Enhancing the Procedure Flow in WirelessMAN-CX Operating Stage
----Methods to Fairly Use Channels in WirelessMAN-CX Operating Stage

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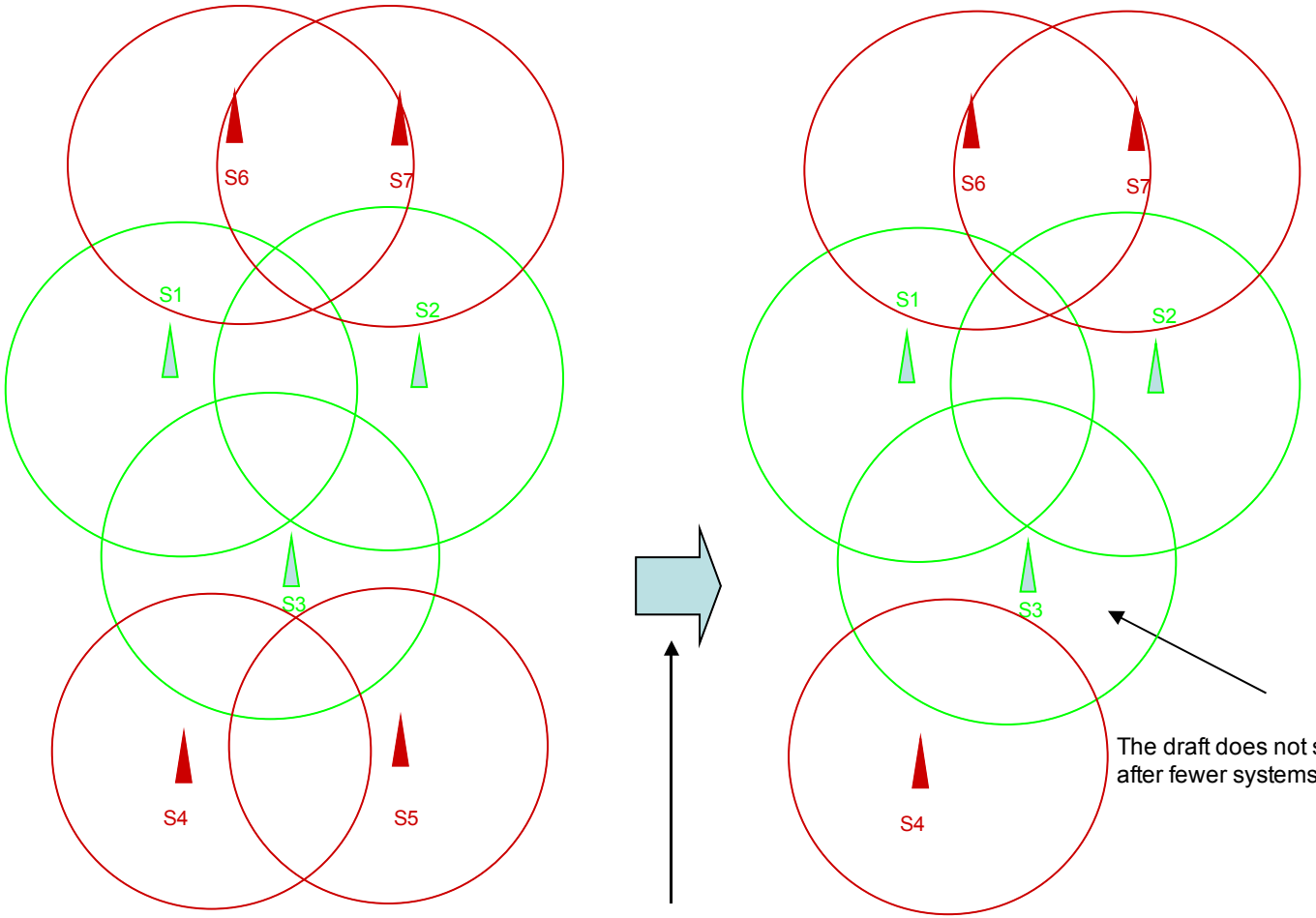
Purpose: Enhance the WirelessMAN-CX operating stage.

