ClickShare: recommendations for Wi-Fi configuration

1. Scope of this document

The goal of this application note is to provide recommendations and advice for the deployment and Wi-Fi configuration of ClickShare in a corporate environment. For large-scale deployments the "ClickShare Network Integration" functionality, documented in the application note "ClickShare Network Integration" offers an alternative approach.

2. ClickShare Wi-Fi configuration

ClickShare relies on the Wi-Fi standard (IEEE802.11a/g/n) for the communication between the base unit access point and the clients (ClickShare Buttons or ClickShare mobile apps).

Wi-Fi spectrum and channels organization

The IEEE802.11 a/g/n standard makes use of a part of the 2.4GHz ISM band of the 5GHz U-NII bands.

The 2.4GHz ISM band (industrial, scientific and medical) goes from 2.400 GHz to 2.500GHz and can be used freely by any radio device for industrial, scientific and medical application. This band is also used by several common telecommunications protocols or standards the likes of Wi-Fi, Bluetooth, ZigBee, RFID devices … A more comprehensive list of systems authorized on this band can be found at http://www.efis.dk/sitecontent.jsp?sitecontent=ecatable for the European Union and at http://transition.fcc.gov/oet/spectrum/table/fcctable.pdf for the United States.

The 802.11 standard divides the 2.4GHz ISM band into thirteen 22MHz wide channels, spaced 5MHz from each other (cf. Figure 1). These channels thus strongly overlap with each other.

The availability of these channels varies from country to country. ClickShare respects local regulations, and Table 1 below depicts the channels enabled for the different regional versions of ClickShare.
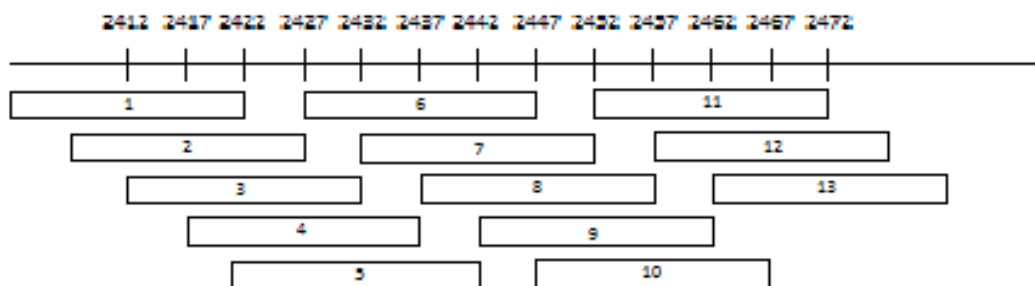

Figure 1: Wi-Fi channels in the 2.4GHz band

Channel number	Frequency range (MHz)	ClickShare regional version			
		NA	JP	EU	CN
1	2401 – 2423	X	X	x	X
2	2406 – 2428	X	X	X	X
3	2411 – 2433	X	X	X	X
4	2416 – 2438	X	X	X	X
5	2421 – 2443	X	X	X	X
6	2426 – 2448	X	X	X	X
7	2431 – 2453	X	X	X	X
8	2436 – 2458	X	X	X	X
9	2441 – 2463	X	X	X	X
10	2446 – 2468	X	X	X	X
11	2451 – 2473	X	X	X	x
12	2456 – 2478		X	X	
13	2461 - 2483		x	X	

Table 1: ClickShare channels in the 2.4 GHz frequency band

The 5GHz U-NII band covers discontinued parts of the RF spectrum between 5.15GHz and 5.825GHz and allows the use of unlicensed wireless systems. The U-NII band is divided into 4 different sub-bands subjected to specific restriction (cf. Table 2).

Band	Frequency range (MHz)	Number of Wi-Fi channels	Restriction
U-NII 1	5150 - 5250	4	Until recently[1], limited to indoor use only
U-NII 2	5250 – 5350	4	Requires use of radar detection
U-NII 2 extended	5470 – 5725	11	Requires use of radar detection
U-NII 3	5725 - 5825	4	

[1] http://www.fcc.gov/document/5-ghz-u-nii-ro

Contrary to the channels defined on the 2.4 GHz band, the channels defined on the 5 GHz band do not overlap with each other.

As stated in Table 2, the U-NII 2 and U-NII2 extended sub-bands are also used by several radar systems and can only be used by Wi-Fi access points using the Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC) algorithms. These 2 algorithms have been defined by the IEEE802.11h standard and specify a set of procedures to detect and avoid interference with radar systems operating in the U-NII 2 and U-NII 2 extended sub-bands.

