

A multiLink architecture for a global wireless Internet connectivity

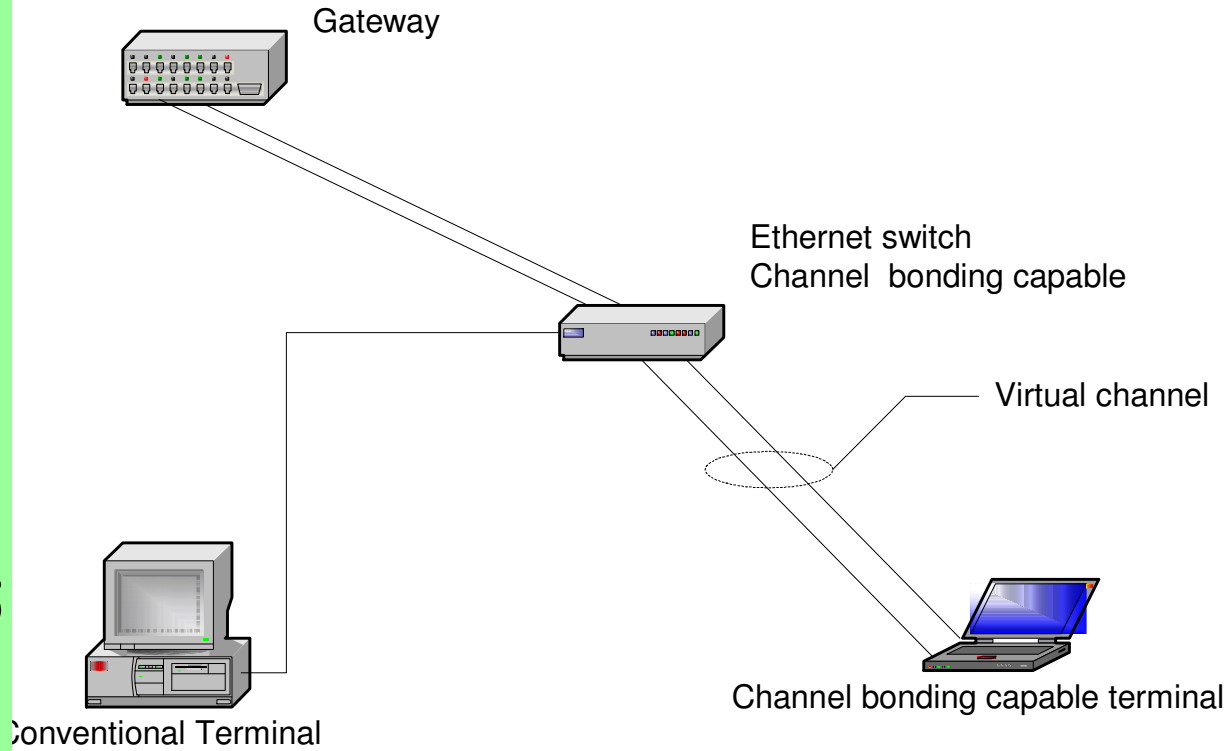
WIBRACE workshop – June 23 2005

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- Multi-link technologies: state of the art
 - Channel bonding
 - Layer 2 multilink access
 - Layer 3 multilink access
 - Drawbacks
- Network Inter-working concept
- Always Best Connected (ABC) concept
- A multilink service
 - The multilink gateway
 - The tunneling method
 - The multilink control protocol
 - The multilink core network
 - Advantages and issues
- Conclusion

