

Enabling free connectivity for under-privileged communities



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The Connected World



Opportunities exist in abundance

The Disconnected World



Epidemics



Influenza – 250,000-500,000 deaths annually [WHO]

Cholera, Malaria, Flu, Dengue Fever, Small pox

and many more....



The Invisible epidemic

Every minute of every day a woman dies of complications in pregnancy or childbirth

4 million babies die worldwide within one month

Solutions are there...



Knowledge is all-pervasive; world is in one hands
– *thanks to the Internet*

Technological advances facilitate better healthcare and monitoring

Cheaper computers (~\$25)

Sensors, lab-on-chips, mobile phones

Social networks to predict epidemic spread

Internet is an important (potentially life saving)
enabler

Virtualization of health services

But connectivity in general costs money!



Fixed line broadband as proportion of monthly income



Least Expensive

Macau, China (0.30%)

Israel (0.33%)

Hong Kong (0.49%)

USA (0.5%)

Singapore (0.55%)

Most Expensive

Central African Republic
(3891%)

Ethiopia (2085%)

Malawi (2038%)

Guinea (1546%)

Niger (967%)

Connectivity is the key – Free connectivity is the key!

But costs money to the end user (even SMS) – *the under-privileged user*

Political, economic, social agendas to overcome....

So lets think in terms of technology



Could we have a free IP address system (like the free-phone numbers) ?

Move essential services (government, health, education etc) to this system

Anybody (with access to infrastructure) can connect

Using **Lower than Best Effort (LBE)** service to provide access to the under-privileged

Provides new transmission opportunities..

Network sharing opportunities (for e.g WiFi) (urban/sub-urban)

Transmit data without affecting other competing resource

Offer transmission opportunities only when there is free capacity (rural)

Ideal for Radio Resource Managed networks (DVB-RCS, WiMAX etc)

Solution 1: Wifi crowd-sharing for urban poor



You need to pay for accessing these services!

Community-based Wifi crowd-sharing is a potential solution

How can we convince them to share without any financial benefit?

Community Wifi crowd-sharing



Users can share their Wifi AP with the community APs

Set privileges, access options (time of day, maximum limit etc)

Community APs can load balance based on preferences or when user APs are free

How to ensure the free user traffic is not affecting the paid user?

Lower than Best Effort - Challenges



Traffic from under-privileged subscribers could be assigned at lower priority than BE

Scavenger class?

Should not contend for resources from traffic from privileged subscribers

If it contends with Background traffic, CBQ should solve the problem

Link layer issues..

Underprivileged traffic at low rate can affect the volunteer!

Solutions exist: IEEE 802.11e (EDCF)?

Internet works on BE nature

Works under the delay threshold allowed by TCP

LBE could introduce delays which may exceed the delay allowed by TCP

Most applications such as web would fail!

QoS has to be enabled manually in APs ?

Low Extra Delay Background Transport



IETF LEDBAT WG is currently looking at methods to support LBE applications

P2P, background file transfers etc

Focuses on techniques that allow large amounts of data to be transmitted without affecting delays experienced by other users and applications

Could we utilize the concept of LEDBAT to create free/low cost transmission opportunities?

So they do not compete with traffic from privileged subscribers

Can current apps work on LEDBAT?

Asynchronous file transfer should work

Recorded video, audio, emails

Solution 2: Providing free connectivity for Rural poor using satellite



Satellite provides global coverage – connectivity anytime, anywhere

Standardization efforts are in place for efficient, low cost two way satellite technology (for e.g DVB-RCS2)

Satellite technology is still expensive for infrastructure-less disadvantaged communities!

