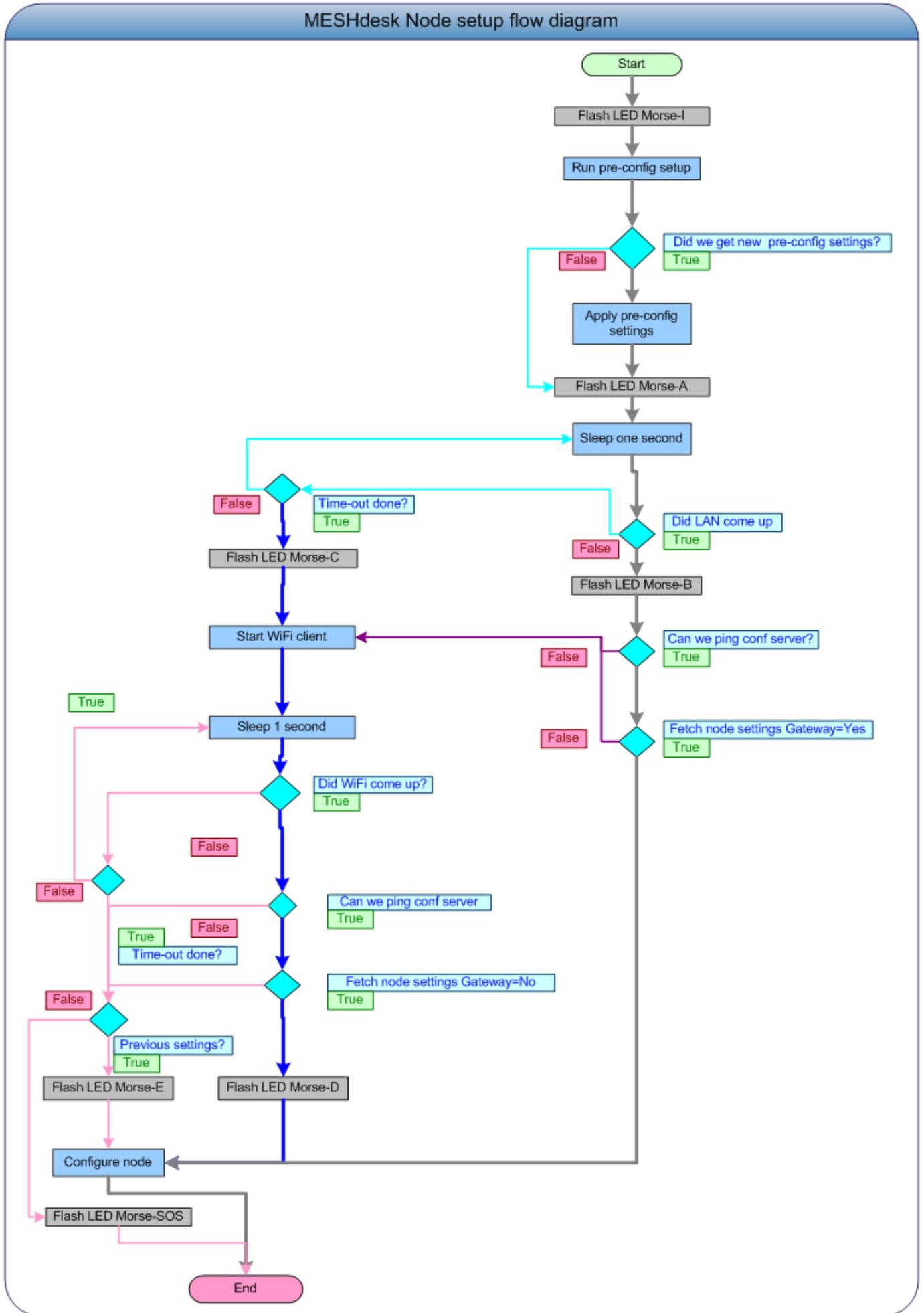


How the MESHdesk firmware works

- The following flow diagram indicates the steps a node takes to fetch its settings.

