

BENCHMARKING OF POCKET ROUTERS



1

Version: 1.0 – September 29th 2016

Author: Francis Vachon (CartONG)

Review: Sandra Sudhoff (CartONG)

Owner & commissioner: UNHCR Public Health Section, Geneva

Purpose: Pocket routers are becoming increasingly available and offer many potential advantages for mobile data collection (MDC) in remote location with little connectivity and unreliable power supply. This document discusses potential uses for MDC and evaluates the performance of 3 of them.

This publication has been produced with the assistance of the Office of the United Nations High Commissioner for Refugees (UNHCR). The contents of this publication are the sole responsibility of CartONG and can in no way be taken to reflect the views of UNHCR.

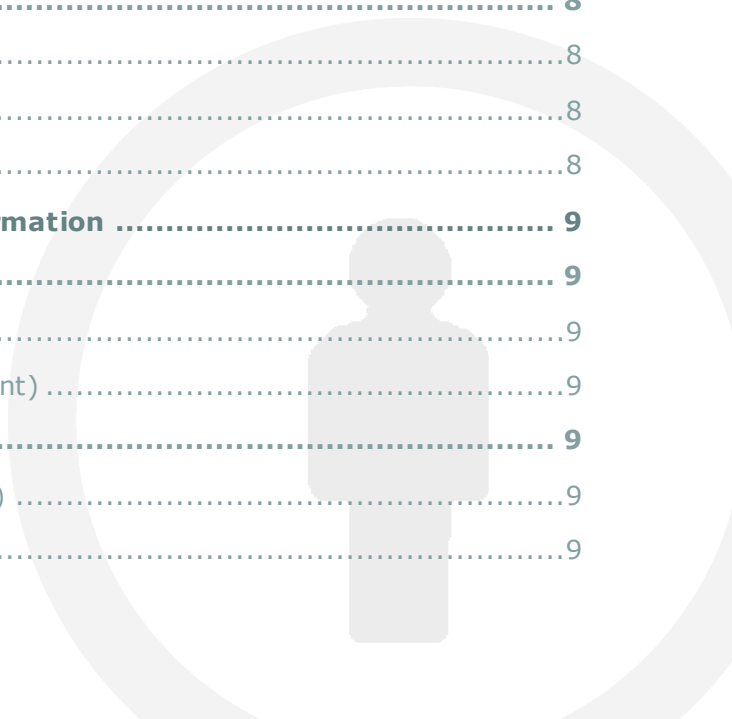
Reproduction and dissemination for educational or other non-commercial purposes is authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction for resale or other commercial purposes, or translation for any purpose, is prohibited without the written permission of the copyright holders. Applications for such permission should be addressed to the Public Health and HIV Section of the Office of the United Nations High Commissioner for Refugees (UNHCR) at HQPNN@unhcr.org

These devices were first tested in November 2015, and the information updated in June 2016. As with all technologies, these products tend to change quickly and/or be rendered obsolete by newer products.


BENCHMARKING OF POCKET ROUTERS

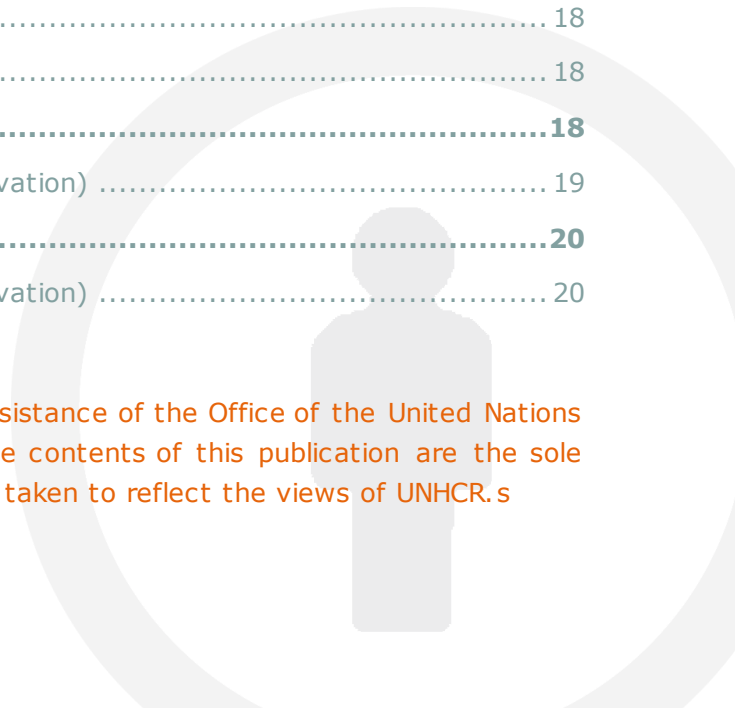
Contents

1. Acronyms	4
2. Executive summary	4
3. Summary of networks in SENS surveys	5
3.1. Networks in MDC	5
3.1.A. Types of networks & access	5
3.2. Management of networks - hardware	6
3.2.A. Android phones.....	6
3.2.B. Conventional (plug-in) routers	7
3.2.C. Pocket routers (PR)	7
3.3. Use case for PR in MDC	8
3.4. Testing points for MDC	8
3.4.A. Networking	8
3.4.B. Power management	8
3.4.C. Configuration/ease of use	8
4. Pocket routers – background/technical information	9
4.1. Useful modes for MDC	9
4.1.A. 3G/4G router (or USB Modem)	9
4.1.B. WAP (Wireless Access Point or Access Point)	9
4.2. Other modes:	9
4.2.A. WISP (Wireless Internet Service Provider)	9
4.2.B. File sharing	9