Channel Bonding

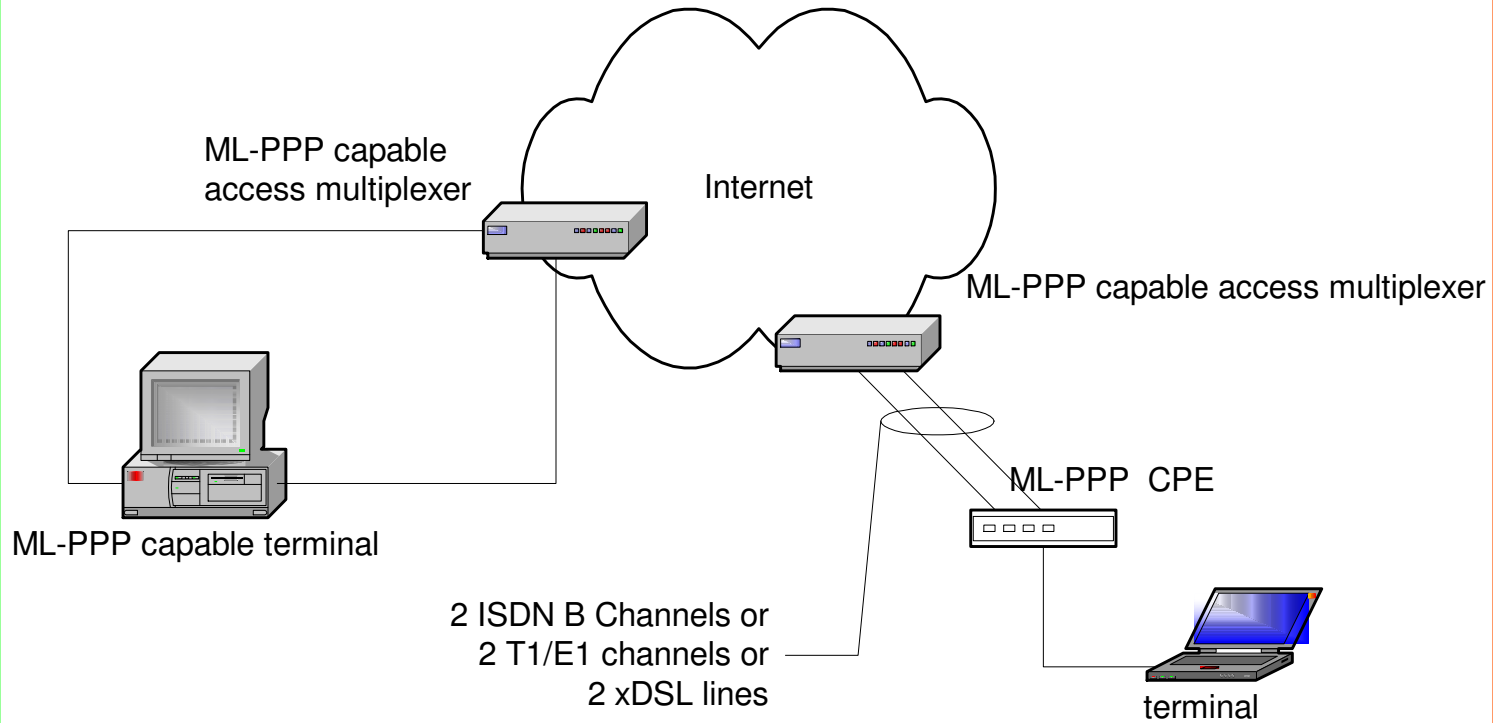
Increase bandwidth and throughput
Simple technology