Abstract

802.16h draft [1] defines the procedure of WirelessMAN-CX systems in operating stage. But the procedure in [1] does not describe what should the systems in a congested channel do when they find channels with fewer systems working in them. The procedure in [1] also does not provide the methods to avoid the channel switching collisions and to guarantee the fair channel usage when the systems switch to a new working channel.

Here, we provide the procedure for the systems in a congested channel to switch to a channel with fewer systems working in it. We also propose the priority-based backoff mechanism to solve the switching collision problem and make channel usage more fair when 802.16 systems switch to a new working channel. The key idea is that the systems trying to switch to a new working channel generate backoff periods before the channel switching and the higher priority (smaller backoff period) are given to the systems in more congested channels. So the systems in more congested channels have more chance to switch to a new working channel.

Unfairly Channel Usage Example 1



The draft does not say if S3 should switch to channel 2 after fewer systems work in channel 2.

S5 ceases operation or does not interfere with S4.

Si System in channel 1

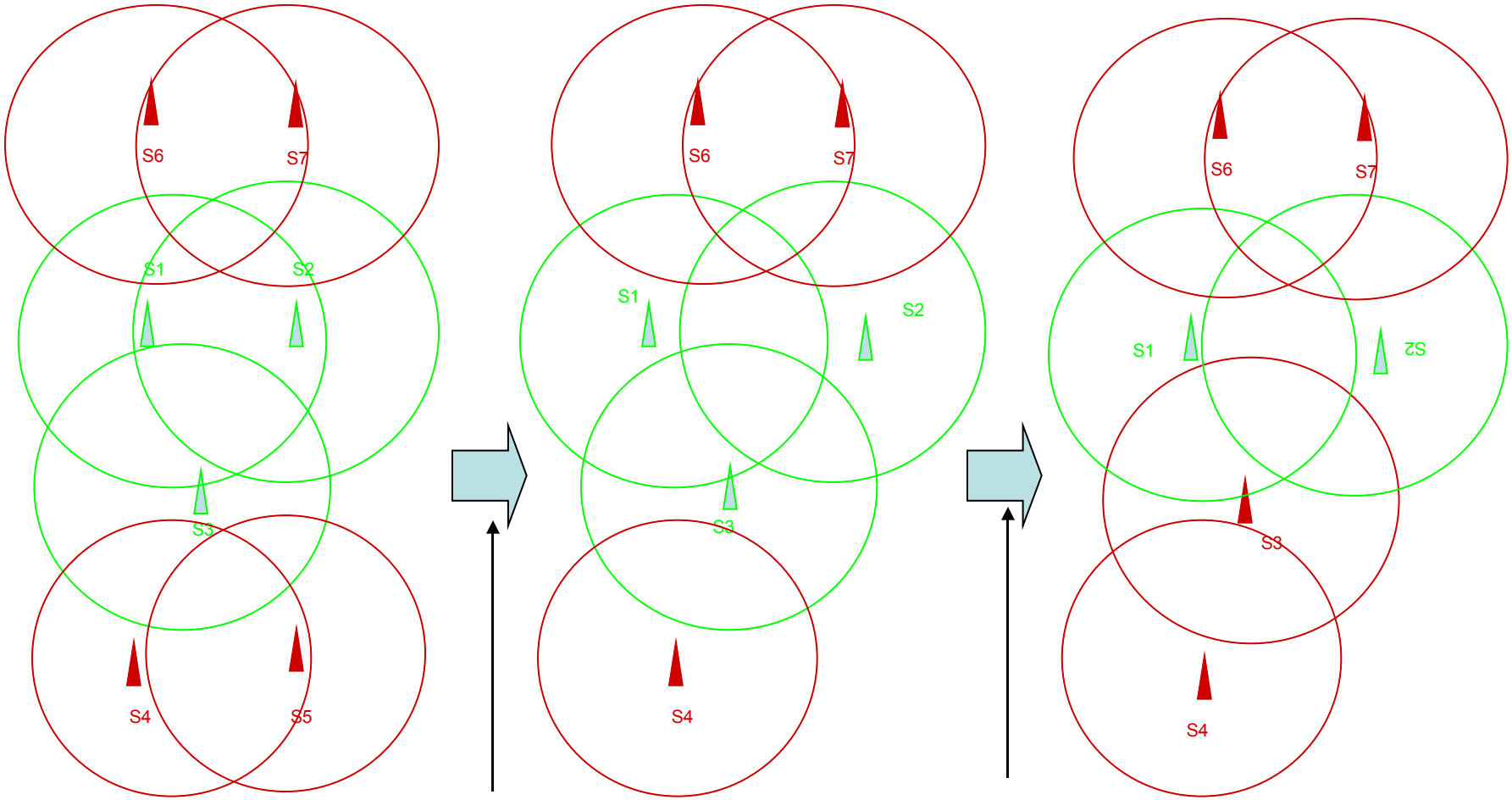
Si System in channel 2

BS of a 802.16 cell

Solution to Unfairly Channel Usage Example 1

- If , after a system in operating stage finds a channel with fewer systems and switches to it, the new working channel does not become more congested than the original working channel, the system should switch its working channel to the channel with fewer systems.
- The switching system may request its coexistence neighbors to delete it from their coexistence neighbor list by using CXP message. The switching system shall also negotiate with the systems working in the new working channel channel about the new frame structure, OCSI. The switching system may also update its neighbors with its new working channel, OCSI after it joins the new community.

Solution to Unfairly Channel Usage Example 1



S5 ceases operation or does not interfere with S4.

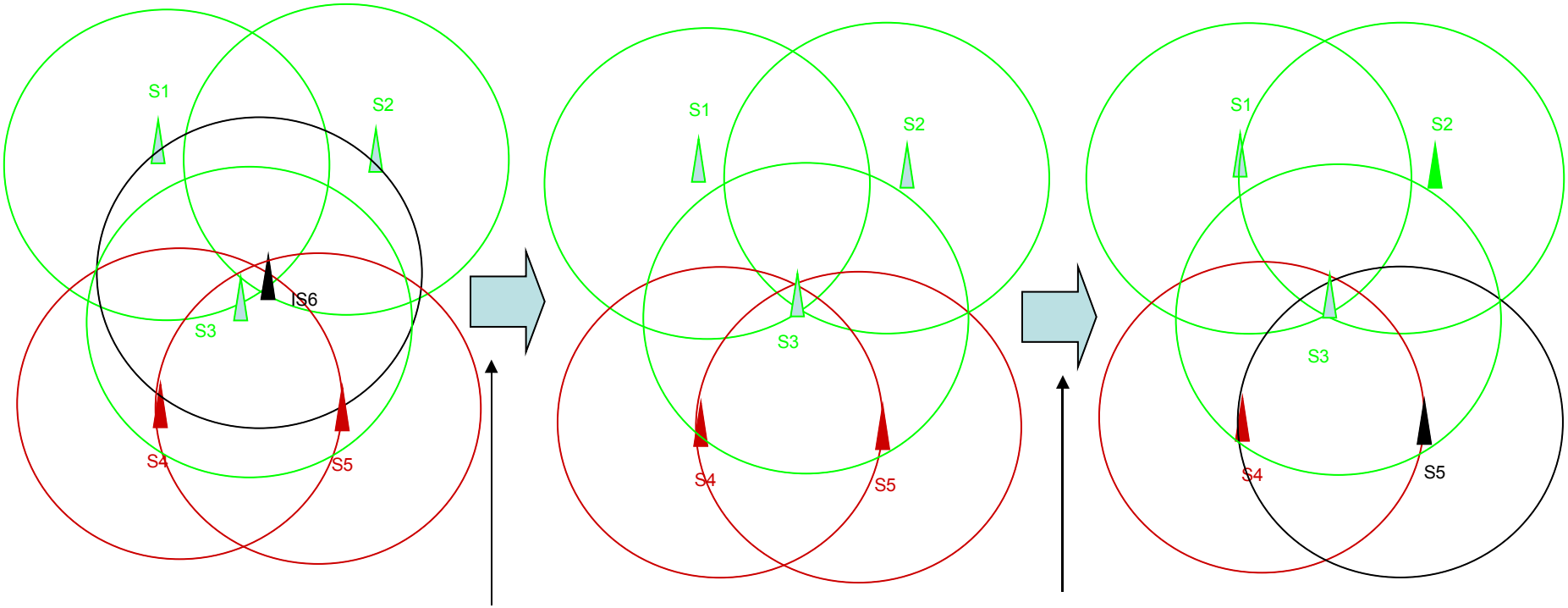
S3 switches to a channel 2 since fewer systems work in channel 2.