4.2.C. Router mode	9
4.3. Useful features	9
4.4. Available Features less important for MDC	10
4.4.A. Transfer speed	10
4.4.B. Range	10
4.4.C. USB and file-sharing	10
5. Pocket Router – tested models	10
5.1. TP-LINK TL-MR3040	11
5.1.A. Networking	11
5.1.B. Power management	11
5.1.C. Configuration/ease of use	11
5.2. Netgear trek N300 PR2000	12
5.2.A. Modes offered	12
5.2.B. Networking	12
5.2.C. Power management	12
5.2.D. Configuration/ease of use	12
6. D-Link Wi-Fi AC750	12
6.1.A. Modes offered	12
6.1.B. Networking	12
6.1.C. Power management	12
6.1.D. Configuration/ease of use	13
7. Annex: Overview Matrix	14
8. Annex: Setup & test notes	17
8.1. TP-LINK TL-MR3040	17
8.1.A. Selecting operation mode (first start of the router only or after reset)	17
8.1.B. Setup WISP	18
8.1.C. WISP mode:	18
8.2. Netgear trek N300 PR2000	18
8.2.A. Assigning a fix IP address (address reservation)	19
8.3. D-Link Wi-Fi AC750	20
8.3.A. Assigning a fix IP address (address reservation)	20

 This publication has been produced with the assistance of the Office of the United Nations High Commissioner for Refugees (UNHCR). The contents of this publication are the sole responsibility of CartONG and can in no way be taken to reflect the views of UNHCR.s



1. Acronyms

- **IP (address)**: the address at which a device can be reached. For example, the VM for offline data collection typically can be reached at: <http://192.168.0.111>
- **ISP**: Internet service provider. The company or source of internet access (either telephone company or SIM card provider, etc)
- **LAN**: Local area network. It does not allow connection to internet, but otherwise works as a regular wifi network. It allows devices (phones, computers, etc) to exchange information locally.
- **MDC**: Mobile data collection
- **PR**: Pocket routers
- **VM**: Virtual machine, the system used to manage the survey data for SENS survey while being offline. This is the software that allows ODK Aggregate to run, so that data from the phone can be sent to the computer.
- **WAP**: Wireless Access Point. A device to which phones and computer can connect to access internet.

2. Executive summary

Pocket routers (PR) are a new alternative to conventional routers, which have been used for a few years already in MDC to allow exchange of data between the phones and the survey computer. Just like conventional routers, they can be used to manage a WIFI network, but they require constant electrical supply to work which can at times be problematic in the field.

Some features of particular interest from a MDC perspective are power autonomy, greater flexibility to provide internet connection than convention routers, including the use of SIM card for 3G networks which are fairly common in field operations where options for internet access are limited. They otherwise tend to work similarly to conventional router, although their cost is slightly higher and different models tend of focus on different features – meaning that careful testing and research would be needed before settling down on a particular model.

Of particular importance for MDC uses are the ability to fix the IP address at which the VM can run. Being able to keep this address fix makes it easier for survey managers to obtain the data from the phone. Another key point for potential PR are ease of use from the end user perspective – once they are configured, they should ideally only need to be started much like conventional routers currently used.

Three models have been tested: TP-LINK's TL-MR3040, Netgear trek's N300 PR2000 and D-Link's AC750. It seems at this point that they each have pros can cons, though none seemed to be a perfect fit from a MDC perspective. TP-LINK's router have most of the desired features, however some bugs have been noticed in its use and they would need to be corrected (perhaps in a newer version) and tested anew in order to be recommendable.

3. Summary of networks in SENS surveys

3.1. Networks in MDC

For MDC operations, a network is needed to facilitate data transfer from the mobile phones to either a computer or a server. For SENS surveys, it is generally easier to work locally (offline) using a local network. In remote locations, working locally has the advantage of not relying on often unstable and poor quality WIFI or 3G networks. This can easily be accomplished using a simple, household type of router that creates a (local) wifi networks, which allows the easy transfer of data from the phones to the server (which is simply installed on a laptop).

Recently, pocket routers have appeared on the market and are becoming increasingly affordable. While they generally are still more expensive than conventional routers, they may offer significant advantages for MDC. Because they include an internal battery, they do not need electricity to function and provide a way to transfer data. Combined with the use of smartphones and laptop, both of which also have a certain power autonomy, it could allow work for some amount of time even without electricity. Some models also offer the ability to use SIM cards directly to connect to the internet, effectively providing a local hotspot to work online in a more convenient manner than what is possible using the smartphones themselves.

