Hospital Mode Design in Smartphones and Tablets for Wireless Security in Healthcare Facilities

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Abstract

Despite the presence of policies and procedures regarding the regulation of the use of wireless devices in hospitals, they are hard to make effective for employees, patients and visitors. Considering many concerns related to electromagnetic interferences and patient privacy, we suggest a more realistic approach based on the design of a Hospital Mode in smartphones and tablets. Hospital Mode manages electromagnetic interference, noise nuisance, protection of privacy, sound level and inhibits video camera and forces the phone ring mode to vibration in non-clinical area. A key aspect of Hospital Mode resides on its ability to switch automatically the smartphone or tablet ON and OFF depending on the area of the hospital. We recommend a regulation towards smart building integrating dedicated frequencies bandwidth to manage Hospital Mode for any compliant wireless technology.

Keywords: **Electromagnetic Interference, Electromagnetic Safety, Privacy, Health and Safety, Cell Phones, Medical Equipment, Hospital Mode, Smart Building.**

I. INTRODUCTION

More and more electromagnetic devices transmitting frequencies are being used in hospitals, and may interfere with medical devices: pagers, cordless phones, cell phones, and tablets, portable radio transceivers, tracking devices, laptop computers, telecommunications antennas and medical equipment. These wireless technologies are increasingly available to the general public and are found in hospitals with the employees, patients and visitors. Local policies prohibit entirely or partially the use of cell phones in the hospital compound or only in some critical care units [1].

Cell phone and Tablets being the most spread technology in healthcare facilities, our approach is to design a Hospital Mode for wireless devices based on the Airplane Mode concept in Airplane transportations.

II. MATERIALS AND METHODS

A. Airplane Mode or Flight Mode

When activated, Airplane Mode suspends signal transmitting functions on many mobile phones and other electronic devices while still permitting use of functions that do not require signal transmission [2].

B. Wireless communications concerns in Healthcare

Electromagnetic interferences are believed to cause medical devices malfunction [3]. However, wireless technologies are more and more introduced in clinical practice, as medical devices or simply as professional or personal communication tools. To manage the risk, a dispositive similar to Airplane Mode will be necessary to develop and contain the risks to the patient.

C. Key parameters of an Hospital Mode

The primary work of a medical care provider is to heal the patient. It is important to reduce all peripheral interventions that are not directly related to the caring act. A Hospital Mode will need mainly to provide the following capabilities:

- Hand-free operations;
- Smart activation and deactivation of the phone communication and recording functions.

D. Hand-free setup

There is no need for human intervention to activate or deactivate a Hospital Mode if the building is Hospital Mode ready.

E. Activation and deactivation frequencies

In accordance with The Food and Drug Administration, Health Canada and other healthcare regulation agencies, the International Commission for Electromagnetic Safety will need to determine two frequencies and bandwidth reserved for activation and deactivation of Hospital Mode in smartphones and tablets.

III. RESULTS

Hospital Mode can be considered an enhancement of the actual Airplane Mode as illustrated in Table 1. It disables in addition sound and video recording, while the activation/deactivation is automatic according to the area inside the hospital.

Table 1: Comparison on Airplane Mode and Hospital Mode

	Airplane	Hospital
Activation	Manual	**Automatic**
Dectivation	Manual	**Automatic**
Antenna - Transmission		
Place calls	No	No
Receive calls	No	No
Edit text messages	Yes	Yes
Send text messages	No	No
Receive text messages	No	No
Edit Emails	Yes	Yes
Send Emails	No	No
Receive Emails	No	No
Antenna - Reception		
FM radio	Yes	Yes
GPS	Yes	Yes
Entertainment		
Games	Yes	Yes
Built-in camera	**Yes**	**No**
MP3 player	Yes	Yes
Sound recorder	**Yes**	**No**
Sound level control	**No**	**Yes**
Communication technologies and cellular services		
GSM, UMTS, LTE	No	No
Wi-Fi	No	Hospital Wi-Fi Network (if equiped)
Bluetooth	No	No

IV. DISCUSSION

A. Noise nuisance control

In a clinical area, silence is an element of comfort and patient recovery. Cell phone can be a noise nuisance and thereby impair the well-being of patients, especially during the night shift. It is therefore recommended that any employee, patient and visitor ensures that the volume of his mobile phone be either discrete or off.

The design of Hospital Mode could control the sound level so that it couldn't reach 40% of its original maximum.

Ring tone is forced to vibrate only, when the cell antenna is only active in non-clinical areas.

A maximum voice level is automatically configured according to the country noise regulations [60 dB, default]. Above this level, 5 sec countdown warning is eared prior to shut down the cell phone and end prematurely the communication. If the voice level is reduced, the warning disappears and the communication continuous.