MESHdesk Node setup flow diagram



A typical Request and Reply

What the node requests from the server

- We assume the node is a gateway node with a MAC Address of AC:86:74:10:03:08 and the MESHdesk server is on 192.168.99.1.
- We run a 'tail -f' on the web server's access log file.
- Note that **gateway=true**

```
192.168.99.125 - - [06/Feb/2014:09:59:13 +0200] "GET
/cake2/rd_cake/nodes/get_config_for_node.json?mac=AC-86-74-10-03-08&gateway=
true HTTP/1.1" 200 2247 "-" "Wget"
```

- We now have our gateway node and can start the other nodes who will fetch their settings through the hidden configuration AP which forms part of every mesh managed by MESHdesk.
- Here is the entry when the node with MAC Address AC:86:74:10:03:10 fetched it's settings. Note that **gateway=false**.

```
192.168.99.125 - - [06/Feb/2014:10:05:59 +0200] "GET
/cake2/rd_cake/nodes/get_config_for_node.json?mac=AC-86-74-10-03-10&gateway=
false HTTP/1.1" 200 2049 "-" "Wget"
```

What the server replies

- Time to see what our server has to say for himself!
- The feedback of course will depend on how the mesh is defined.
- The feedback will also depend on the fact that a node can be a gateway node or a standard node.
- Here is the feedback if the node was specified as a gateway node:

```
{"config_settings":
  {"wireless":[
    {"wifi-device":"radio0","options":{"channel":"11","disabled":}},
    {"wifi-iface":"zero","options":
{"device":"radio0","network":"mesh","mode":"adhoc","ssid":"02_CA_FE_CA_00_01
","bssid":"02:CA:FE:CA:00:01"}},
    {"wifi-
iface":"one","options":{"device":"radio0","mode":"ap","encryption":"psk-
mixed","network":"one","ssid":"meshdesk_config","key":"radiusdesk","hidden":
"0"}}, {"wifi-iface":"two","options":
{"device":"radio0","mode":"ap","network":"ex_five","encryption":"none","ssid
":"Paul","key":"verysecure","hidden":false,"isolate":false,"auth_server":"","
"auth_secret":""}}, {"wifi-iface":"three","options":
{"device":"radio0","mode":"ap","network":"ex_two","encryption":"none","ssid
":"Simon","key":"","hidden":false,"isolate":false,"auth_server":"","auth_secr
et":""}}}],
```

```
"network": [{"interface": "loopback", "options": {"ifname": "lo", "type": "bridge", "proto": "static", "ipaddr": "127.0.0.1", "netmask": "255.0.0.0"}}, {"interface": "lan", "options": {"ifname": "eth0", "type": "bridge", "proto": "dhcp"}}, {"interface": "mesh", "options": {"ifname": "wlan0", "mtu": "1544", "proto": "batadv", "mesh": "bat0"}}, {"interface": "one", "options": {"ifname": "bat0.1", "proto": "static", "ipaddr": "10.5.5.3", "netmask": "255.255.255.0", "type": "bridge"}}, {"interface": "ex_two", "options": {"ifname": "bat0.2 eth0.100", "type": "bridge"}}, {"interface": "ex_two", "options": {"ifname": "bat0.2 eth0.100", "type": "bridge"}}, {"interface": "ex_three", "options": {"ifname": "bat0.3 eth0.101", "type": "bridge"}}, {"interface": "ex_three", "options": {"ifname": "bat0.3 eth0.101", "type": "bridge"}}, {"interface": "ex_four", "options": {"ifname": "bat0.4 eth0.103", "type": "bridge"}}, {"interface": "ex_four", "options": {"ifname": "bat0.4 eth0.103", "type": "bridge"}}, {"interface": "ex_five", "options": {"ifname": "bat0.5", "type": "bridge", "ipaddr": "10.200.105.1", "netmask": "255.255.255.0", "proto": "static"}}, {"interface": "ex_five", "options": {"ifname": "bat0.5", "type": "bridge"}}], "gateways": [{"ex_five"}], "success": true, "timestamp": 1}
```

