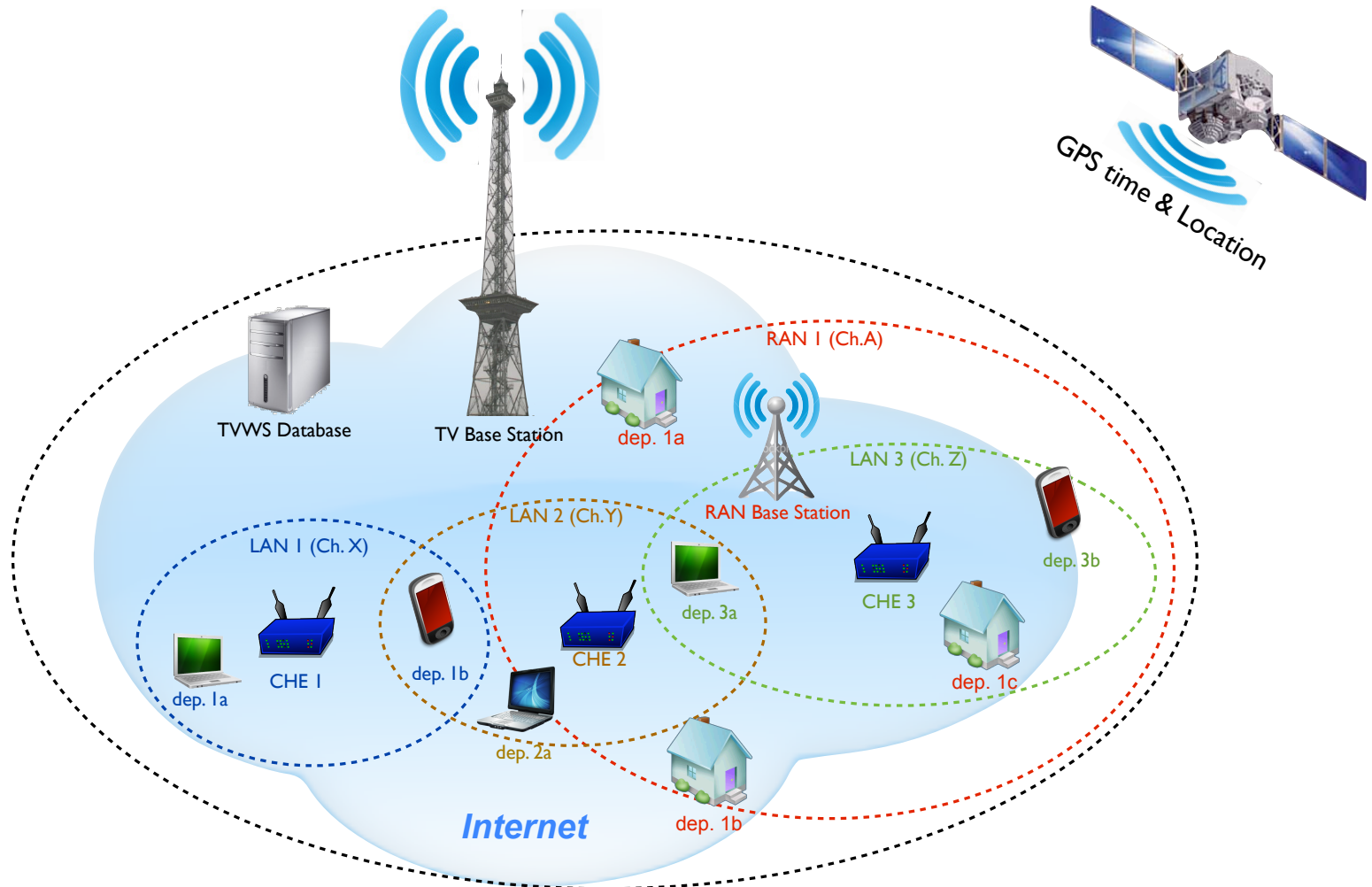
* **CHE is a dual-radio device**

PROCEDURE FOR COEXISTENCE BETWEEN DUAL-BAND CHES:

1. The initiating CHE check its geo-location and its time through GPS.

2. The initiating CHE access the TVWS database to get a list of available channel(s) in its location.

3. Upon availability of TV channel(s), the initiating CHE switches to the common RAT to identify the broadcast channel.

4. During the "coexistence window" , the initiating CHE receives beacons from already established CHEs, which are likely to be in its interference range, with specific information regarding geo-location, spectrum utilization, Tx power, QoS and etc.

5. The initiating CHE makes an autonomous coexistence decision regarding which TV channel to access (out of a subset of unoccupied channels).