Currently, the ClickShare access points do not support DFS and TPC as specified in the IEEE 802.11h standard and the list of the 5 GHz channels enabled for the different ClickShare regional variants is displayed at Table 3.

The 5 GHz band is much less used by non Wi-Fi devices than the 2.4 GHz band. Besides, many of the older Wi-Fi devices only support the 2.4 GHz channels, meaning that the 5 GHz band is less crowded. Moreover, 5 GHz channels do not overlap with each other. ***As a result, the use of the 5 GHz channels is most often the preferred choice when installing a new ClickShare***.

Channel number	Frequency range (MHz)	ClickShare regional variant			
		NA	JP	EU	CN
36	5150 – 5170	X	X	x	
40	5170 – 5190	X	X	X	
44	5190 – 5210	X	X	X	
48	5210 – 5230	X	X	X	
149	5735 – 5755	X			X
153	5755 – 5775	X			X
157	5775 – 5795	X			X
161	5795 – 5815	X			X
165	5815 – 5835	X			X

Table 3: ClickShare channels in the 5 GHz frequency bands

ClickShare Wi-Fi channel selection

Wireless communication signals travel over the air. Therefore, two devices transmitting at the same time, on the same frequency, and within range of one another, will disturb each other. When the interference caused by other devices is too strong, the packets transmitted by the Wi-Fi transmitter get so distorted that they are no longer correctly understood by the receiver, and as a result these packets must be retransmitted. This causes a decrease in the actual data rate achieved between the transmitting and the receiving Wi-Fi devices.

To limit the effect of interference between Wi-Fi devices, the 802.11 standard makes use of the CSMA/CA and Clear-Channel Assessment (CCA) algorithms. Before sending a packet, the device checks whether an other transmission is currently going on. If this is not case, the device can use the channel and sends some packets. Otherwise, the device will do a random back-off and retry to access the channel after a short period of time.

Even with the use of the CSMA/CA and CCA algorithms, the presence of too many Wi-Fi devices on the same channel will have a negative impact on the maximum achievable data rate. Moreover, these algorithms are inefficient against interferences coming from non Wi-Fi devices or from Wi-Fi devices operating on overlapping channels. Therefore, it is strongly recommended to select a Wi-Fi channel with little to no congestion for ClickShare.

Site survey

Ideally, the selection of the ClickShare channel should be made after conducting a wireless site survey. This site survey maps out the different sources of interference and the active RF systems. Several Wi-Fi survey tools are available on the market, for example:

- The Wi-Spy USB dongle, the Channelyzer and InSSIDer software tools developed by Metageek (http://www.inssider.com/, http://www.metageek.net/).
- The Ekahau Site Survey ESS tool (http://www.ekahau.com/wifidesign/ekahau-site-survey)

Based on the results from the site survey, the least occupied channel can be found and selected for each meeting room..