However, a natural contender for providing LBE service

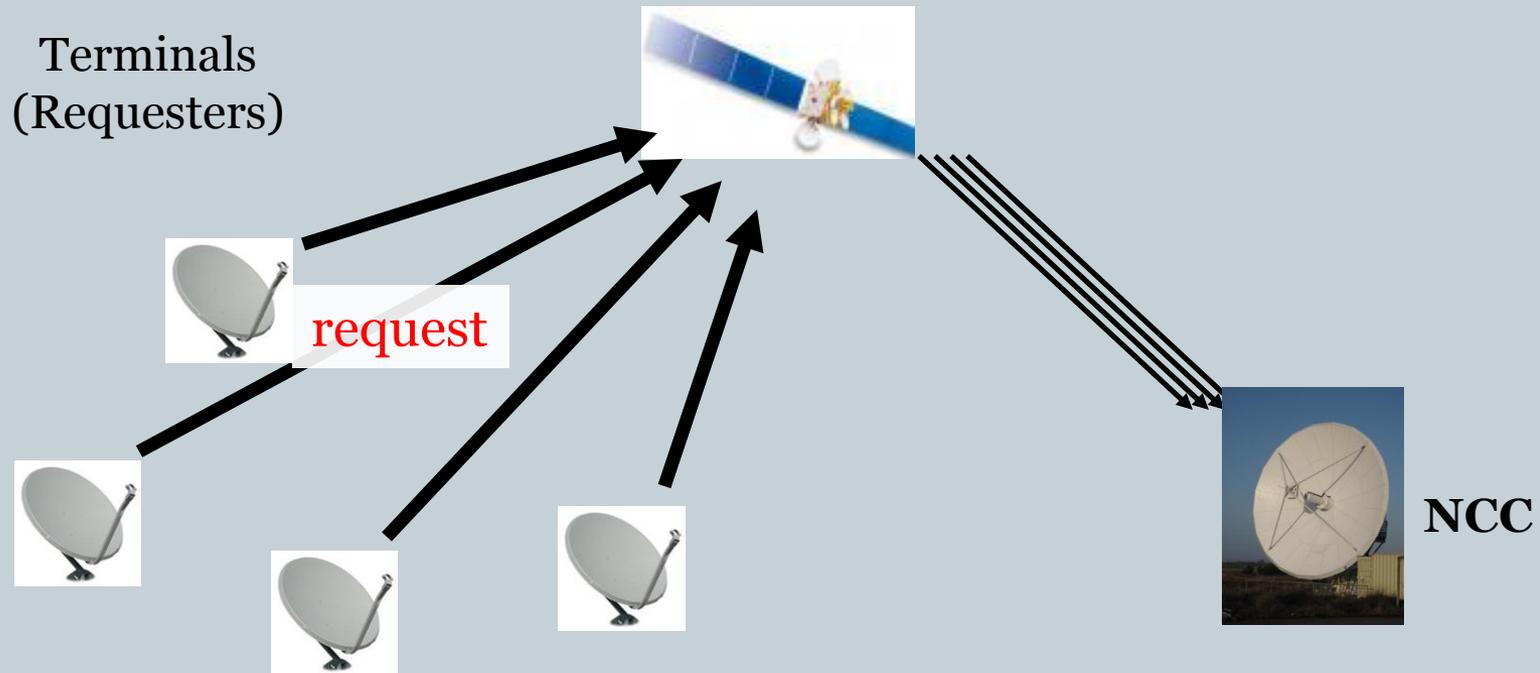
Radio Resource Managed

Allocate capacity only when there are extra resources (unused capacity) for under-privileged users

Return Link: Capacity Request



Each traffic terminal periodically submits to NCC an allocation request based on the incoming traffic rate or traffic backlog at the terminal

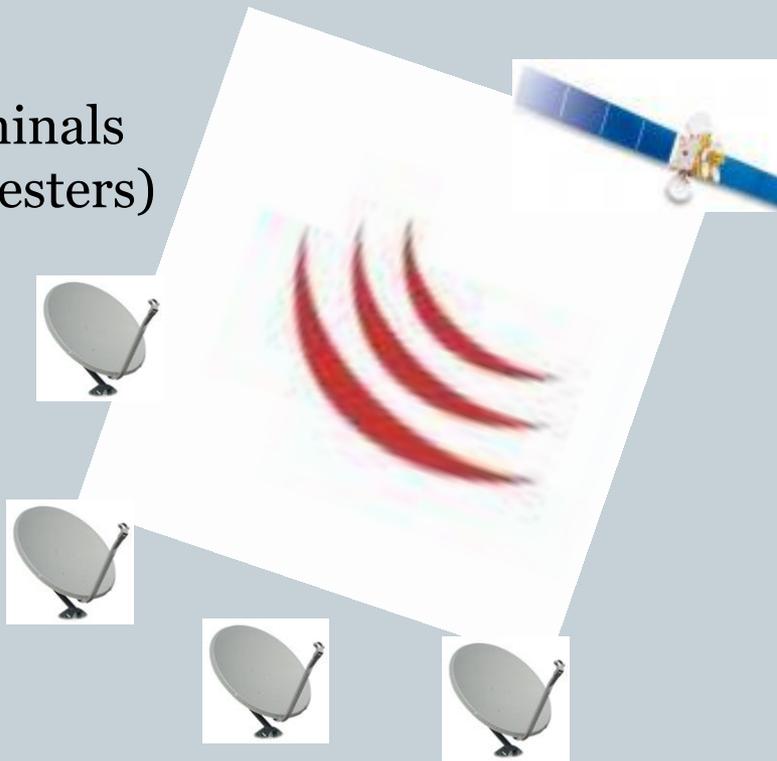


Return Link: Capacity Allocation

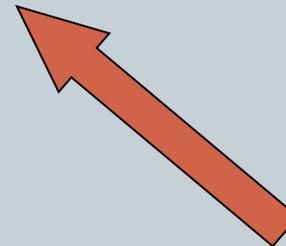


The NCC collects the request of all the active traffic terminals, computes a burst time plan and broadcasts it back to the terminals

Terminals
(Requesters)



allocation



NCC

What happens if there is no free capacity?



Take the DTN approach for very large delays (in several mins/hours) ?