6. The initiating CHE broadcasts its updated channel utilization (i.e, time, frequency, code).

7. The initiating CHE informs its dependent stations on which TV channel they should utilize for communications.

8. The dependent stations start communication during the "communications window".

FLOW CHART - HETEROGENEOUS NETWORKS (A)

COEXISTENCE SCENARIO 2 - HETEROGENEOUS (B)

HETEROGENEOUS NETWORKS (B)

* **CHE is a dual-radio device**

* **Wide coverage area network base stations need not be dual-band**

**PROCEDURE FOR COEXISTENCE BETWEEN DUAL-BAND CHEs AND BASE STATIONS:**

1. The initiating CHE check its geo-location and its time through GPS.

2. The initiating CHE access the TVWS database to get a list of available channel(s) in its location.

3. Upon availability of TV channel(s), the initiating CHE switches to the common RAT to identify the broadcast channel.

4. During the "coexistence window" , the initiating CHE receives beacons from already established CHEs, which are likely to be in its interference range, with specific information regarding geo-location, spectrum utilization, Tx power, QoS and etc.

5. The initiating CHE makes a preliminary autonomous coexistence decision regarding which TV channel to access (out of a subset of unoccupied channels).

6. The initiating CHE broadcast a beacon in this channel requesting any device from the wide range dissimilar network to report its presence through beacon (IP address, Tx power, required QoS and etc). Received beacons are considered to be in interference range.