- Here's the feedback for a normal node:

```
{"config_settings": {"wireless": [{"wifi-device": "radio0", "options": {"channel": "11", "disabled": {}}, {"wifi-iface": "zero", "options": {"device": "radio0", "network": "mesh", "mode": "adhoc", "ssid": "02_CA_FE_CA_00_01", "bssid": "02:CA:FE:CA:00:01"}}, {"wifi-iface": "one", "options": {"device": "radio0", "mode": "ap", "encryption": "psk-mixed", "network": "one", "ssid": "meshdesk_config", "key": "radiusdesk", "hidden": "0"}}, {"wifi-iface": "two", "options": {"device": "radio0", "mode": "ap", "network": "ex_five", "encryption": "none", "ssid": "Paul", "key": "verysecure", "hidden": false, "isolate": false, "auth_server": "", "auth_secret": ""}}, {"wifi-iface": "three", "options": {"device": "radio0", "mode": "ap", "network": "ex_two", "encryption": "none", "ssid": "Simon", "key": "", "hidden": false, "isolate": false, "auth_server": "", "auth_secret": ""}}], "network": [{"interface": "loopback", "options": {"ifname": "lo", "type": "bridge", "proto": "static", "ipaddr": "127.0.0.1", "netmask": "255.0.0.0"}}, {"interface": "lan", "options": {"ifname": "eth0", "type": "bridge", "proto": "dhcp"}},
```

```

{"interface":"mesh","options":{"ifname":"wlan0","mtu":"1544","proto":"batadv
","mesh":"bat0"}},
{"interface":"one","options":
{"ifname":"bat0.1","proto":"static","ipaddr":"10.5.5.3","netmask":"255.255.2
55.0","type":"bridge"}},
{"interface":"ex_two","options":{"ifname":"bat0.2","type":"bridge"}},{"inter
face":"ex_two","options":
{"ifname":"bat0.2","type":"bridge"}},{"interface":"ex_three","options":{"ifn
ame":"bat0.3","type":"bridge"}},
{"interface":"ex_three","options":{"ifname":"bat0.3","type":"bridge"}},{"int
erface":"ex_four","options":
{"ifname":"bat0.4","type":"bridge"}},{"interface":"ex_four","options":{"ifna
me":"bat0.4","type":"bridge"}},
{"interface":"ex_five","options":{"ifname":"bat0.5","type":"bridge"}},{"inte
rface":"ex_five","options":
{"ifname":"bat0.5","type":"bridge"}}}],
"success":true,
"timestamp":1}

```

Flashing LEDs

A well designed interface is done in such a way that it is easy for you to interact with and easy to read. We use these principles with the nodes on which the MESHdesk firmware are running.

Where possible we use three LEDs to allow a mesh node to report visually about its status at a glance:

- **Morse LED** is used to flash a Morse code about:
 - The stages of the setup process
 - After setup it will flash a digital Morse code number to indicate how many neighbor nodes it sees.
- **Wifi LED** will be associated with the working and traffic on the Batman-adv mesh.
- **Internet LED** will be on if the node can get onto the Internet
- **Morse LED** will be used to indicate which stage the process of setting up the node is in. We use the old tried and trusted Morse code flashing.

Text	Morse code	Meaning
A	. _	Starting up - waiting for LAN
B	_ . . .	LAN is up - Trying for the Config server
C	_ . _ . .	Conf server not available through LAN - Bring up WiFi
D	_ . .	Conf server reached - Applying latest config
E	.	Conf server down - Applying previous config
I	. .	Running the pre-configure code
SOS	. . . _ _ _ . . .	Conf server down No previous config to use

- After the setup the node will continuously ask the Batman-adv daemon how many direct neighbors it sees and flash a Morse code digital number to indicate the count. **If there is none**

around the Morse LED will be off.

Text	Morse code	Meaning
1	. _ _ _ _	One
2	.. _ _ _	Two
3	... _ _	Three
4 _	Four
5	Five
6	_	Six
7	_ _ . . .	Seven
8	_ _ _ . .	Eight
9	_ _ _ _ .	Nine
0	_ _ _ _ _	Ten or more

- **Wifi LED** will be used to indicate if the bat0 (mesh interface) is up. This LED will also indicate when traffic flows through it by flashing proportionally to the traffic flow.
- **Internet LED** may not come up immediately on **non-gateway** nodes but should come up after 5 minutes provided that the gateway node has Internet connectivity.

The **Internet** LED is actually an indication that the Alfred daemon could report the mesh status fine back to the **MESHdesk** server. So this light might actually be on without Internet connection if the **MESHdesk** server runs local.

Fetching settings through mesh

MESHdesk nodes which are not directly connected to a LAN will be able to reach the configuration server in the following way.

- Each gateway node of a MESHdesk defined mesh network will run a NAT/DHCP termination point.
- This NAT/DHCP termination point will be propagated through the mesh and accessible through a hidden SSID.
- This hidden SSID is secured through WPA2 Personal security.
- If a node that is not connected to the LAN starts up; the MESHdesk script will try to connect this node to this hidden SSID.
- If successful it will subsequently try to fetch its settings through the mesh by means of this hidden SSID.