3.1.A. Types of networks & access

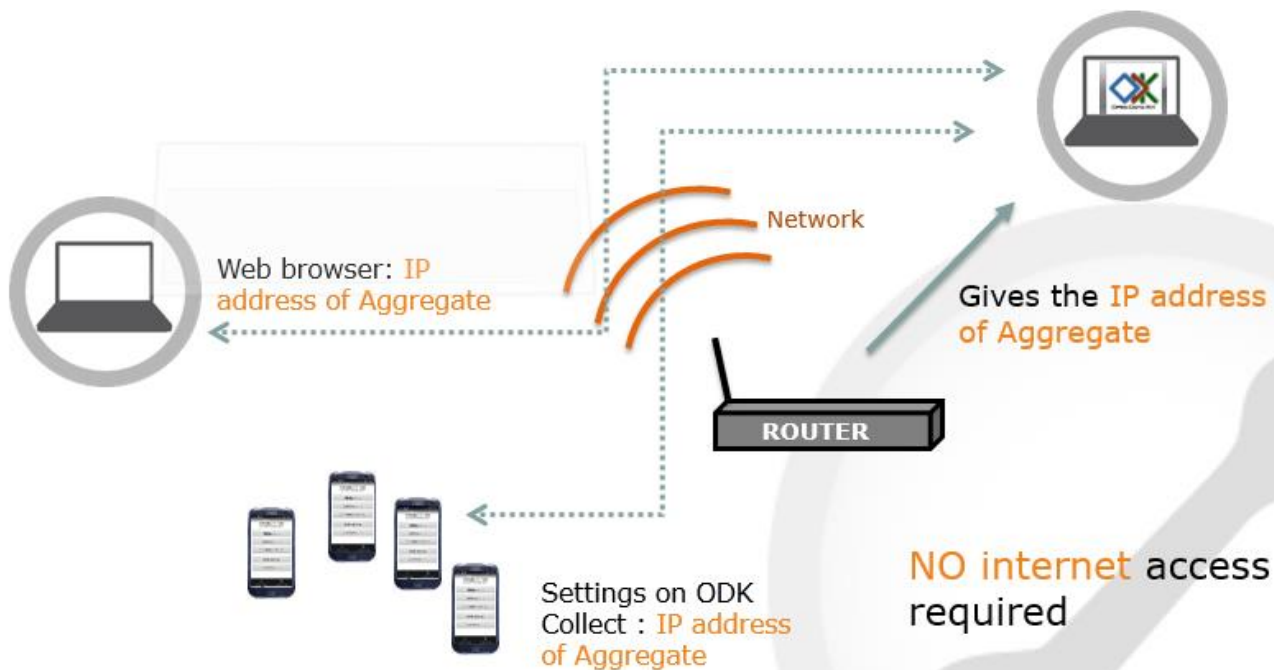


Figure 1: A schematic view of how the VM works on a local network

When no internet connection is required, then a local area network (LAN) is sufficient. Only devices directly connected to that network (therefore in range of the signal) will be able to exchange data. It is the Router (conventional or PR) that provides ODK Aggregate (the server that can be access on a web browser) with the URL, or the address that must be entered in the web browser to access it. Some router and some PR will allow users to decide what is the IP address at which a device or a service (such as Aggregate) can be reached, while others will make the choice but will now allow customization of that address.

When internet access is required, one option is an internet service provider (ISP) with a wired/satellite connection. Typically this is a longer-term solution that requires a local operation already established.

When shorter term internet access is needed and no local office exists in the zone of operation, SIM cards are often the only option for internet access.

3.2. Management of networks - hardware

3.2.A. Android phones

It is possible to generate a hotspot through an Android phone, but their capacities are limited (bandwidth & network management options). They are convenient in remote locations because the technical know-how to set up a data plan on a phone is likely to be available locally.

They don't require constant power supply – only a charged battery. Phones are required for MDC, therefore they offer in a sense a “free” option for network access – however that option is generally not user-friendly for users not familiar with smartphones & tech (some manipulations required to switch on/off).

Some phones do NOT allow users to create a LAN if no SIM card is inserted.

It is also possible to have each phone equipped with its own SIM card with data. However, unless enumerators work autonomously in remote locations (and need individual internet access), this option isn't cost-effective.



At a glance:

+PRO+	-CON-
Power autonomy	IP Address can't be fixed
Many people using smart phones privately already know how to set it up	Some phones can't work without SIM



3.2.B. Conventional (plug-in) routers

Routers are generally meant to work with a wired or satellite internet connection, but most allow creating a LAN and working locally. They typically do not allow the use of SIM cards & data plan through local providers and require constant power supply. However they allow greater versatility in network management, such as fixing IP addresses.



Generally easy to use as they can just be plugged in and computers can be configured to remember the network (once they have been properly configured).

At a glance:

+PRO+	-CON-
IP Address can be fixed	No power autonomy, will always need electricity
Easy to use for the end user	Setting them up requires a person with technical/IT skills

3.2.C. Pocket routers (PR)

They are a combination of phones & plug-in router in terms of functionalities. Like phones, they support the use of SIM cards for easier internet and they work on battery and/or allow the use of power charges.

Like conventional routers, they also allow network management options (such as fixing the IP addresses) that are similar to what conventional routers provide. They also allow the creation of a LAN.

Overall, they offer the most versatile option for network access/management. However the features offered aren't uniform and must be verified on a model-per-model basis to avoid surprises. They are also costlier than conventional routers – typically 2-3 times the price, although simple plug-in routers are very cheap these days (15-20 euros).



At a glance:

+PRO+	-CON-
IP Address can be fixed (on some models)	Slightly costlier than other options

Power autonomy for all models – some perform better than others	Setting them up requires a person with technical/IT skills
Easy to use for end users (some models more than others)	Inconstancies in features: models need to be well researched and tested

3.3. Use case for PR in MDC

Based on the above, a few factors could motivate the use of PR instead of conventional routers for MDC operations:

- The possibility to benefit, from a single device, from advantages that are usually available in either a conventional router or a smartphone, but not simultaneously in both, such as:
 - Power autonomy (smartphone)
 - Capacity to access internet through SIM cards (smartphone)
 - Capacity to access advanced network management features, such as fixing IP addresses (conventional routers)
 - Capacity to create LAN and work locally even if no internet access is possible (conventional routers and some smartphones but not all)
- The potential to have these advanced features available even in low technical-skills environments and remote locations
- Using a smartphone as a hotspot has the downside that this specific phone cannot be simultaneously connected to the LAN to send submissions and be used as the hotspot. Using a PR instead removes this complication

3.4. Testing points for MDC

In **bold** are necessary features, other features may not be required in all context and their absence may be acceptable in an otherwise well-features model.

