AUGMENTING RF DETECTORS TO FIND NOISE IN PARTICULAR FREQUENCIES

INVENTOR:

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Description

Augmenting RF detectors to find noise in particular frequencies. Internal to CM or external, part of tap maybe, remotely programmable perhaps or just reconfigurable before deployment depending on use case and implementation. Tie into Gridmetrics sensors too, and-or power supplies. May be solar powered or collect RF energy to power.

Inexpensive, battery powered, hand held RF detectors can be obtained for just a few dollars each. Hitron makes one version. VeEX has prototype for another version. PPC has designs they can build for yet another version. These are intended to use small batteries and simple RF receivers, like older TV receiver chips as in the Hitron design, to detect RF energy. Inexpensive processors are added to allow logic and basic rule-based decisions based on what is detected, including features like level of energy, frequencies detected, etc. While these do not decode the RF signal to determine if it is say DOCSIS, there is still reliable information in the frequency information which will enable differentiation from say DOCSIS and MoCA, for example, assuming the RF detector is connected to a coax that is expected to provide a given type of signal.

It is conceivable that an RF detector could be used to find upstream noise sources by setting thresholds in some bands higher than a CM would transmit, or capturing in quiet times, or be useful for capturing any energy that is not at appropriate signal or noise floor levels.

The threshold levels and frequency bands could be set automatically, by remote connection and configuration, or manually configured based on collected data. For remote access, these would be added to a CM at say a power supply CM, but can be added anywhere if configured before placement or at time of placement so that ongoing communication was not necessary.

But if connected to a CM, noise detected could be logged for troubleshooting, or the CM can send a MIB response indicating the condition, etc. If not, then the device can log times that noise were detected for later retrieval by other means. Alternately, the capability can be added to small IoT devices and the information collected by the means of those device designs. Can also be set to send a signal in a certain frequency if triggered so that a detector at the node or CMTS can indicate the event. A logic flag, switch, LED, or other indicator can be switched over when the event has happened for a technician to later reset when troubleshooting and isolating.

Connect to upstream frequency side to get house noise captured. Point DS for spurious elevated energy or noise floor detection in cases where a CM is not present, to allow better location of issues (less likely to be important). To watch for US noise, attach to the US side at the tap and-or power supply and-or amplifier and-or node location to help isolate US noise better remotely (remote access the results or send results upstream when indicated as described above) or over time (if the information is logged or a flag is set to later be found as described above).

If connected to a CM, a small circuit could be designed to let the RF detector only detect when the CM is not transmitting, thus assuring accurately that if any energy is captured above a threshold that there is noise in that line.

Then, if tied to an RF transmitter, the captured signal can be sent to a noise cancelling circuit which adds the cancelling signal to the CMs signal, and cancels the signal. Because of timing delay, the cancellation will not be perfect, and may introduce more noise instead of less, so would need to be disabled automatically if found it is adding noise overall.

Method flow Figure 1: logic for RF detection of noise (upstream or downstream)

1) Monitor for noise.
2) Is noise captured? No - return to 1. Yes - go to 3.
3) Is the noise an acceptable signal type such as DOCSIS or MoCA? No - go to 4. Yes - go to 1.
4) Is the noise significant? No - go to 1. Yes - go to 5.
5) Capture information about the signal captured including, as is possible, the time, energy level, duration, maximum energy, minimum energy, whether a CM was known to be transmitting at the same time or not, etc.
6) According to the implementation, log the information for later retrieval, turn on any warranted indicators, send necessary signals or messages, etc.

Method flow Figure 2: locating a fault remotely using multiple RF sensors (upstream; reverse directions for downstream)

1) Collect the noise indicators (or time stamped data if available) for all RF detectors in the section of network (for example after the amplifier).
2) Filter the RF detectors by those that captured the noise versus those that did not.
3) Take those detectors that found noise and find the detector furthest down the network.
4) Is that indicator located at an end of line? Yes - check to see if there are more than one indicator at end of line, and for each do the following: indicate whether the noise is determined to be in the home or could be in the drop or the tap, and decide if the noise is severe enough to address or place on a watch list for further action. No - check all RF detectors that are further downstream. These were determined to not have noise indicated. In reference to the indicator identified, use this information to determine that the noise is between the closest RF detector not triggered and the RF detector that was triggered and was furthest downstream. Decide if the noise is severe enough to address or place on a watch list for further action.
5) If RF detectors need to be rest, do so now, and return to 1.