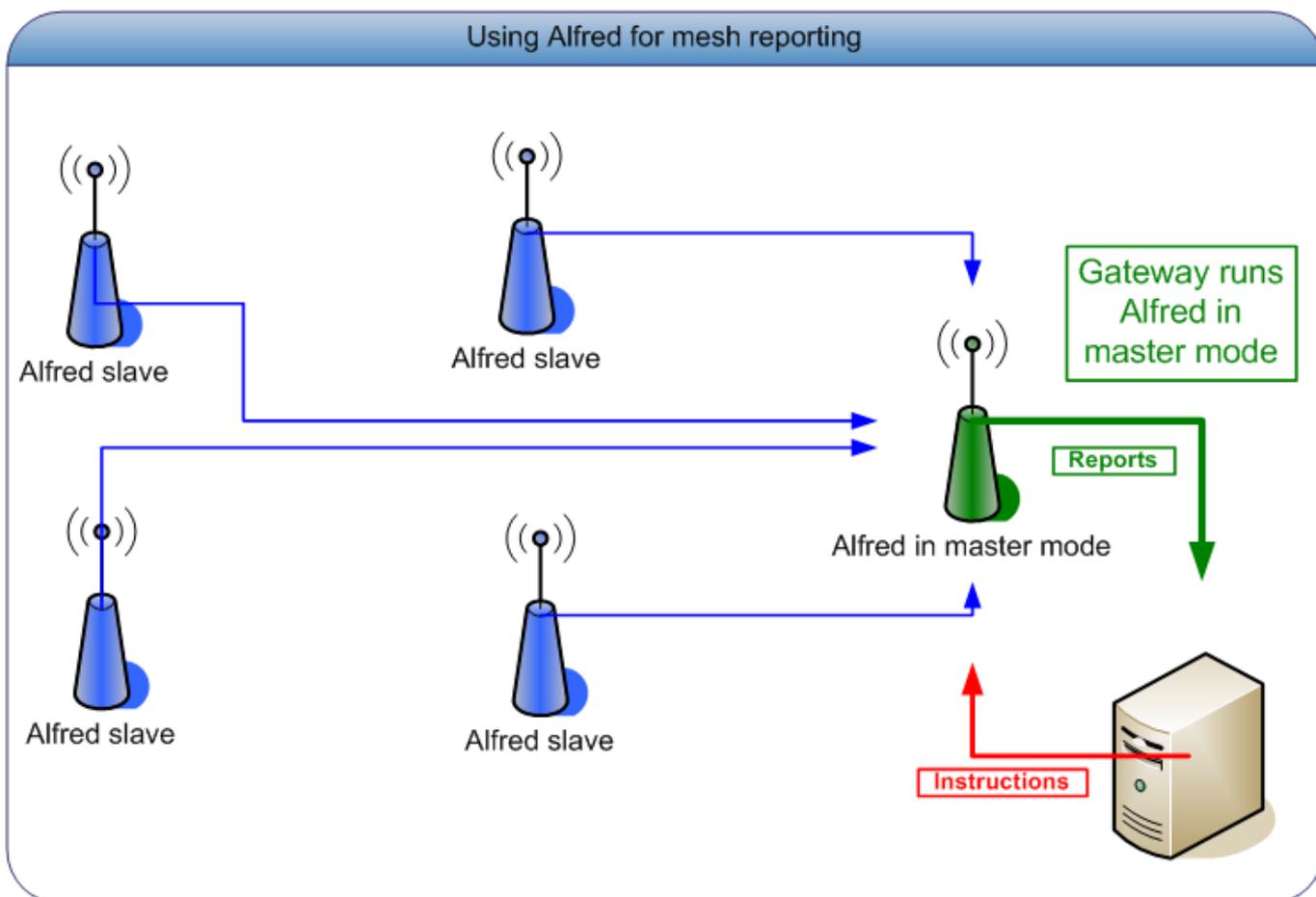
Advantages

- A node belonging to one mesh can get its settings through the hidden SSID of another mesh.

- When these settings are applied by the node; the node can potentially move to another mesh.
- This will allow two or more mesh networks to co-exist while still be separate since the ad-hoc Wi-Fi network in which each mesh network rely will be unique and exclusive.
- Their hidden SSID used to obtain the configuration settings however will be common between all MESHdesk networks.

Reporting the status of the mesh

- We use the Alfred daemon to collect and report collectively the status of the mesh.
- This reduces traffic since only one node (typically the gateway node) will fulfill this function.
- When a node starts up it will determine whether it is a gateway node or not.
- If it is a gateway node, Alfred will be started in **master** mode.
- If it is not, Alfred will be started in slave mode.
- The server can also reply to each status report from a mesh. The reply can contain the following:
 - Reboot request for a node.
 - Reload request for a node.
 - Execute instructions for a node.
- A node will then periodically ask on the Alfred 'bus' if there are any instructions for him. If so; it will confirm with the back end by asking the back-end directly for its instructions.
- Again this way we reduce traffic to the back-end when we use one node as a proxy.



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