Not an access technology

Ethernet channel bonding

Enhanced reliability
Increase bandwidth and throughput

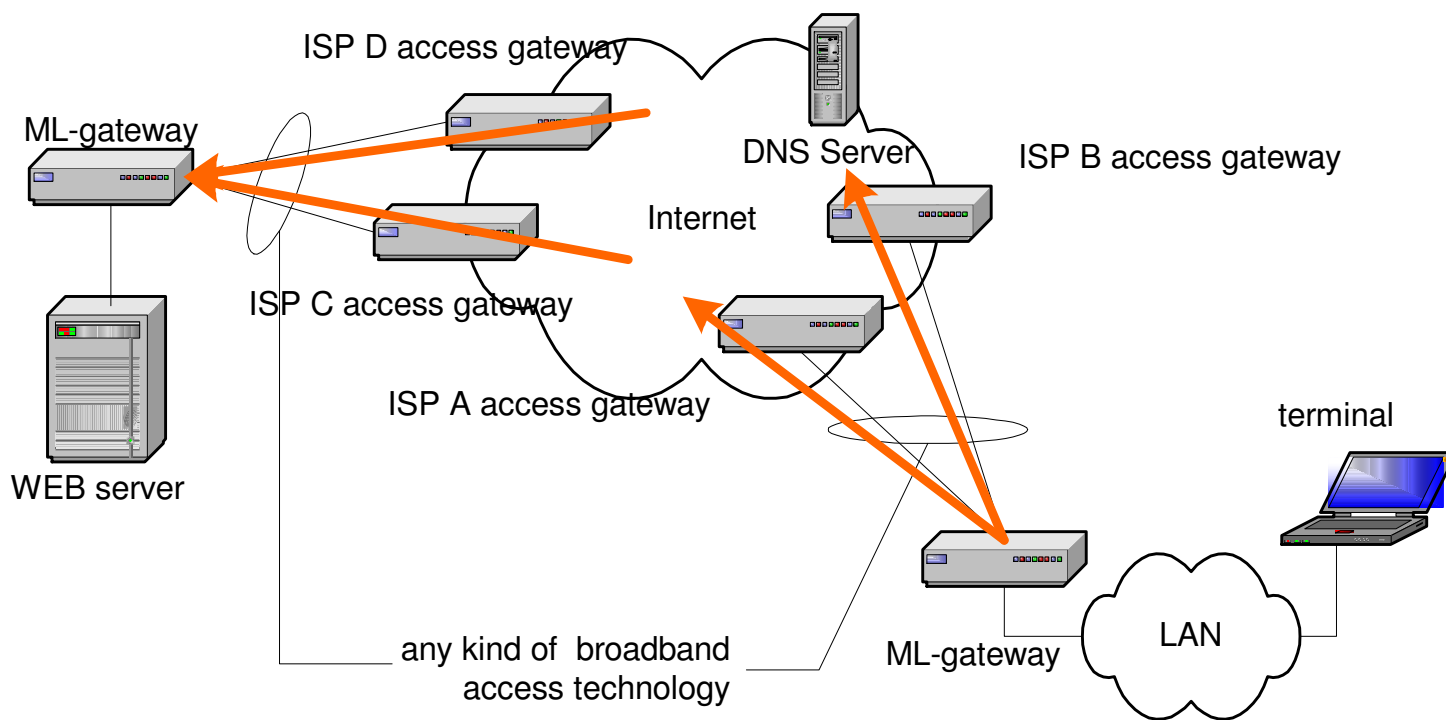


Service provider dependant

Multi-Link PPP (ML-PPP)
MultiLink Frame Relay (MFR)
Inverse Multiplexing over ATM (IMA)

