Ubiquitous Computing

Seamless Connectivity

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• What is Ubiquitous Computing?
• What is Seamless Connectivity?
• Need for Seamless Connectivity.
• How do we achieve it?
• Some remarks!
• Conclusion
What is Ubiquitous Computing?

In simple terms it is:

A model of computing in which computer functions are integrated into everyday life, often in an invisible way. The model requires both small, inexpensive computers and wired and wireless ("dumb") devices connected to larger computers. ...

invisible, everywhere computing that does not sit on the desktop but lies deep inside the environment we live in
Issues and Challenges in Ubiquitous Computing

- Software architecture
- Context Aware Applications
- Database Management and Access
- Routing and Traffic
- Modifications to the Layered Stack
- Device integration into environment
- Adaptive Visualization
A Scenario

Wi Fi Hotspot

stadium

Network

GPRS Network

Server1

Server2

Server3
Scenario continued...

Looking for the ability of a Mobile Device to remain connected as it roams across different types of Networks..

The Device has to do it automatically without user's intervention

Device should remain connected even when Server changes..

All this means the Device should have unbroken session all through...

In technical terms this is called Seamless Connection!
Ubiquitous Healthcare System

A Patient or Elderly person to be continuously monitored

Some sensors placed on the patient's body. An interface collects data and sends this data to the Monitoring system.

The patient might enter a zone where the Interface cannot connect to the current network anymore.

But the Interface has to remain connected to the Monitoring System!!

Shows the need for Seamless Connectivity!!
Picturization of the Scenario!!
Applications contd....

Situation more serious when the patient in case of emergency is being taken to hospital and has to be monitored while in Ambulance. Again Seamless Connectivity is of prime importance.

Another Scenario:

Person investing in shares might want to take important decision on some shares by keep track of share values continuously while on the move. For him the knowledge of fluctuations in the share values at all moments may be useful.

The solution is Seamless Connectivity!!
Issues and Challenges

Device should have the ability to recognize different networks differing in many ways..

Simply means Device should be able to recognize Wi Fi, GPRS, Wi Max etc...

Should account for change in the IP Address when the Device changes its Network

Should account for change in Network characteristics

If Device finds no network to connect to then possibly try to connect to some device in Ad hoc Mode!!!
What is Seamless Connectivity?

- User zooming along the highway in a BMW wanting uninterrupted connection to a remote application throughout the trip.
- A Laptop moves out of Wi Fi and is still connected to Internet through GPRS.
- An Airtel User gets connected to Reliance CDMA Network because of absence of Airtel Connectivity while an Internet session is on.
Seamless Connectivity

• The ability to remain connected as a Mobile device roams across different types of Networks
Need for Seamless Connectivity

• Mobile Devices are proliferating so as Mobile Computing.

• People are on the move!

• Ubiquitous Computing is the future and the concept of Ubiquitous Computing is built based on Seamless Connectivity.

• Importantly we desire continuous sessions!!
How do we achieve it?

• By making the devices compatible with different types of existing technologies.

• Simply speaking a Laptop or any Mobile Device should work in WiFi, GPRS, Wi Max, MANET and so on.

• So what is the simplest solution? Have multiple interfaces to support multiple technologies.
A detour!

Is there any other option other than interconnecting different Networks? Let's check!

Taking out all the existing different technologies and having only one network in this world? Ruled out...

Else have a totally infra-structureless Network in the world!!!! Devices of the world form a MANET. Looks like one crazy thing to do.
Solution is Inter connecting!!!

- Inter connecting can be done by vertical hand off of the device when Mobile Device moves from one Network to another.

- Within a Network connectivity is assured through Horizontal hand off.
Horizontal Hand off

- Hard hand off and Soft hand off.
- Hard hand off based on SNR. Mobile device connected to the Base Station giving better SNR. At anytime there is only one connection.
Hand off contd.....

- Soft hand off is probabilistic. Or also the Mobile device has more than one connection but communicates with better SNR BS.

- In any case hand off within the same network. Initiated by the Mobile Device.
Vertical Hand off ......

• Hand off between Network APs having different Network technologies.

• Suddenly the complexity becomes enormous!!!

• Why? Simply because the underlying physical layer schemes are totally different.. viz.. Modulation, carrier frequency, signal strength, Bandwidth, signaling scheme and so on.
Issues and Challenges....... 

• Which Interface to be picked?

• By whom? On what basis? When to pick?

• Does user have a role to play? Hand off Latency?

• What are the trade offs?

• Implications of hand off... like Routing table updating.
Solutions to the issues and challenges

Interface can be picked on the basis of many factors

Interface picked by the system automatically

System keeps checking the signal on each interface..

Pick the one with the best RSS

Modifications to the Protocol stack

Mobile IP already exists!!
A Seamless Connectivity System
Remarks....

• Wireless Networks have fading channel whose characteristics behave on a Coherent time basis. At what rate VHO occurs.

• In absence of any Network infrastructure can the device form a MANET Network with nearby nodes or devices? A point that can be explored...

• Which layer has to participate in Hand off procedure?
Conclusion

• Lot of work has been done towards this end but still many aspects can be explored.

• The issues and challenges only multiply as we enter into the Ubiquitous world because there are no restrictions in Ubiquitous Networks unlike the present infrastructure Networks.