Si — System in channel 1

Si — System in channel 2

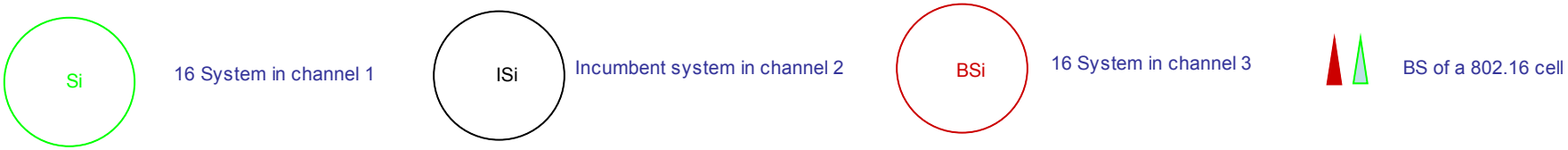
BS of a 802.16 cell

Unfairly Channel Usage Example 2

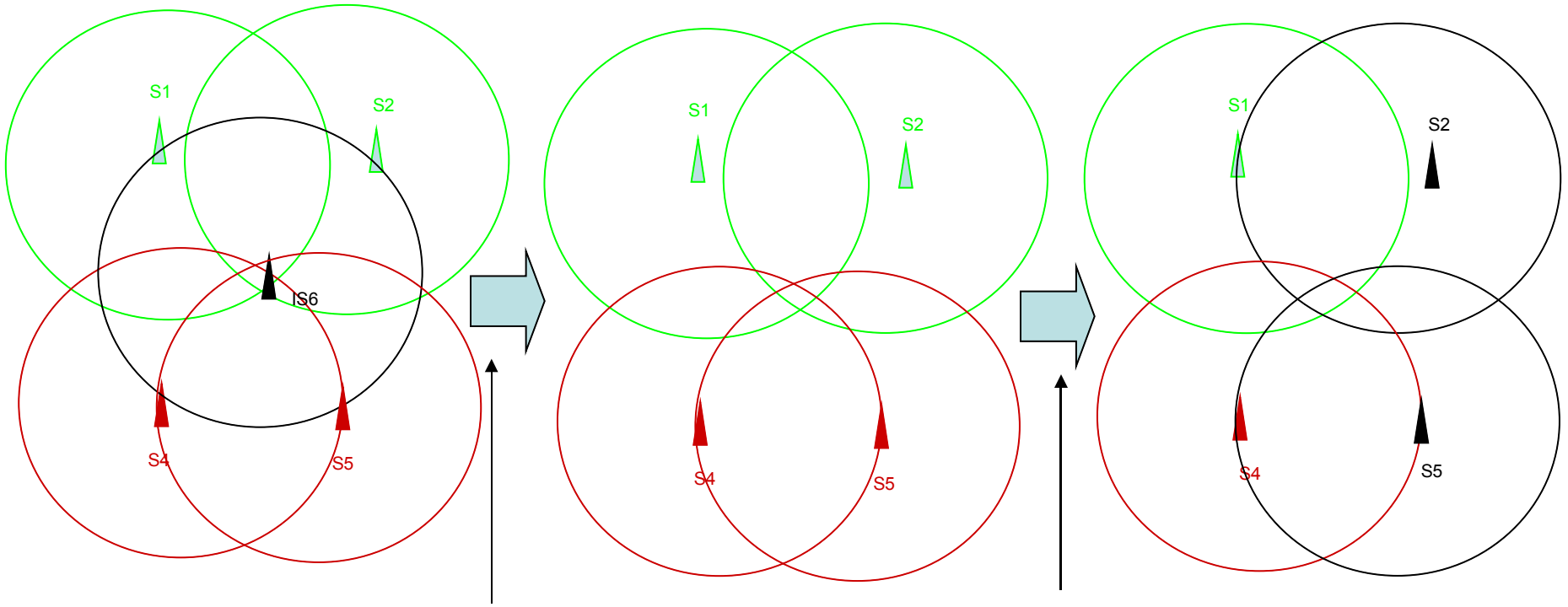


Incumbent user 6 ceases operation or does not interfere with 16 systems.