Layer 3 MultiLink Access

Enhanced reliability
Increase bandwidth / ISP independent

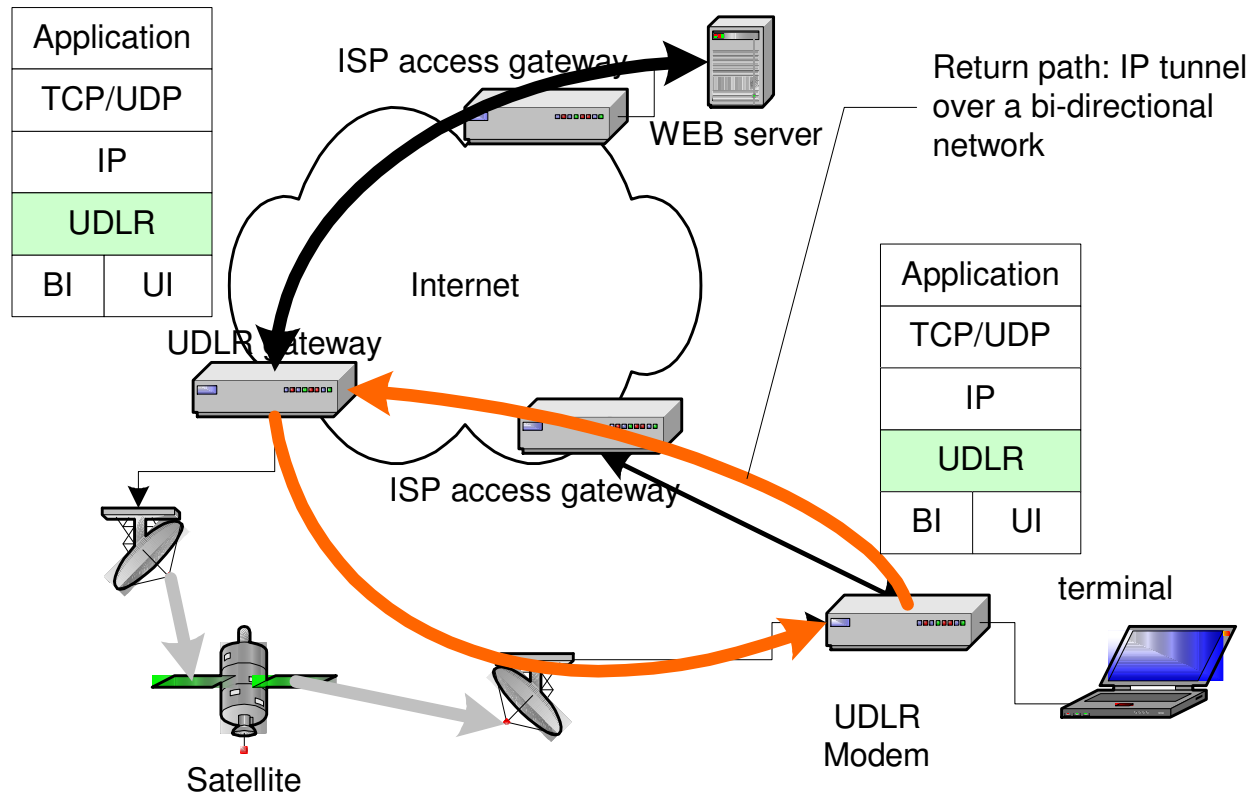


ML on session basis only
ML inbound connections based on DNS

Multilink based on multi-homing
(several home IP addresses)

Unidirectional Link Routing (UDLR)