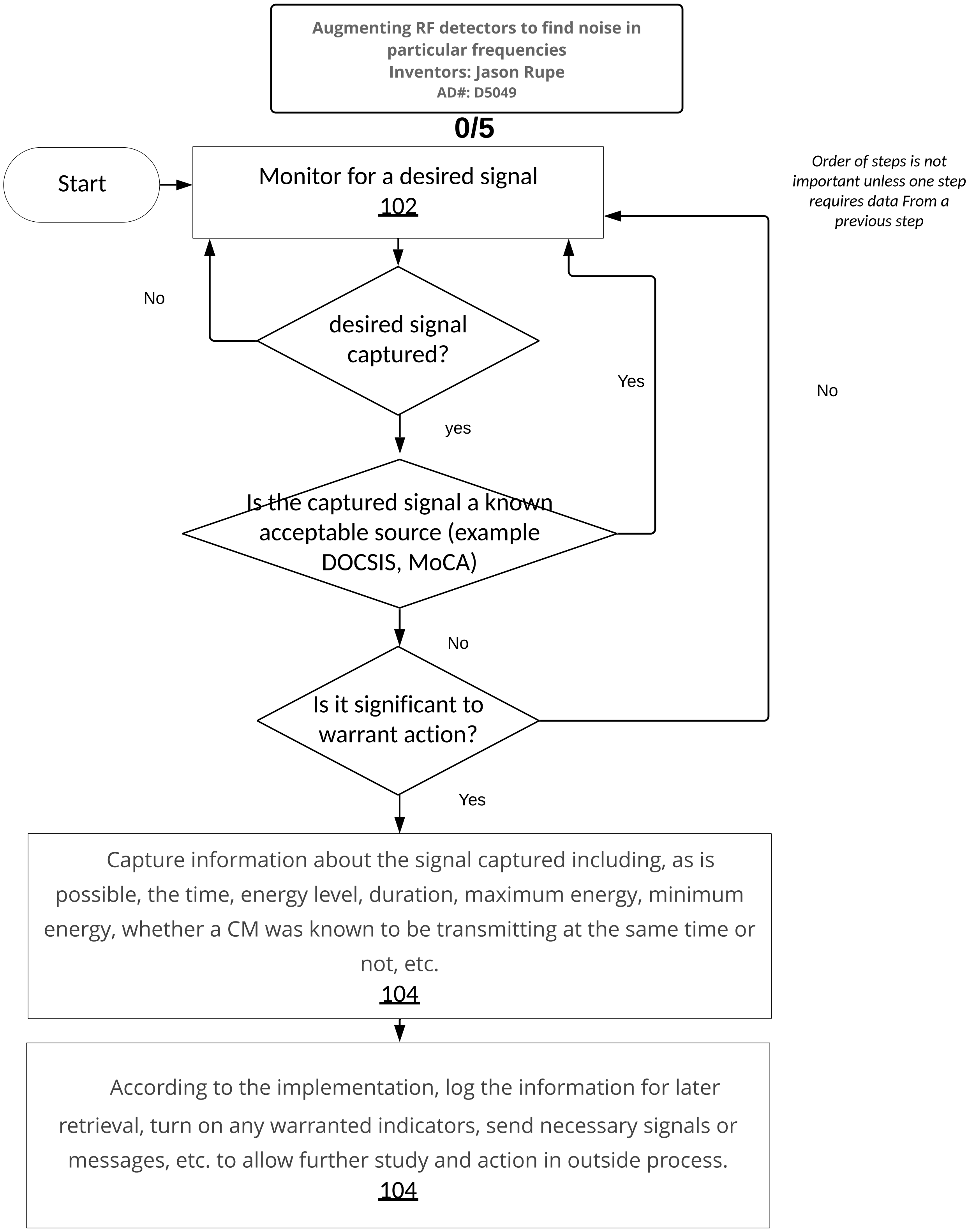
Method flow Figure 3: locating a fault in person using multiple RF sensors (upstream with modification needed for downstream)

1) Technician checks the RF noise indicator on the RF detector
2) RF noise indicated? No - move on and return to 1 when encountering the next RF detector. Yes - (optional, for sensor integrity) do a depth first search in the downstream direction until finding an RF detector that does not indicate noise found and go to 3, or return to the first one found and go to 4.
3) If an RF detector is found to not have found noise, check for malfunction. If malfunction found, replace and continue search in 2 as though it found noise. If malfunction not found, consider replacement of this suspect component as well as replacement of the first RF detector that indicated noise found using a voting scheme to determine the failed component(s) or other method. Go to step 5.
4) Search for network faults and-or leaks in the network that are potential causes for noise in the upstream of the network and fix all.

5) Search upstream from the fault location and replace any RF detectors that should have detected noise but did not.
6) If RF detectors need to be rest, do so now, and return to 1.

