



Application Note

Mobile Access Routers in a pervasive computing scenario

PERVASIVE COMPUTING

In the pervasive computing scenario the information processing has been thoroughly integrated into everyday objects and activities. As opposed to the desktop paradigm, in which a single user consciously engages a single device for a specialized purpose, someone "using" ubiquitous computing engages many computational devices and systems simultaneously, in the course of ordinary activities, and may not necessarily even be aware that they are doing so.

The Eurotech's model of pervasive (ubiquitous) computing is made of small, inexpensive, robust networked processing devices, distributed at all scales throughout everyday life. With this enormous computational power virtually any kind of application can be made. Through wireless networks mainframes can be connected to vehicular and wearable computers creating a "grid" of computing devices allowing peripheral sensors to access to a powerful computing virtual device.

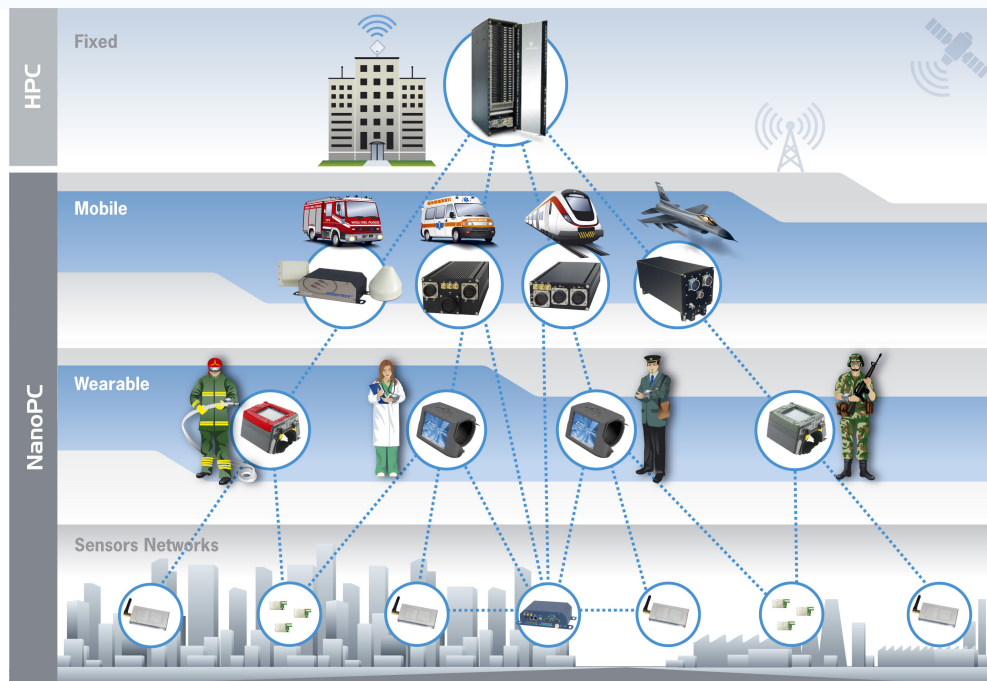


Figure 1 – PERVASIVE COMPUTING AND GRID SCENARIOS

MOBILE ACCESS ROUTER

Mobile Access Routers (MAR), network devices used to connect remote sites via private lines or public carriers, play a key role in the pervasive computing scenario. The router is required at both ends and provide the protocol conversion between the internal network (LAN) and the external network (WAN).

Through a MAR it is possible to stay always connected to a network from a vehicle while moving, such as trains, buses, trucks, ships and even airplanes.

DURAMAR: THE EUROTECH MOBILE ACCESS ROUTERS FAMILY

DuraMAR, a mobile access router, is one of the Eurotech products for the ubiquitous computing world; it can be placed in moving vehicles (e.g. car, bus, train) to enable high-speed data access.

DuraMAR infrastructure exploits wireless diversity (e.g. channel diversity, network diversity, and technology diversity) to provide improved data performance for wireless data users.

Our system design stems from the observation that rather than choosing a single wireless service provider, a single technology (e.g. GSM/GPRS, UMTS/HSDPA, CDMA, 802.11, WiMax, satellite) or a single wireless channel, users can obtain significant benefits by using the multiplicity of choices available.

DuraMAR dynamically instantiates new channels based on traffic demand, aggregates the bandwidth and dynamically shifts load from poor quality to better quality channels providing a faster, more stable, and reliable communication channel.