3.4.A. Networking

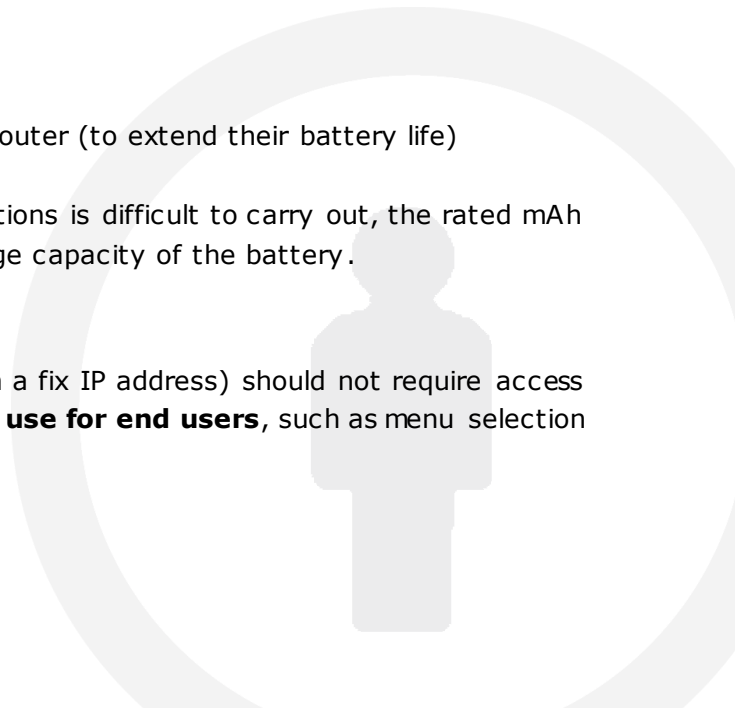
- **Creation of a LAN and successful launch of the VM**
- **Fixing of the IP address for Aggregate on the LAN (as is done with conventional routers)**
- **Can use 3G/4G SIM cards for internet access**
- **Can use Ethernet (plug-in) internet access**

3.4.B. Power management

- Allows the use of external charges to power the router (to extend their battery life)
- Can be used as external charges for phones
- Battery life: while extensive testing in field conditions is difficult to carry out, the rated mAh rating gives a good indication of the power storage capacity of the battery.

3.4.C. Configuration/ease of use

- Basic use (such as starting and using the VM with a fix IP address) should not require access to any menus in the browser. **It must be easy to use for end users**, such as menu selection with a button or starting the router.



4. Pocket routers – background/technical information

There is some confusion possible when looking up the different modes of operation that pocket routers (PR) may offer – some have different names and at times the same name might not have the same meaning from 2 different sources. It is therefore relevant to establish some conventions.

4.1. Useful modes for MDC

4.1.A. 3G/4G router (or USB Modem)

Some PRs have a USB port that can be used to directly connect a USB modem (with SIM card). The router then broadcasts that network as a WIFI network. In that sense it is similar to a hotspot through a phone, with additional configurations options not generally available with smartphones (such as fixing IP addresses of clients, which is often used when working offline).

4.1.B. WAP (Wireless Access Point or Access Point)

The PR is connected via an Ethernet cable and broadcasts that network as a WIFI network, much like a plug-in router. If no Ethernet connection is provided (or it offers no actual internet connection), then the PR offers a LAN network, effectively working as a wired router for SENS survey (or a hotspot from Android phones).

4.2. Other modes:

4.2.A. WISP (Wireless Internet Service Provider)

This mode allows the router to connect to an existing WIFI network. The router then acts as a secondary router for your devices. In the PR's admin page, the credentials for the existing network must be entered. For the devices that must be connected to the PR, then the credentials selected for the PR's network must be entered (not those of the original network).

→ It can be used as a range extender, by placing the PR mid-way between the original router's location and the desired location to wish one would like to extend the signal to. In some cases, the original signal may be strong enough for a computer, but not for some smartphone which often need stronger signals to work properly.

4.2.B. File sharing

Some routers also allow file sharing if a hard drive is connected through USB.

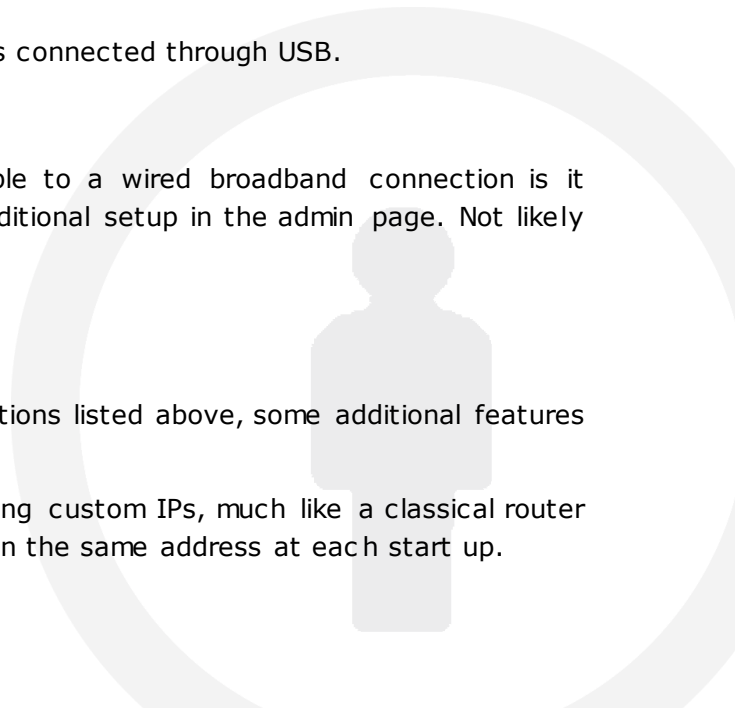
4.2.C. Router mode

Similar to WAP, however instead of Ethernet cable to a wired broadband connection is it connected via Cable or DSL. This mode requires additional setup in the admin page. Not likely to be of use for MDC but included for completeness.

4.3. Useful features

In addition to the existence of the 3 modes of operations listed above, some additional features would be desirable in the ideal PR:

→ Fix IP: a good PR for MDC needs to allow assigning custom IPs, much like a classical router does, so that the Virtual Machine (VM) can run on the same address at each start up.



- Battery life: while it can be hard to come up with standardized tests, specifications can be used as a rough guideline, along with external tests/reviews. The battery capacity rating (mAh) is the best indicator for this. Since the energy needed from one PR to the other to perform basic tasks is likely to be comparable, this would give a good indication of available use time on a single charge.
- Compatibility with external chargers through USB: some models can be plugged through the same external charges that smartphones uses, which is practical. Not all PR support this. Conversely, some routers can also work as external batteries themselves for smartphones.

4.4. Available Features less important for MDC

4.4.A. Transfer speed

Except in very specific context, it seems unlikely that the performance in terms of transfer speed of PRs would matter for MDC.