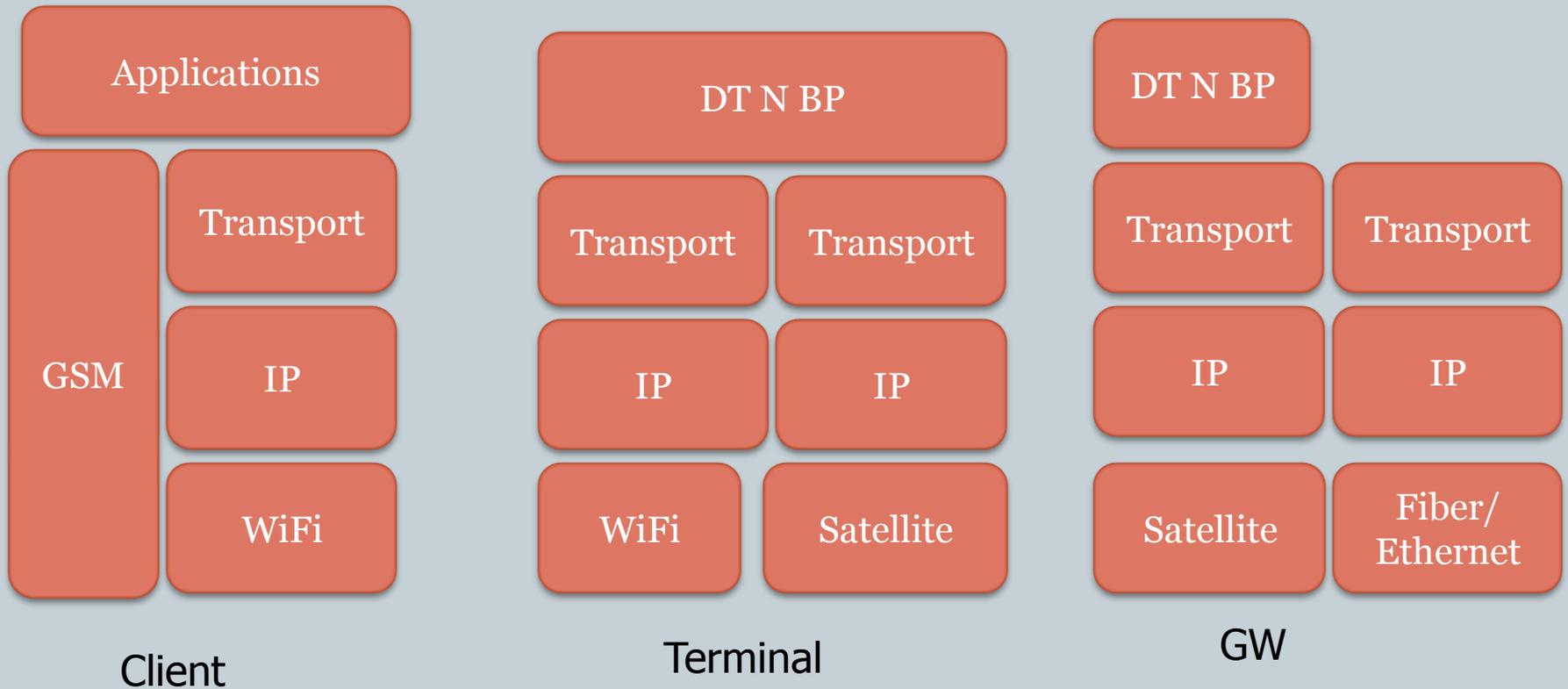
DTN – store and forward architecture

Routers can wait for the link to be free, and then can send data

RCSTs and NCC can be DTN enabled

RCSTs wait till capacity is given by NCC (could be hours - worst case)
data stored as bundles in DTN layer

Basic Building Blocks (if DTN enabled)



Technology challenges



Engineer new methods to support efficient use of spare spectrum

How should the NCC allocate the spare capacity between under-privileged terminals?

Engineer new access methods for satellite

Enabling DTN in satellite terminals and GW

Extending BP layer to trigger Capacity Requests (CR)

If there is high priority data that needs to be sent immediately, what should the terminals do?

Use random access ? Or

Utilising adaptive quality of service to deliver increased capacity on-demand (e.g for telemedicine video conference)

Reverse micro-pricing models

Can a sponsor pay for “urgent” capacity?

Can a doctor request and pay for capacity ?

Applications

Delay -Should they be DTN enabled - asynchronous

Location based caching can enable localised web services!

Haggle architecture

Today's LBE is tomorrow's BE – The Impact



Open up the science to look at new ways of providing free/low-cost connectivity

Use resources without affecting others

So no harm in supporting them – I am not affected!

Provides new low-cost economic opportunities..

Network operators can sell connectivity at a lower cost

NGOs/charities can become Virtual Network Operators (VNOs) and provide free connectivity

Network operators can provide LBE as a basic free service with opportunities to top-up

Input to standards?

Input to policy making

Fundamental overhaul needed in current economic, social, political models

Telecom regulators should support

Governments should change their policy to encourage these initiatives

ITU-T support so far is encouraging!

The ~~Dis~~Connected World



Connectivity can save individual lives



Connectivity can empower communities

Make a difference to the lives of the under-privileged!