All the systems have the same priorities to switch to channel2 and and S5 wins. Channel1 is still a congested channel and another channel switching may be required.



Unnecessary Multiple Channel Switching Example



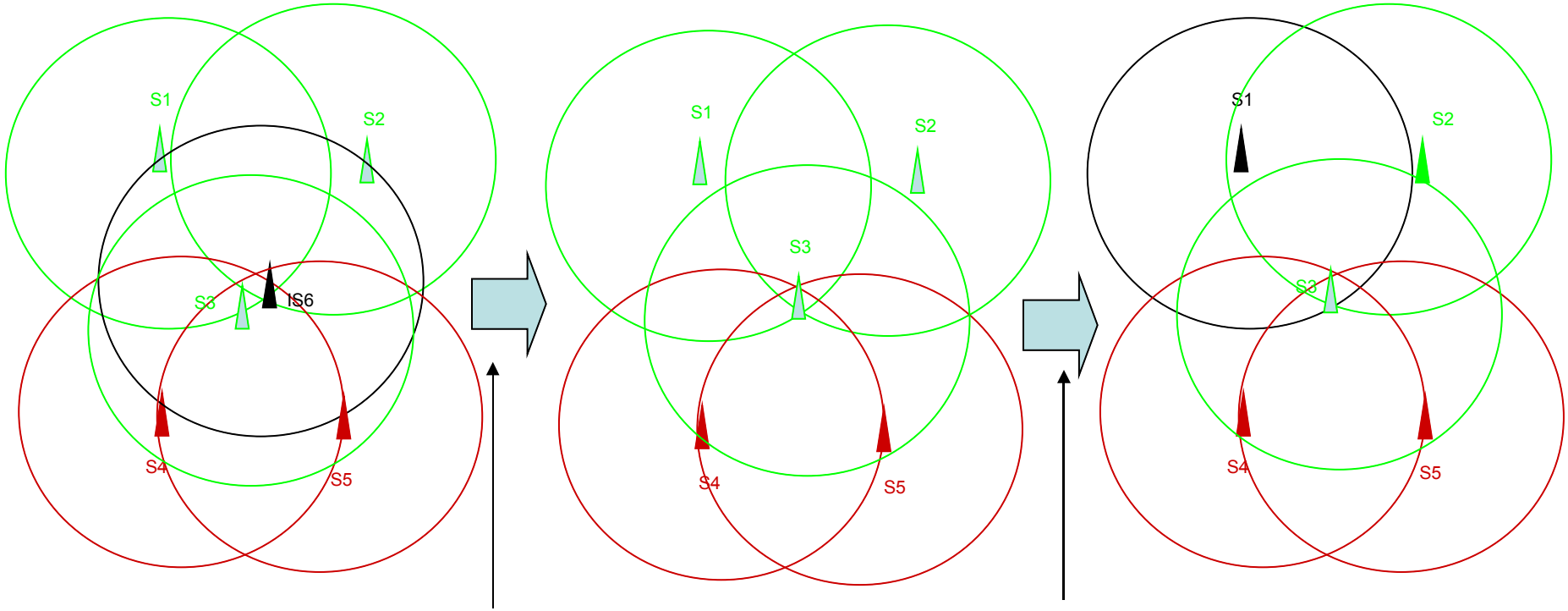
Incumbent user 3 ceases operation or does not interfere with 16 systems.

S2 and S5 try to switch to idle channel2 at the same time.

Solution to Unfairly Channel Usage Example 2 and Unnecessary Multiple Channel Switching

- The higher priorities (smaller backoff periods) are given to the systems in more congested channels. The Systems with 3 (maximal value) overlapping neighbors working in the same channel has the smaller backoff window. The Systems with 2 overlapping neighbors working in the same channel has the larger backoff window. The systems trying to switch to a new channel select a random numbers from the backoff windows.
- A BS will generate a backoff period before it tries to switch its working channel to an idle channel or a channel with fewer systems working in it.
- During the backoff procedure, the BS and its associated SSs shall allocate more resource to measure the channel that it tries to switch to. In case another BS switch to that channel, the BS shall stop the backoff procedure. If the channel is still a sparsely used channel, the BS may start another backoff procedure or keep stay in the original working channel.