- If working online, in most field settings, the bottleneck would be the ISP and the strength of its network
- If working offline, the amount of data handled are always small enough so that even the most basic transfers speeds will be sufficient

Therefore performance in terms of transfer speed doesn't need to be tested thoroughly for this benchmarking: it will be possible to rely on available numbers and specifications provided or available online.

4.4.B. Range

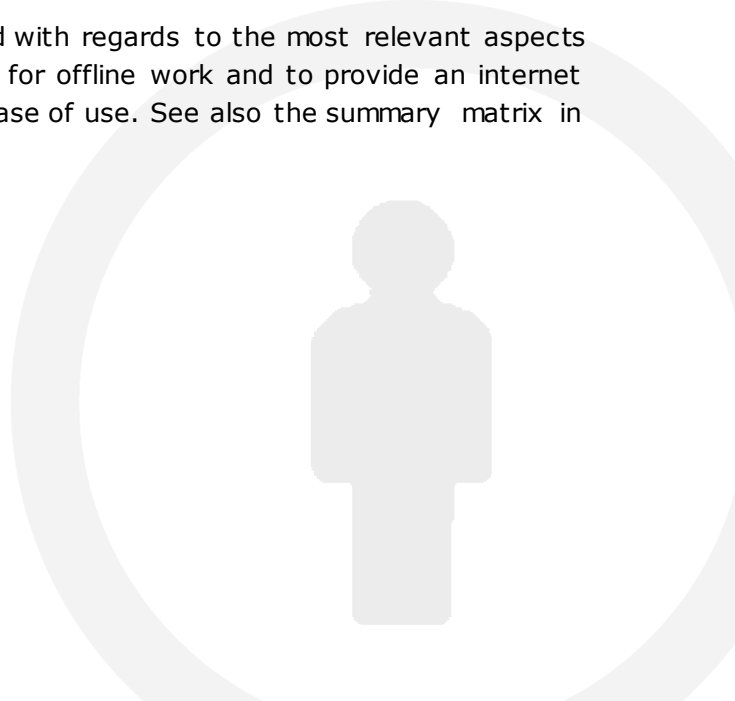
Since routers for MDC are generally used only by supervisors in a confined area, the signal's range isn't a factor that would come into play. Hence information from the providers or found online are cited for this, but not tested independently.

4.4.C. USB and file-sharing

Many PRs can also act as wireless file-sharing devices if connecting an external HD through USB. While this is a potentially useful feature, for current use in MDC there isn't a clear use case. Its availability will therefore be noted for each device, but not specifically tested.

5. Pocket Router – tested models

Details are provided on each of the three PR tested with regards to the most relevant aspects for MDC: networking (their ability to provide a LAN for offline work and to provide an internet connection), power management, configuration & ease of use. See also the summary matrix in Annexe for more information.



5.1. TP-LINK TL-MR3040

Modes offered: WISP, Router, 3G/4G, WAP.

5.1.A. Networking

The router allowed for the VM to be started and a fix IP address assigned to it, and the IP address was maintained after restarting of the VM. To select the mode of operation (WAP, 3G/4G access, etc) the user must access the setup menu from a browser at least for the first use. Once the router has been setup however, it will restart with the last configuration used. It also works with internet connection through an Ethernet cable as is sometimes still seen in the field. The maker also lists connection through SIM cards as available (though this feature was not tested).

Some problems noticed at start-up: sometimes, after the PR had been configured and shut down, it would not readily offer a network to connect to upon restart. In order to obtain a network, it seemed that it was then necessary to reset the PR (a reset button is available). However, when resetting the router, any configuration saved is lost, and the mode of operation needs to be selected again. In that case, the fixed IP address for the VM would also be lost and have to be configured again. This would not be acceptable for use in the field, as the ability to perform the configuration again may or not be readily available.

The problem was inconsistent and the exact cause could not be determined. Other users have reported similar and related problems. There were no clear unique solutions that emerged. Perhaps an update of this model will solve these issues – it would need to be tested thoroughly again before use.

5.1.B. Power management

This model offered good features for energy management, as it allows the use of external charges to extend its battery life and it can also be used as an external charge for smartphones. The battery rating of 2000 mAh is in line with other similar devices, but not outstanding.

5.1.C. Configuration/ease of use

This model only has an on/off button and any operation must be performed through the browser, which is less user-friendly than a switch (such as the Net gear PR offers). It defaults upon restart to the last configuration used, therefore assuming that only one such configuration would be used it is then very easy to use.



5.2. Netgear trek N300 PR2000

5.2.A. Modes offered

WISP, Router, WAP and file sharing.

5.2.B. Networking

The Netgear PR allowed to create a LAN very easily (through a switch on the side of the device). Setting the fix IP address for the VM was successful and the VM worked well with this device. However, the process to assign this IP address is more complicated than with the TP-link model. This may not matter for technical users, however remote support with this model would be harder to provide.



One drawback of this model is the impossibility to use SIM cards for internet access. The only ways to connect to internet with this device is either with an Ethernet cable, or by using it as a range extender (WISP mode on an existing wifi that does provide internet access).

5.2.C. Power management

The power management on this device is not optimal: the branches to connect to a socket are directly on the device (no USB wire), which is not as practical – other devices allows the use of UBS cables, therefore any phone charger could be used which reduces the need for socket adapters.

It also does not allow the use of external chargers to extend its battery and has a standard 2000 mAh capacity. It can, however, be used as a charger for smartphones.

5.2.D. Configuration/ease of use

With its switch on the side, it is the easiest device to use. It has also performed reliably during testing and no specific problems were noticed.

6. D-Link Wi-Fi AC750

6.1.A. Modes offered

WISP, Router, 3G/4G, WAP and file sharing.

6.1.B. Networking

This model does include connection to 3G/4G networks using SIM cards, however those SIM cards will need to be mounted on a USB stick and connected to the device and they cannot be inserted directly. Additionally, it will accept Ethernet cables. The VM could be started and used with this device, however it was not possible to assign a fix IP address to the VM.