A screen capture of InSSIDer is reproduced below when data are collected on the UNII-1 and UNII-2 bands. It shows that channels 40 and 44 are the preferred ones as they are much less used by Wi-Fi devices than channels 36 and 48.
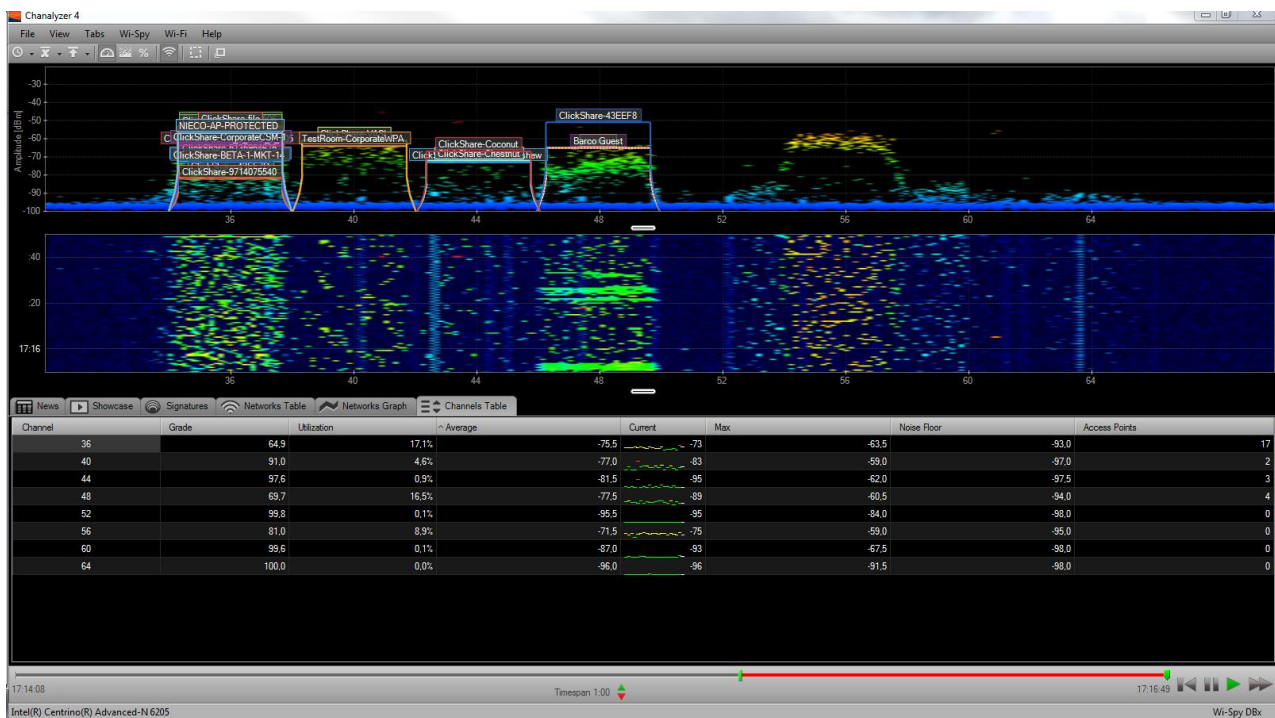

Figure 2: Screen capture of the InSSIDer spectrum survey tool (http://www.inssider.com/)

Generic configuration rules

In case no site survey can be made, the following rules of thumb should allow for a correct configuration:

- The ClickShare access point in a particular meeting room should not re-use a Wi-Fi channel that overlaps with one of the channels used in the corporate WLAN infrastructure. Ideally, at least two channels in the corporate WLAN should be reserved exclusively for ClickShare. In case many ClickShare systems are located closely to one another, more channels may be required. When installing ClickShare base units, we recommend checking with the local IT department which channels are not used by the corporate WLAN infrastructure.

- In an ideal setup, overlapping channels should not be used for two ClickShare base units within range of each other (a possible configuration is shown in Figure 3). As the channels in the 2.4 GHz band overlap with each other, best practise is to use channels 1, 6 and 11 on a single floor (illustrated in Figure 4). On floors above and below, the channel pattern will be shifted to avoid overlap between floors (e.g. by placing channel 6 at the centre of the illustrated pattern).

- In case there are not enough channels available, two or more ClickShares can be placed on the same channel. This will of course have an impact on the quality of the link when several clients are sharing simultaneously. In a worst case scenario, with three base units place on top of one another, this can result in performance issues, as illustrated in Table 4 and Table 5. Table 4 shows a scenario in which all clients are streaming video content, and Table 5 shows a standard office situation where clients share typical office documents or presentations.
  To limit this effect of overlapping networks, we strongly advise to reduce the RF Tx Power (standard range of about 30m) of the ClickShare base units. This can be adapted via the base unit web interface ("Setup" > "Advanced" tab). Reducing the Tx Power to its minimal value will reduce the actual range of the ClickShare to about 10m. By doing so, the size of coverage overlapping area will shrink and the risk for quality degradation on scenarios illustrated in Table 4 and Table 5 will decrease or even disappear.