DuraMAR ARCHITECTURE

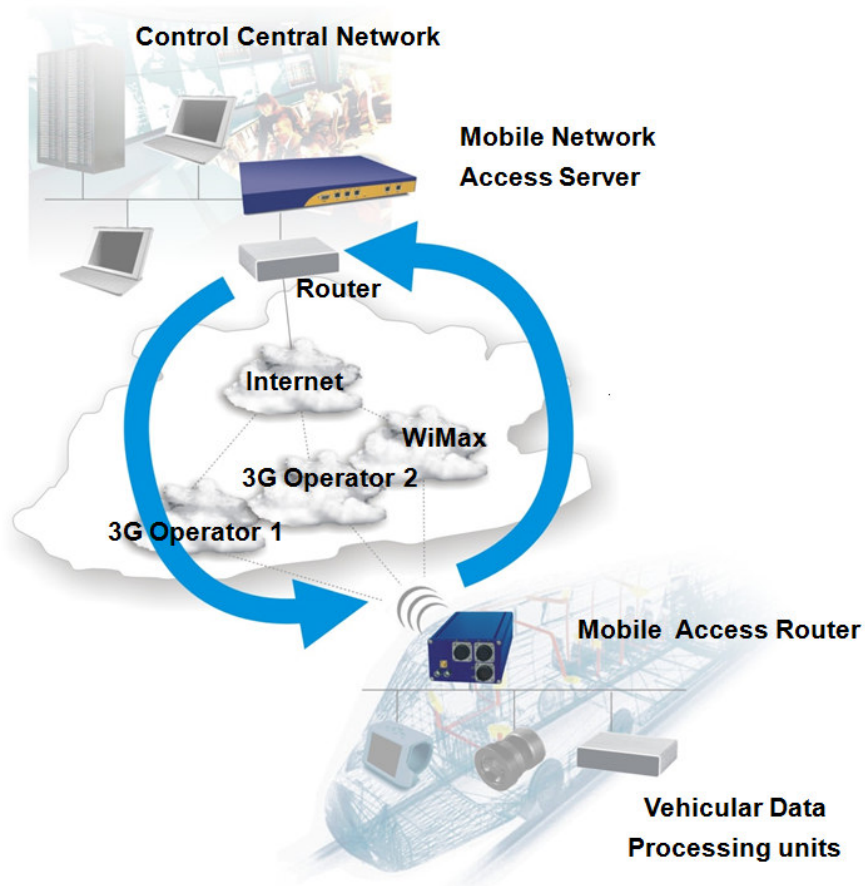


Figure 2 – DuraMAR ARCHITECTURE

The DuraMAR system consists primarily of the MAR router which performs bandwidth balancing across multiple network wide-area wireless interfaces to exploit the diversity available from different wireless networks to provide a faster, smoother, and more reliable wireless channel. When used in conjunction with

a MAR server proxy located in the wired infrastructure (see figure 2) the communication channel can further be optimized to provide transparent TCP, UDP or application based protocol enhancements.

The core components of the MAR router are presented in Figure 2 and they include a ruggedized Mobile Access Router and a Mobile Network Access Server.

The mobile router provides a set of local interfaces as well as a number of wide-area wireless interfaces. Local interfaces provide access to local mobile users. They can include both wireline as well as wireless technologies (e.g. RS232/422/485 ports, Ethernet ports, 802.11b/g) to provide connectivity to PDAs, laptops, sensors, data loggers and other devices.

DuraMAR provides a DHCP server that dynamically assigns private IP addresses to local users from a pool of addresses. Mobile devices are configured to use MAR as their default router and DNS server. To this extent, the DURAMAR router runs a local DNS server. MAR also provides a number of wide-area interfaces that can accommodate a variety of wide-area wireless technologies (e.g. GSM/GPRS/EDGE, UMTS/HSDPA, CDMA, long-range 802.11, etc.). The DuraMAR router automatically connects to all preconfigured wide area networks, authenticates with each operator, and obtains the required parameters to enable each wide-area interface (e.g. IP address, DNS server, default router, etc).

Through the DuraMAR Session API, the router can also accommodate a wide-range of session scheduling policies to load balance packets/connections among different interfaces.

The session scheduler can include various policies such as round-robin, least loaded interface, weighted policies, etc. To help determine which interface should be responsible for a given packet/connection, DuraMAR the interface's average throughput. Based on such information, DURAMAR can determine the weight that should be assigned to each interface to properly perform load balancing (e.g. busier interfaces will be assigned fewer number of TCP connections, while faster interfaces will be assigned higher number of TCP connections).