6.1.C. Power management

The devices works well as an external charge for smartphones and its battery life can also be extended by using an external charge with it. Additionally, it has the best battery capacity (4000 mAh, twice the other models tested).



6.1.D. Configuration/ease of use

The router offers a switch to select between online and charger mode, it also offers two different modes, at 2.4 GHz as well as 5Ghz. additionally, it allows to establish a guest Wifi which will give access to the internet but not the devices on the same network.

The configuration page is accessible at dlinkrouter.local (or 192.168.0.1).



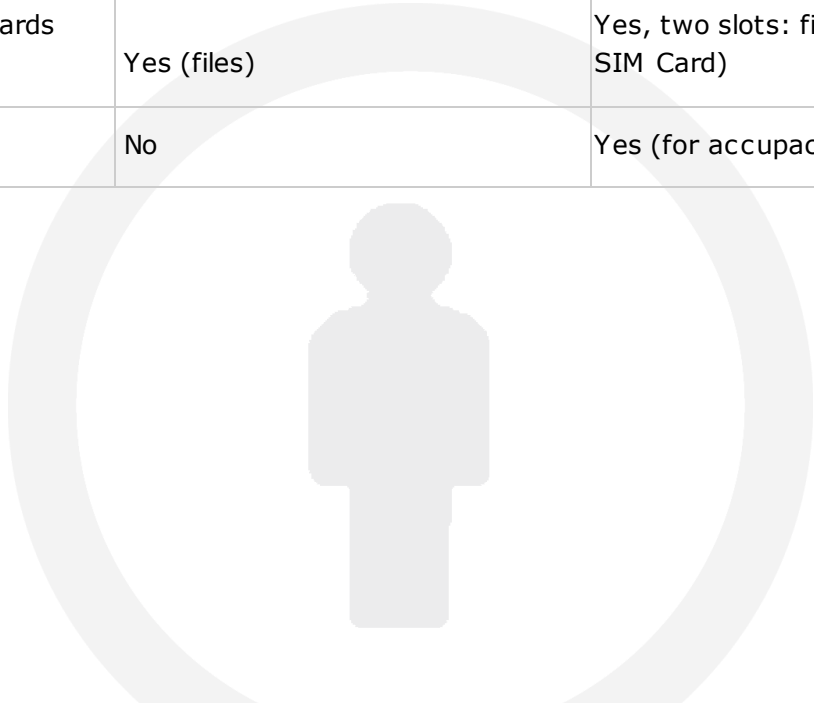
7. Annex: Overview Matrix

	TP-LINK TL-MR3040	Netgear trek N300 PR2000	D-Link Wi-Fi AC750
Price (Amazone.fr, June 2016)	50€	25€	78€
Pros	<ul style="list-style-type: none"> • Most important MDC features available • Can work with accupak & external charges • Accepts 3G/4G through USB modem 	<ul style="list-style-type: none"> • Best price • Switch on the side to select mode of operation is more user-friendly 	<ul style="list-style-type: none"> • Can work with accupack & external charges • Accepts 3G/4G through USB modem • Best battery autonomy • Offline mode, i.e. LAN easy to set up
Cons	<ul style="list-style-type: none"> • Some cases noted where the router had to be reset (erases any configuration saved) 	<ul style="list-style-type: none"> • Can't be used with accupak/external charges • Setting fix IP address is possible but less convenient than other models • Can't use of 3G/4G sim cards through USB modem 	<ul style="list-style-type: none"> • More expensive than other options • IP address of VM cannot be fixed, only of physical devices
Battery	2000 mAh	2000 mAh	4000 mAh

	TP-LINK TL-MR3040	Netgear trek N300 PR2000	D-Link Wi-Fi AC750 (DIR-510L)
Modes			
WISP	Yes	Yes	Yes
3G/4G USB modem	Yes (not tested)	No	Yes, but needs to be external, i.e. there is no SIM card slot on the PR,

	TP-LINK TL-MR3040	Netgear trek N300 PR2000	D-Link Wi-Fi AC750 (DIR-510L)
			USB device or phone needs to be attached
WAP (Wireless access point)	Yes	Yes	Yes
Router mode	Yes, not tested.	Yes (not tested)	Yes
File Sharing	No	Yes	Yes (not tested)
How to select mode to use?	Through the admin page only, which isn't convenient. However it does remember the mode in which it last worked and seems to restart using that mode next.	A switch for common mode, however advanced functions must be set through admin page.	Through admin page, except for Charger only.
Other functions			
Assign Fix IP address	Yes	Yes	Yes but not to a VM
Note on assigning fix IP	Similar to DLINK & other router used for MDC	MAC address of the VM needed to be obtained manually from the VM; it wasn't possible to set it up directly through the PR's admin page as was the case with the TP-LINK model.	Physical devices connected are recognised and IP can be set manually, however, this is not possible for VM
VM tested for fix IP	Yes working	Yes working	Not possible.

	TP-LINK TL-MR3040	Netgear trek N300 PR2000	D-Link Wi-Fi AC750 (DIR-510L)
Can use accupack for charge?	Yes	No	Yes (not tested)
Can be USED as accupack for phones?	Yes	Yes	Yes
Ports & connections			
Ethernet (cable/modem in)	Yes	Yes	Yes
2nd ethernet port (to connect to computer)	No	Yes	No
USB	Yes (for modem through SIM cards only)	Yes (files)	Yes, two slots: files and modem with SIM Card)
Mini-USB	Yes (for accupack/charger)	No	Yes (for accupack/charger)