7. Initiation CHE makes a final autonomous decision on which channel to access and how to access it.

8. The initiating CHE informs its dependent stations on which TV channel they should utilize for communications.

9. The dependent stations start communication during the "communications window".
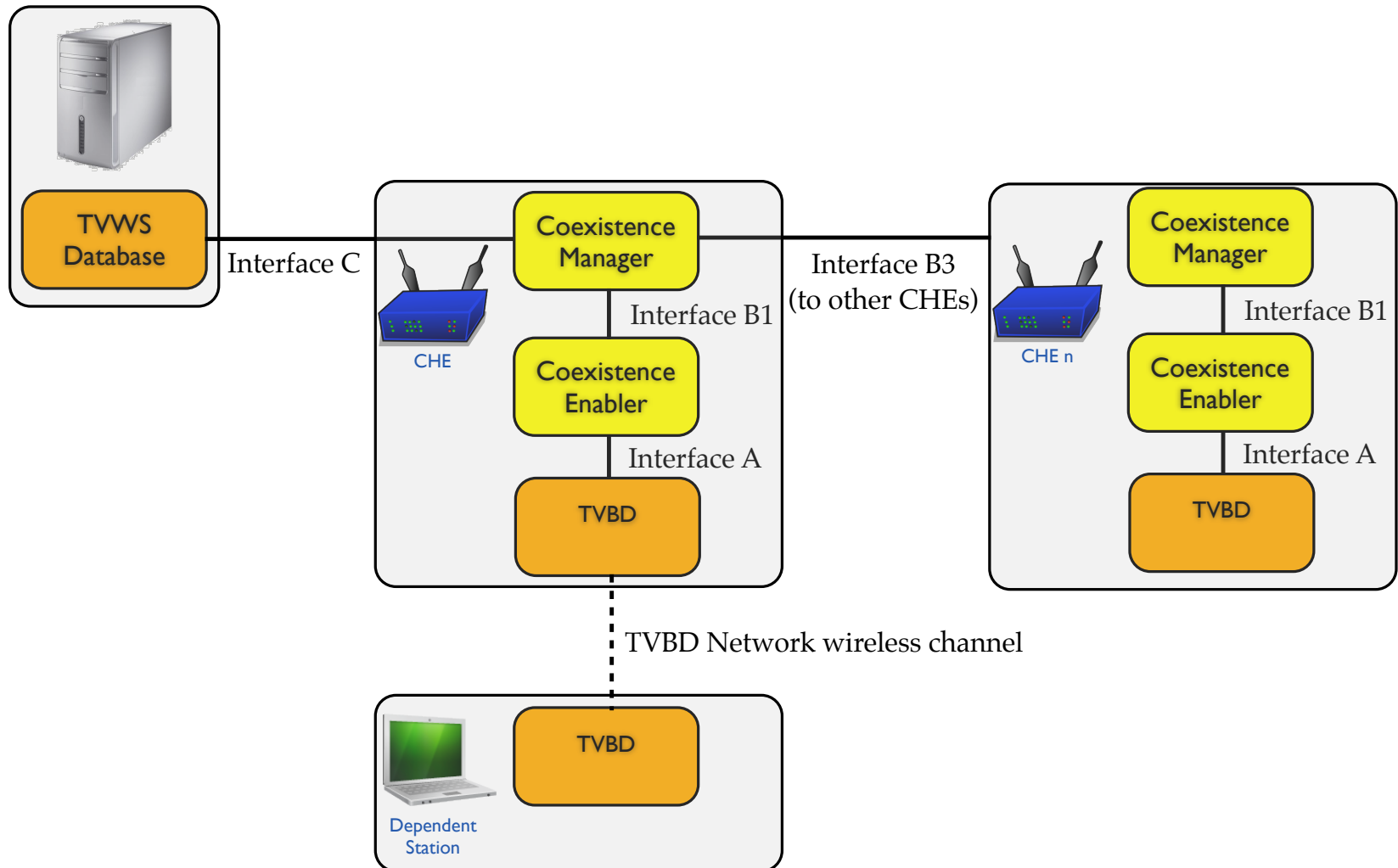
FLOW CHART - HETEROGENEOUS NETWORKS (B)
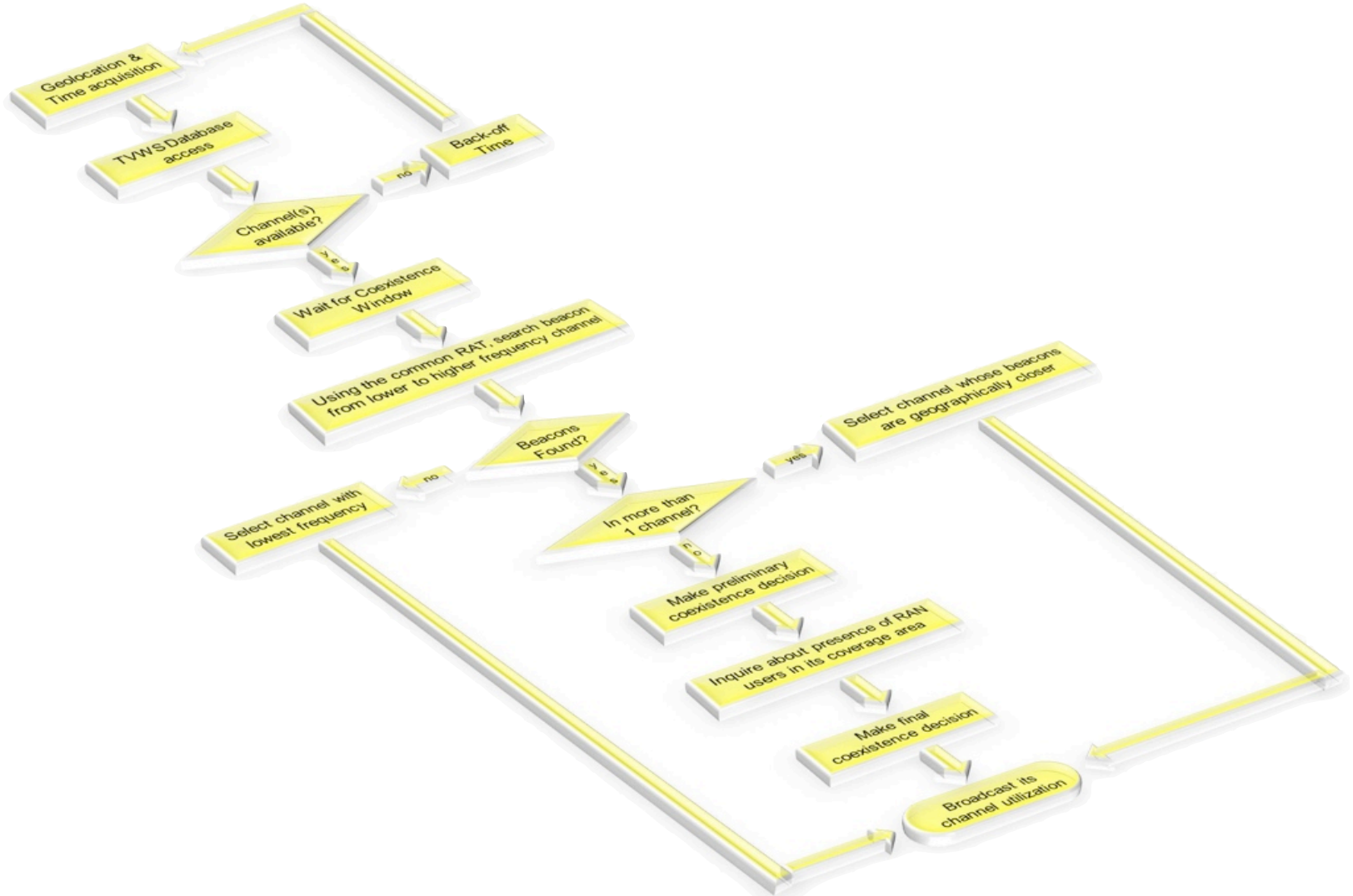
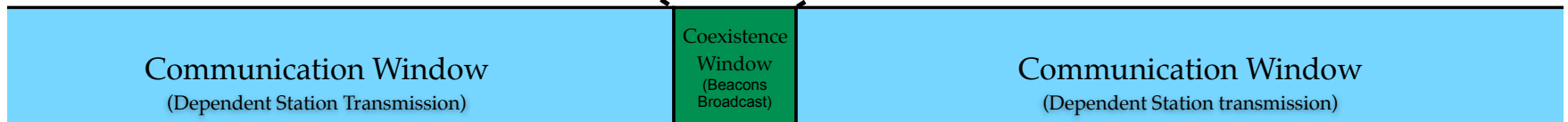# SYSTEM ARCHITECTURE