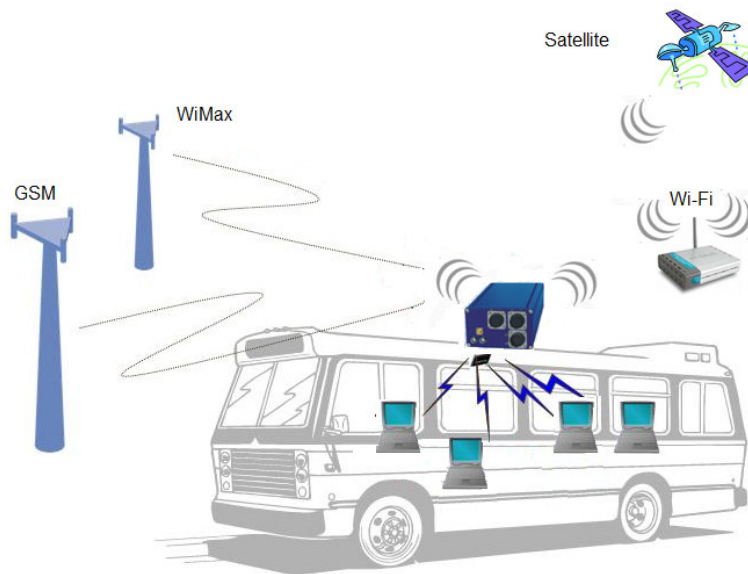
Moreover, DuraMAR can determine whether an interface is in a blackout period or not. For instance if the SNR falls below the minimum sensitivity level or if no packets have been seen for a given period of time, the router can safely assume that a given interface is non-functional. When DuraMAR detects that an interface is going through a blackout period, it stops sending data to that particular interface and re-schedules new packets/sessions to active interfaces.

The router works in cooperation with a **Mobile Network Access Server** proxy located in the wired infrastructure (see figure 2). At a higher level, the DuraMAR server-proxy can compress application data objects before forwarding over the wireless links, reducing transfer size and thereby improving response time. Data can be compressed using application-specific compression techniques.

MARKETS AND APPLICATIONS

Being a Mobile Access Router ideally suited for integration in vehicles, it offers secure data, voice and video communications, seamless mobility and interoperability across multiple wireless networks.

Applications can be made in the transportation, defense, public safety, homeland security, and transportation markets. Listed below are just a few scenarios where MAR proves to be an invaluable tool.



Mobile Internet Access

There is a strong growth in mobile Internet access, fuelled by the increasing popularity of Wi-Fi and the worldwide deployment of wide-area wireless networks such as GPRS/EDGE/UMTS. Multi-mode devices (e.g. WLAN-GPRS cards) are becoming increasingly affordable, and a growing number of mobile devices such as laptops, PDAs and handhelds are equipped to connect to multiple networks. With the proliferation and ever decreasing costs associated with wireless access devices, providers are increasingly looking towards practical issues of service deployment and performance

guarantees.

Mobility that involves handovers between Wi-Fi 'hotspots', 2.5G and 3/3.5G wireless data services continue to pose a significant challenge, as does the intelligent manipulation of channels and multiplexing/stripping of data across available wireless links to achieve the best possible performance and access under variable and often unpredictable conditions.

Cellular networks provide wide coverage, enabling ubiquitous wireless data access services. However, they are plagued by problems such as high and variable round trip times, packet losses, burrstones and occasional link outages which significantly limit the final bandwidth offered to the end-user.



The use of multiple air interfaces simultaneously builds a better combined wireless communication channel (link). Such a link can provide more predictable data-rates and is better able to meet different mobile application requirements as well as mobility scenarios.

By using a MAR to simultaneously connect to a number of wireless cellular networks of different operators, whose base stations are typically sited at different locations or operate at different frequency bands or protocols, it is possible to provide a fairly reliable communication link.



The Mobile Access Routers on board of trains, buses or even ferries navigating along the coast, connect people to the Internet with a reliable and high speed connection.

Video Surveillance on vehicles from remote



Being possible to address the mobile device through one or more IP address, a video surveillance can be done from a remote control room while the vehicle (bus, train , ferry) is moving far away.



Remote Access to peripherals installed on vehicles



One of the features of some Mobile Access Routers is the so called “serial tunneling”, i.e. a serial port physically located on board of the vehicle, can be seen on a remote computer as a *virtual com port* (VCP). As example I/Os (door open, door closed...) or data stream (temperature monitoring) can be seen and/or managed from a remote location.



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