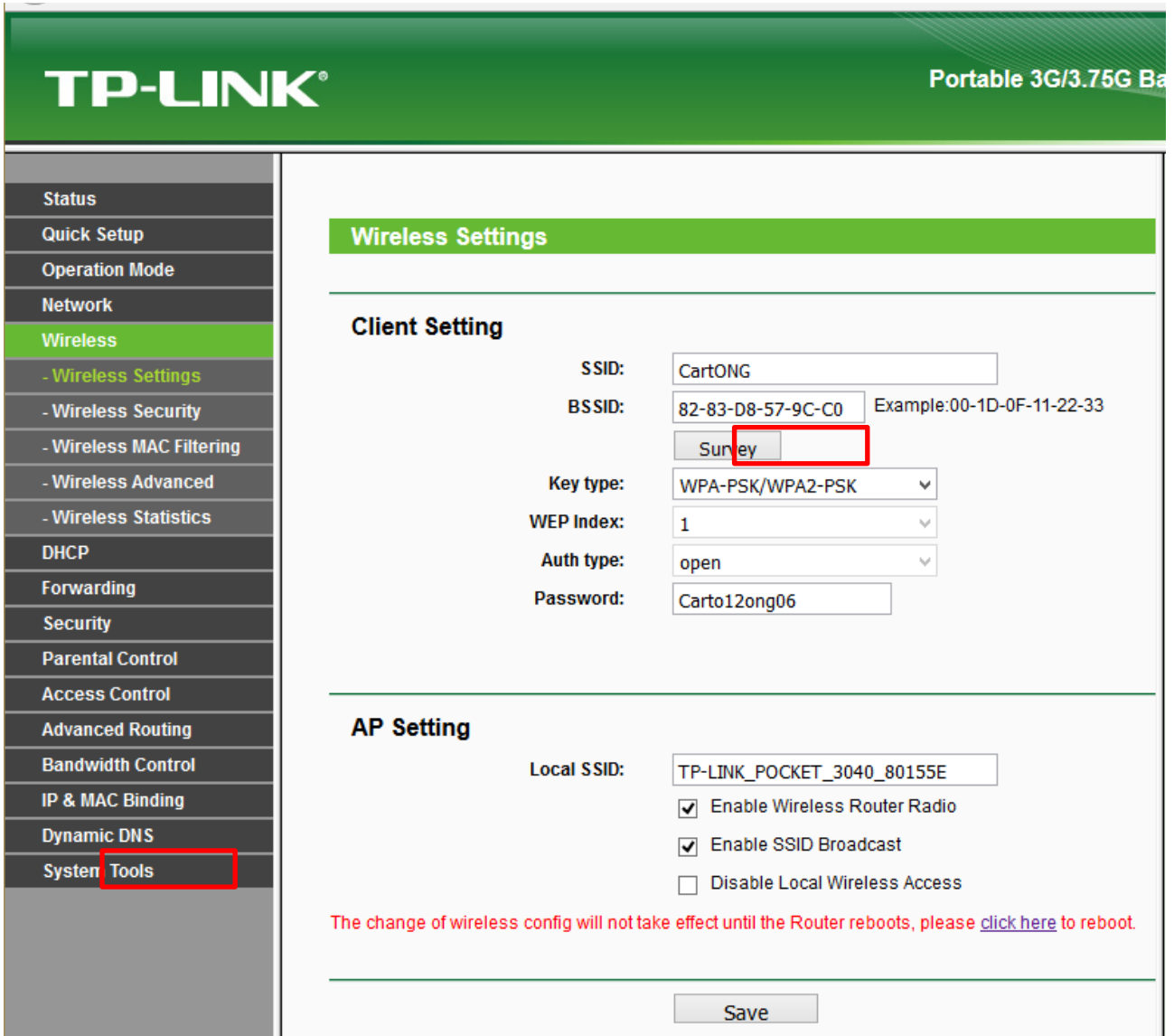
8. Annex: Setup & test notes

8.1. TP-LINK TL-MR3040

8.1.A. Selecting operation mode (first start of the router only or after reset)

- Plug-in the router & let it create the network (TP-LINK TL-MR3040-XXXXX, unless changed previously via admin page)
- Connect to that network
- Open a browser, go to 192.168.0.1 & enter "admin, admin" for credentials
- Then select "Quick Setup" and choose the operating mode desired:
 - 3G router
 - Wireless router
 - Standard AP (e.g. a LAN as we use normally for SENS)
 - AP
 - Repeater
 - Bridge with AP
 - Client
 - WISP client router mode

8.1.B. Setup WISP



TP-LINK® Portable 3G/3.75G Ba

Wireless Settings

Client Setting

SSID:

BSSID: Example:00-1D-0F-11-22-33

Key type:

WEP Index:

Auth type:

Password:

AP Setting

Local SSID:

Enable Wireless Router Radio

Enable SSID Broadcast

Disable Local Wireless Access

The change of wireless config will not take effect until the Router reboots, please [click here](#) to reboot.

8.1.C. WISP mode:

Mixed results have been achieved in setting up WISP mode, which allows to use the PR as the gateway to which clients connects. It was attempted on 2 different networks, one of which was a success. There are actually a number of configuration choices to make and any mistake may deny internet access through the PR. The main router's security configuration may also interfere with the PR's attempt to function in this mode, so network with heavy firewall can prove more complicated (or impossible) to use with this mode.

The VM could be used on the successful connection as well as an online server.

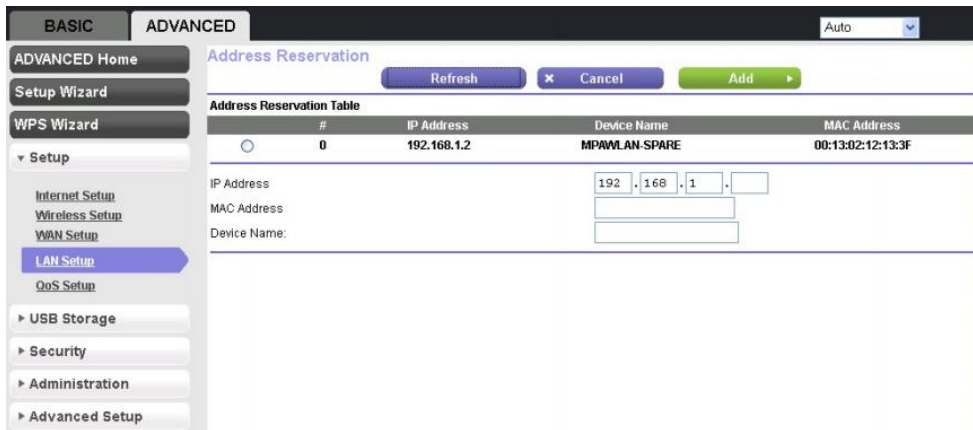
8.2. Netgear trek N300 PR2000

The router offers a switch to select the most commonly used modes, a feature which the TP-LINK model presented above lacked. WISP and WAP modes can be selected this way (or the PR can be turned off). While this is convenient, in most cases the router won't be usable out of the box and the configuration page will still need to be accessed.