■ Distributed - Autonomous
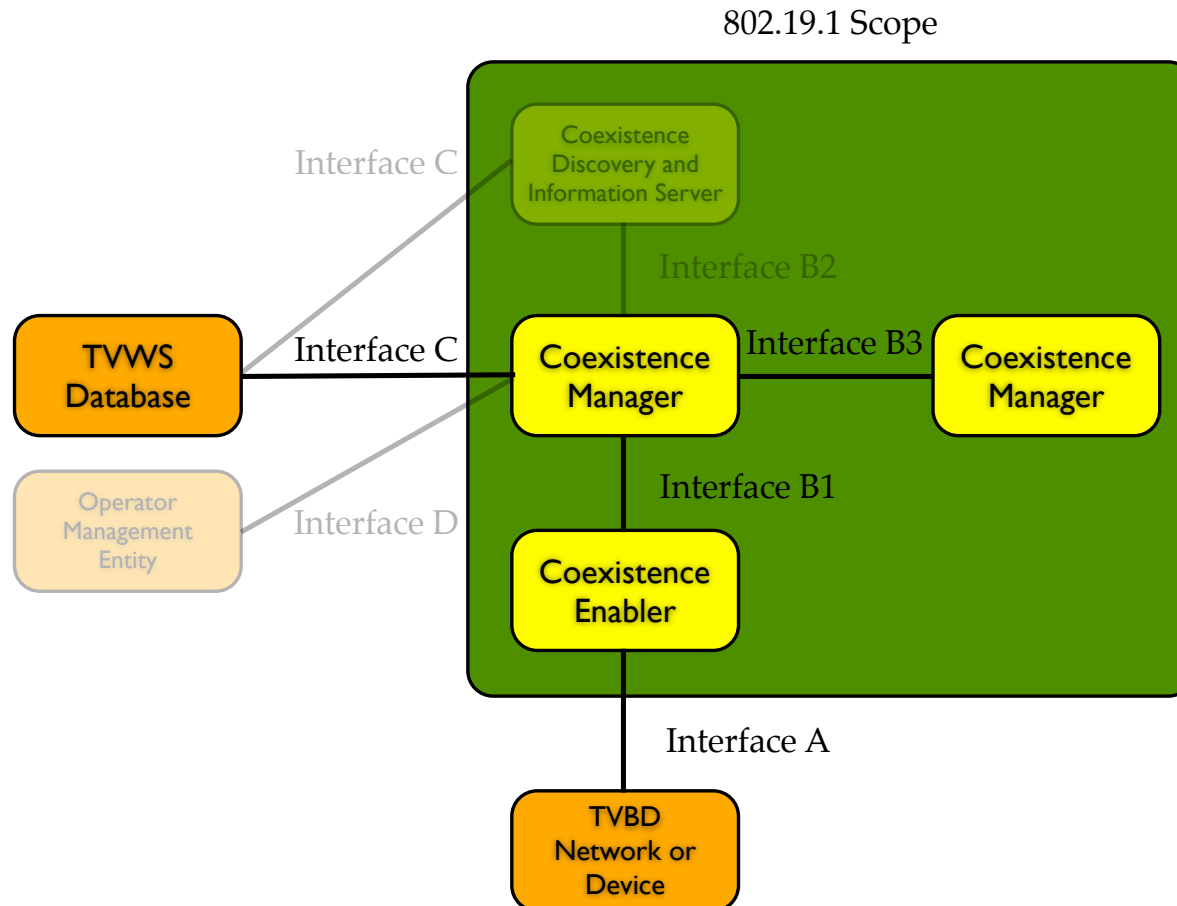
SYSTEM ARCHITECTURE

BEACON STRUCTURE & BROADCAST CH. ACCESS

RAT ID	Geolocation	Spectrum Utilization	TX Power	Tx Time	QoS	Interference Tolerance	...

Communication Window (Dependent Station Transmission)	Coexistence Window (Beacons Broadcast)	Communication Window (Dependent Station transmission)

THANK YOU FOR YOUR ATTENTION!

QUESTIONS?