- As stated above, the 5 GHz channels do not overlap with each other and are less used by non Wi-Fi devices than the 2.4 GHz channels. Moreover, 5 GHz signals are more rapidly damped than 2.4 GHz signals. Therefore the use of a 5 GHz channel is recommended. This will limit the impact of a ClickShare system on other installed ClickShares and on other WLAN users.
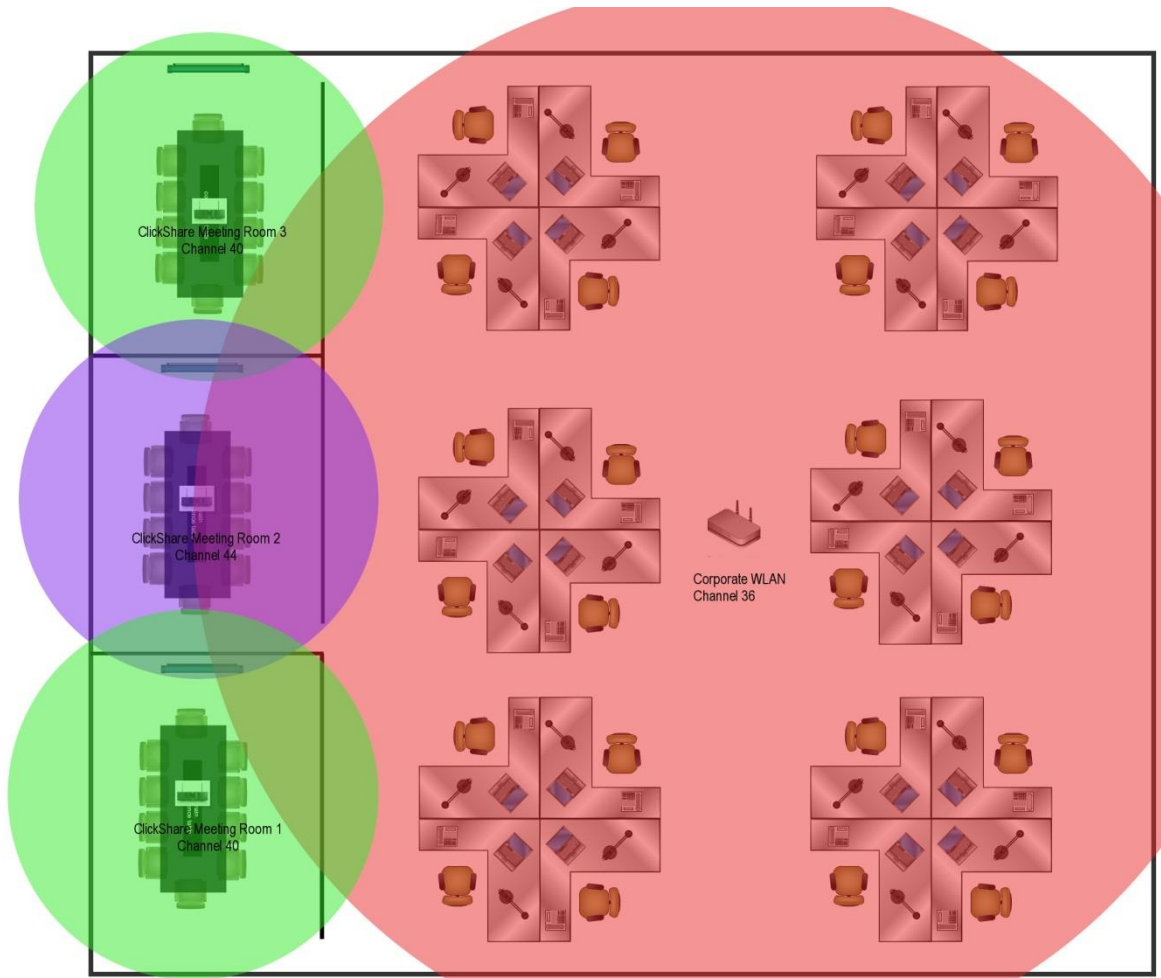
Figure 3: Example of ClickShare installation in a corporate environment with 3 meeting rooms
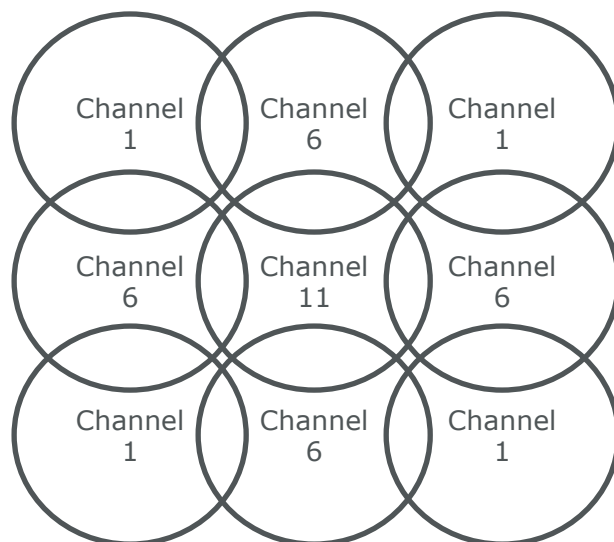