B. Confidentiality and privacy

Most mobile communication devices allow photographing, filming and recording. The privacy of personal, medical and social data as well as any other information concerning the patient shall be secured in compliance to the rights for respect, confidentiality, image, privacy and dignity.

The intimacy and privacy of patients and their families must be preserved.

C. Suggested building layout

Unlike the Airplane Mode that allows to turn manually ON / OFF the communication capabilities of a wireless device (Table 1), a Hospital Mode should automatically deprive the devices [GPS, smart phones, tablets, Windows 8.1] from their ability to communicate at the entrance of the department and restore communication capabilities when returning back to the non-clinical areas. Activation and deactivation antennas with reserved frequencies are installed inside the walls at the entrance of the care unit as illustrated in Fig. 1.

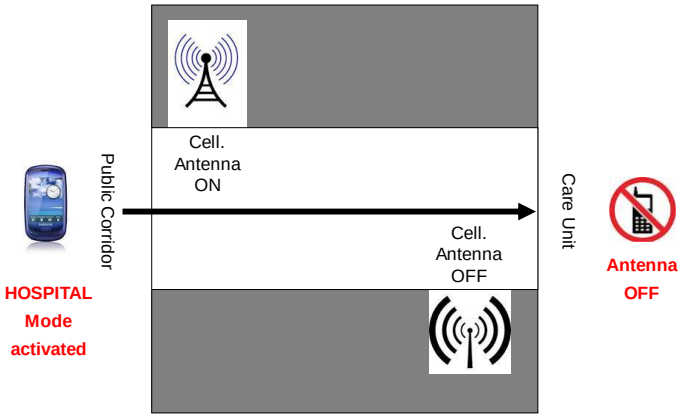

Fig. 1: Infrastructure suggested for the use of Hospital Mode on clinical units

Both frequencies must be chosen to be compliant with medical devices and their radiation range must be limited to the vicinity of the entrance (5 m recommended).

D. Impact on building construction regulations

There is a need to reserve two frequencies (Cell Antenna ON and OFF frequencies) for hospital infrastructure only. An international regulation would be a better alternative to facilitate industrial design of these smart building components.

E. Special authorizations on Hospital Wi-Fi Network (if equipped)

In case of clinical or medical necessity, a smartphone or a tablet can be authorized on the Hospital Wi-Fi Network. This establishes the Internet Access and all Internet-related communications feature. Sound and privacy remain controlled as defined in Table 1. The hospital network must be designed to minimize the communication device's power spectrum in the vicinity of medical devices (less than 25 mW). This setup expires during a limited time defined by the specific clinical or medical use. It is recommended that the activation permission never exceeds 12 hours.

F. Design of a Hospital Mode App for Smartphones and Tablets

Hospital Mode is equivalent to an Airplane Mode which, in addition, prevents the cell from its audio recording capabilities, photo, video and forces it on vibrate. Such a design would be possible within the update of the current Airplane Mode. A new mobile App could be developed to emulate Hospital Mode on any smartphone or tablet.

G. Hospital Mode Logo

To accommodate most countries, the 'H' letter will be used, combined with a wireless symbol (Fig. 2, left). A green letter refers to a safe environment. Hospital Mode logo has to be located close to the logo of Airplane Mode in Smartphone and Tablet's menus. Following a Flight Mode enhancement to a Hospital Mode, the new logo is suggested to be a combination of both (Fig. 2, right).

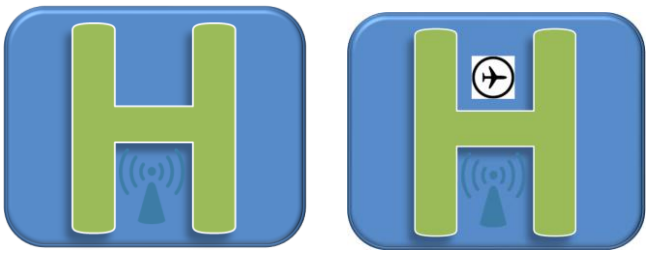

Fig. 2: Logo suggested for Hospital Mode (left) and an enhanced Airplane Mode (right)

V. CONCLUSION

Hospital Mode manages noise nuisance, protection of privacy, and inhibits sound recording, video camera and forces the phone ring mode to vibration in non-clinical areas. A key aspect of Hospital Mode resides in its ability to switch automatically the smartphone ON and OFF depending on the area of the hospital. We recommend a regulation toward smart building integrating dedicated frequencies to manage Hospital Mode for any compliant wireless technology.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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