Background *
Upstream noise detection and isolation is still a challenge for operators. Those who have upstream spectrum capture capabilities can find that noise exists, but it is still difficult to resolve the likely sources. One operator uses amplifiers to isolate Ingress noise sources, but that does not isolate to the component or single user. Further isolation still must be done by technicians. Leakage detection can indicate noise but it is labor intensive and requires specialized gear which is expensive and not deployed to all technicians and on all networks. A solution is needed that captures noise quickly, and helps to isolate the source accurately.
Separate RF detectors have been created lately to aid in self installation and field trials of installation.
The idea here is to repurpose these RF detectors to find and isolate noise.

Abstract
Use RF detectors to cheaply find and isolate noise sources in the network.


Augmenting RF detectors to find noise in particular frequencies
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AD#: D5049
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Start
Monitor for a desired signal
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Order of steps is not important unless one step requires data From a previous step
No
desired signal captured?
Yes
No
yes
Is the captured signal a known acceptable source (example DOCSIS, MoCA)
No
Is it significant to warrant action?
Yes
Capture information about the signal captured including, as is possible, the time, energy level, duration, maximum energy, minimum energy, whether a CM was known to be transmitting at the same time or not, etc.
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According to the implementation, log the information for later retrieval, turn on any warranted indicators, send necessary signals or messages, etc. to allow further study and action in outside process.
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Fig. 1

Augmenting RF detectors to find noise in particular frequencies
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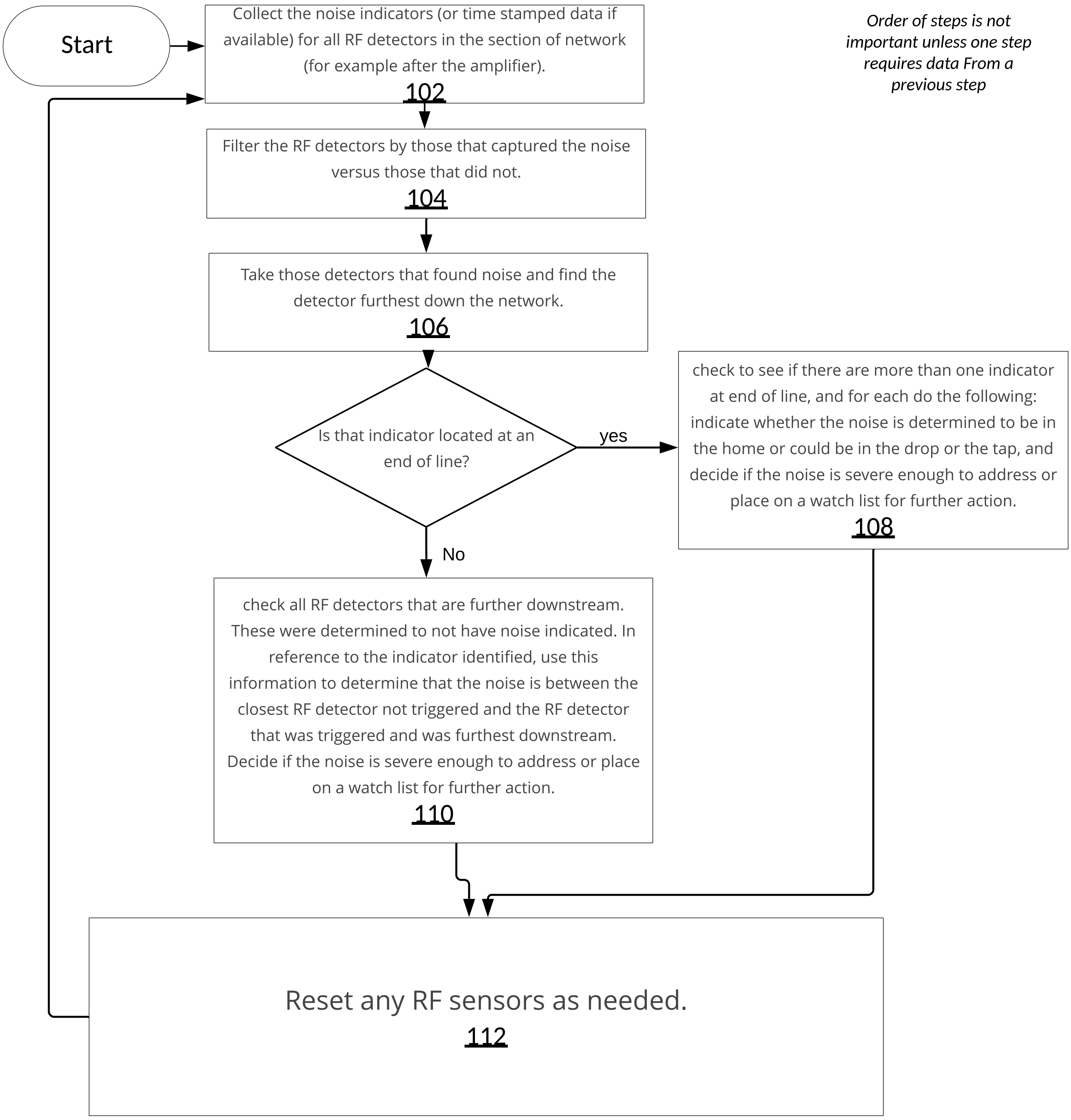