Figure 4: Theoretical Wi-Fi channel allocation map

	Number of co-located Base Units sharing the same channel		
Number of clients sharing video	1	2	3
1	Ok	Ok	Ok
2	Ok	Ok	Moderate risk of reduced quality
3	Ok	Moderate risk of reduced quality	Strong risk of reduced quality
4	Ok	Strong risk of reduced quality	Strong risk of reduced quality

Table 4: Connection quality matrix when multiple co-located base units use the same channel at the same time for video streaming

	Number of co-located Base Units sharing the same channel		
Number of clients sharing typical office documents	1	2	3
1	Ok	Ok	Ok
2	Ok	Ok	Ok
3	Ok	Ok	OK
4	Ok	Ok	Moderate risk of reduced quality

Table 5: Connection quality matrix when multiple co-located base units use the same channel at the same time for daily office work (Power point presentation, Excel sheets …)

Figure 5: Set-up used for the tests reported at Table 4 and Table 5

Important remarks about the ClickShare system installation

A correct installation of the ClickShare base unit is of critical importance to ensure good performance and a robust communication between the ClickShare buttons and the base unit. When installing the ClickShare, please follow the rules below:

- The most favorable setup is a direct line of sight between base unit and buttons. Any obstruction will cause the signal to follow a longer propagation path, which can degrade performance.

- Due to the particular radio pattern of the dipole antennas used with the ClickShare Base Unit, the antennas should not be placed above ClickShare users. In case of ceiling-mounted setup, the advised position for the ClickShare base unit antennas is at the side of the meeting room.

- Do not use the ClickShare base unit without the shipped antennas. Removing the antenna will cause severe degradation of the signal quality and may result in connection issues between the ClickShare base unit and clients.

- Place the base unit in an open emplacement and avoid installing in a metallic shell. A metallic shell (or even shelf) could act as a Faraday cage and block the RF signal. In case this is unavoidable, please use a ClickShare rack-mounting kit or external antennas as explained in the ClickShare application note "Recommendations for using antenna extension cables with ClickShare Base Units".

Once the ClickShare base unit is installed, it is best to control the signal strength at the potential ClickShare Button location. For correct performance, signal strength of -70dBm is needed.

Examples of correct and wrong ClickShare installations

The pictures hereafter show examples of correct and wrong installations.

Figure 6: Example of correct ClickShare base unit installation

Figure 7: Example of correct ClickShare base unit installation

Figure 8: Example of wrong ClickShare installation: the antenna are not connected on the ClickShare rack-mounted kit

Figure 9: Example of wrong ClickShare installation: an incorrect rack-mounted kit is used and the ClickShare base unit antennas are enclosed in the shelf

Figure 10: Example of wrong ClickShare installation: the base unit is placed inside a metallic closet without using antenna extension kit which strongly deteriorates the signal quality

3. ClickShare Wi-Fi Troubleshooting

As the frequencies used by the ClickShare are shared with many other wireless systems (Wi-Fi, Bluetooth …), interferences may occur and might in some circumstances cause connection or disconnection issues. In the case such problem would be observed, we recommend the following steps.

Check the RSSi from the connected Buttons

Even if the selected channel is free of any interference, a too weak signal coming from the ClickShare client (Button or mobile device) can result in an unstable link. In such cases, we recommend:

- Measuring the RSSi from the ClickShare base unit at different Button locations. This can be done by means of a free Wi-Fi survey tool like the inSSIDer. As explained above, the RSSi should be at least -70dBm.

- Check the signal state reported on the ClickShare base unit web interface on the tab "Maintenance" > "Buttons"

If the measured RSSi is too low, check above paragraph "Important remarks about the ClickShare system installation".

Measure interference level

The easiest way to measure the interference level is to use a Wi-Fi survey tool. Most of these tools provide a measure of the channel usage (see the "Utilization" score provided by the InSSIDer software as shown at Figure 2). Too high channel occupancy will be responsible for a lot of packet collisions and retransmissions and can in some extreme cases lead to a disconnection. If such problem is observed, change the Wi-Fi channel used by the ClickShare.

Effect of rogue access point detection system

Some advanced corporate WLAN infrastructures use specific algorithms to detect and to neutralize unauthorized rogue access point. If such systems are not configured correctly, they will wrongly identify the ClickShare base unit as an unauthorized Wi-Fi access point and will cause an unwanted disconnection of the ClickShare. To avoid such problem, the MAC address of the ClickShare base unit Wi-Fi access point must added to the list of authorized access points maintained by the central corporate Wi-Fi controller.