The configuration must be accessed at routerlogins.net (or 192.168.1.1). However, if the PR is in WISP mode, it has the annoying tendency to list all the accessible networks and expects one of them to be selected and the credentials entered. While this is understandable (since WISP mode is supposed to be use with an existing network), it would still be more convenient to have access to configurations options, and only then select a network when needed.

However, if the router is put in WAP mode, admin settings can be accessed readily. The default username is "admin" and the default password is "password" (available from the manufacturer's documentation).

8.2.A. Assigning a fix IP address (address reservation)



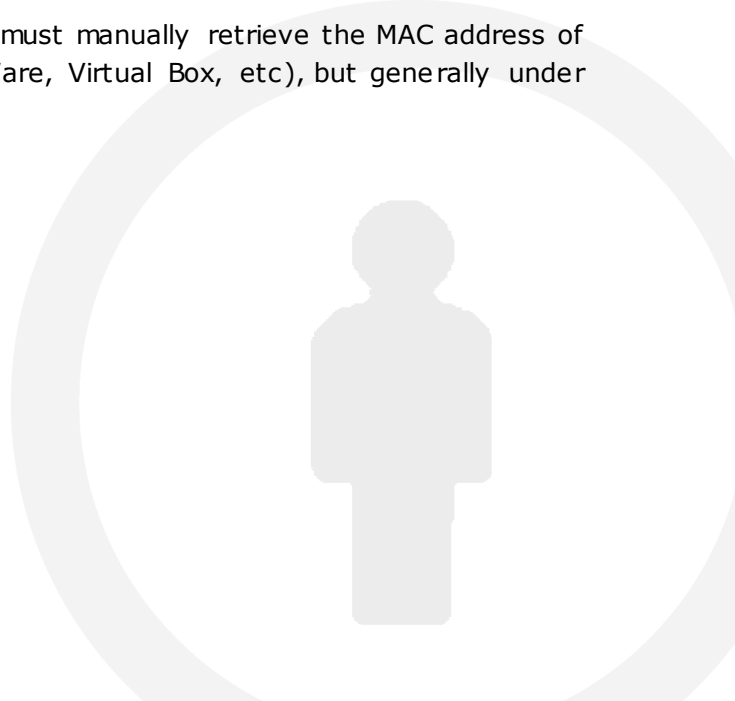
Under "Setup", then "LAN Setup", it is possible to fix the IP address of a client (such as a VM for Aggregate). Netgear calls it "Address Reservation".

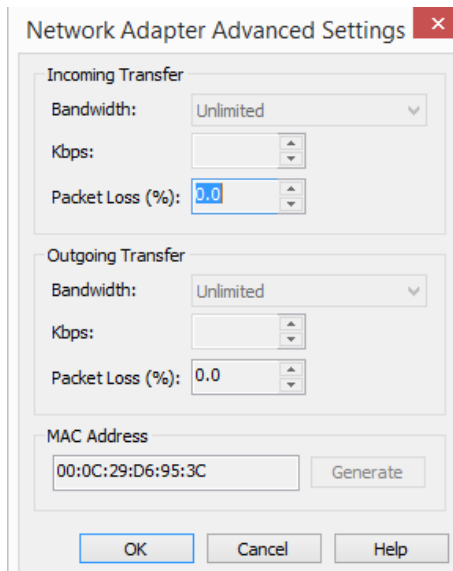
The VM has been tested and works with a fix IP address. With plug-in routers currently used for MDC, it is generally fairly simple to fix the IP address:

- Connect the host computer to the network
- Start the VM on the host computer
- Access the admin page of the router. The VM should be listed there as a client, and often it can be assigned a fix IP address from there.

However, with the Netgear router, it seems that the MAC address it picks up (e.g. the identification of the client to which you want to assign a fix IP) is actually the host's computer address, not the VM. From a network perspective, the 2 are distinct entities: assigning a fix IP address to the host computer does NOT assign a fix IP to the VM (and vice-versa).

Therefore, for the address reservation to work, one must manually retrieve the MAC address of the VM. This depends on the software used (VM Ware, Virtual Box, etc), but generally under "Virtual Machine Settings", "Networks":





This does make the configuration of the fix IP address more complicated than other models, which will allow a simple selection of the VM if it is already running & connected to the network.

Once the IP address for the VM has been fixed however, the device is simple to use: the router can be turned on, the computer connected to the network and the VM started. No further intervention from the user is required in that case.

8.3. D-Link Wi-Fi AC750

8.3.A. Assigning a fix IP address (address reservation)

Currently not possible. It is possible to assign IP addresses to all devices physically connecting to the router including the computer, but the VM is not recognized as a separate device connecting to the system. Whilst the VM is recognised in the network profile and it would be possible to conduct a MAC address filtering based on its address, this option does not allow to fix the IP for this MAC address, at least not in LAN mode. Extensive testing in starting and restarting the device as well as connection was tested and it seems to assigns the same IP address if the VM settings are preserved. However, it is not possible to fully fix this.

The device is simple to use: the router can be turned on, the computer connected to the network and the VM started. No further intervention from the user is required in that case.

¹ Logos used in this post designed by Freepik from Flaticon and from [Angbay - Freepik.com](https://www.freepik.com)