Fig. 2

Augmenting RF detectors to find noise in particular frequencies
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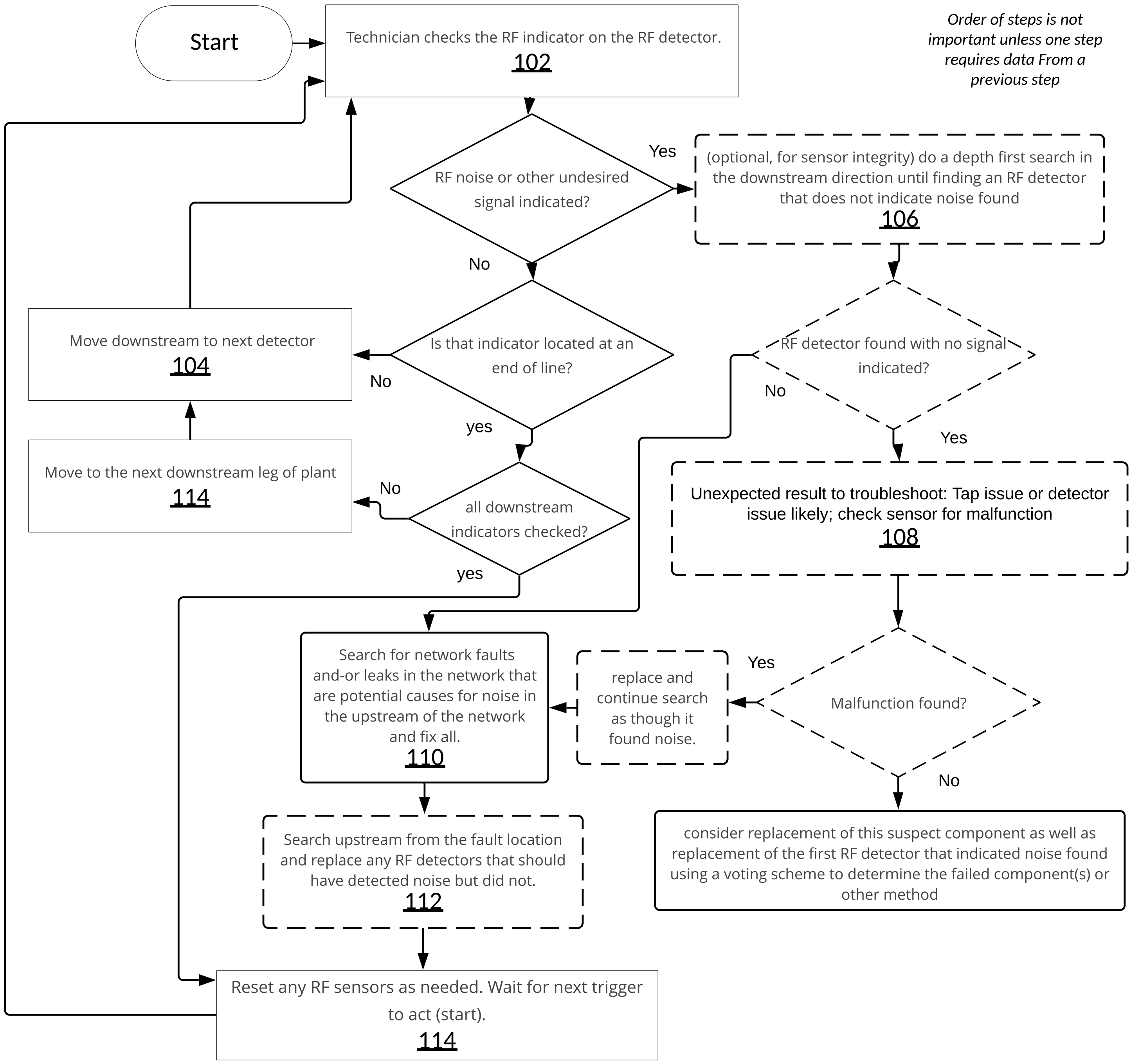

Fig. 3