Solution to Unfairly Channel Usage Example 2



Incumbent user 6 ceases operation or does not interfere with 16 systems.

Congested systems have high priority to switch to channel2. S1 win the switching procedure.

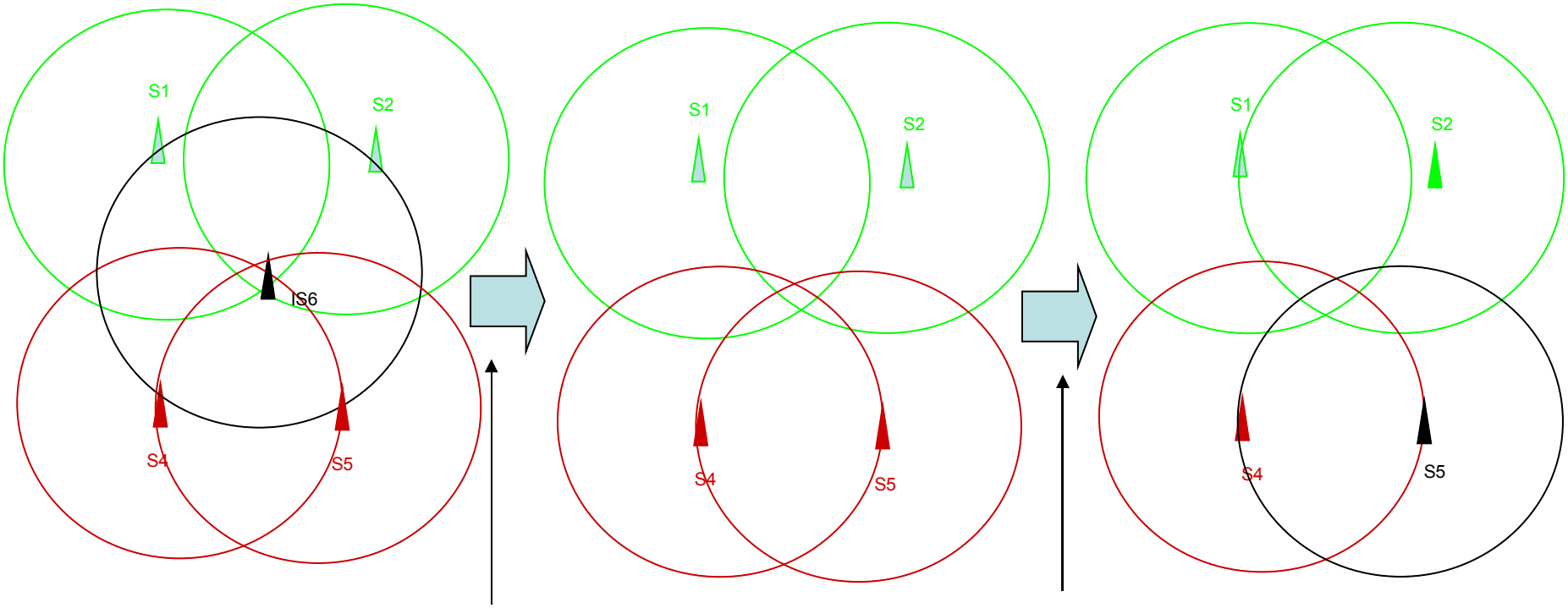
Si — 16 System in channel 1

ISi — Incumbent system in channel 2

BSi — 16 System in channel 3

BS of a 802.16 cell

Solution to Unnecessary Multiple Channel Switching Example



Incumbent user 3 ceases operation or does not interfere with 16 systems.

Before switching the working channel, 16 systems go through backoff procedures. S5 first finish the backoff procedure and switch to channel2

Si — 16 System in channel 1

ISi — Incumbent system in channel 2

BSi — 16 System in channel 3

BS of a 802.16 cell

Reference

[1] Draft in progress, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems----Amendment for Improved Coexistence Mechanisms for License-Exempt Operation, 80216h-06_D2.pdf