Unidirectional networks used for bi-directional broadband access

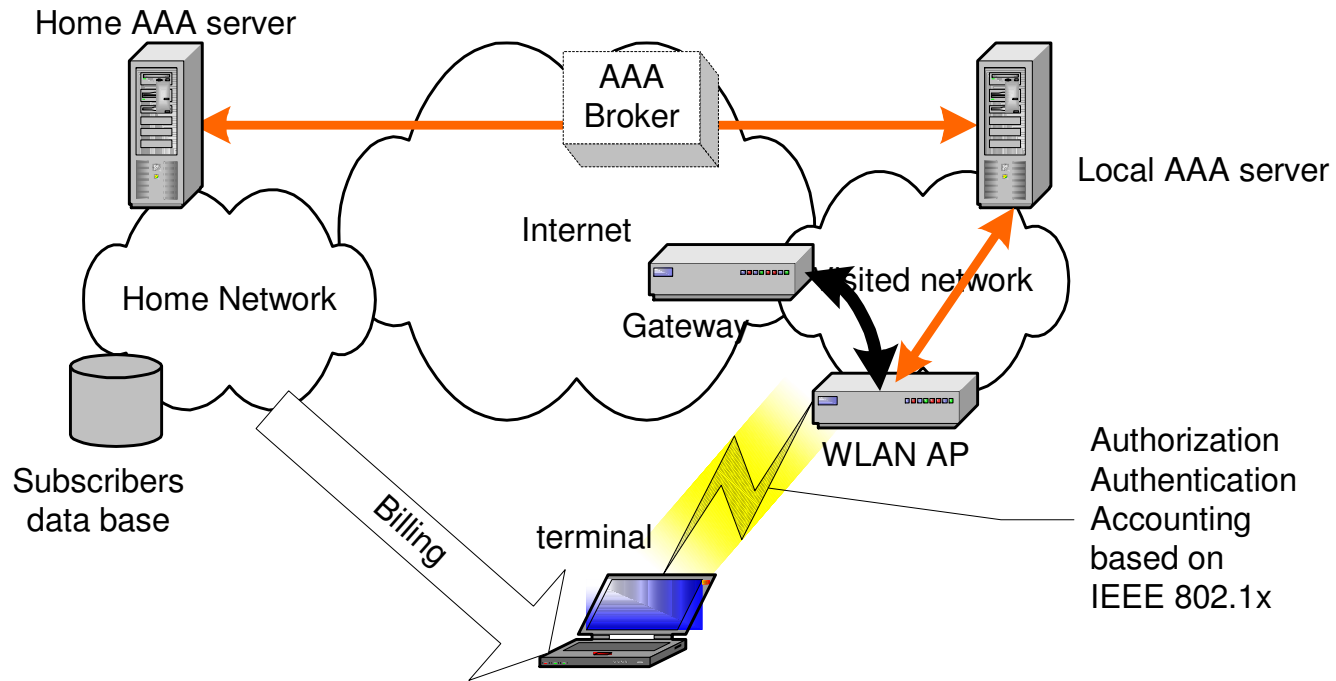


No inbound path selection
One uplink access network

Based on RFC 3077: Link layer Tunneling Mechanism

- Multi-homing
 - How to deal with multiple home IP addresses
- Nomadicity and mobility
 - How to deal with vertical roaming
 - How to deal with service continuity
- Inbound connection
 - No easy control of the inbound path selection
 - Only possible through the usage of DNS

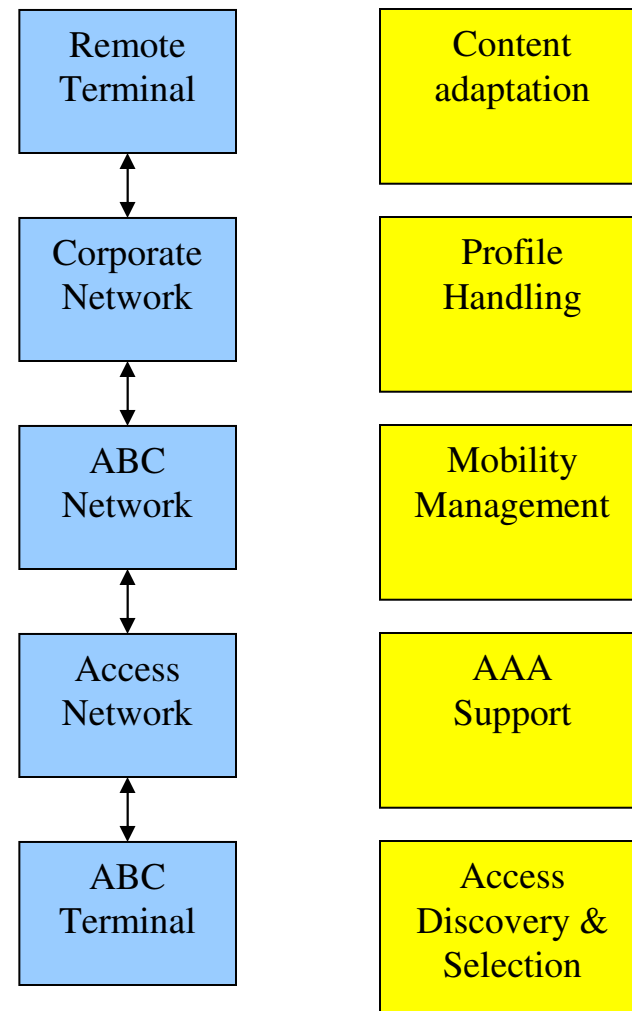
A global AAA model for public broadband access



May not be adapted to different access network technologies

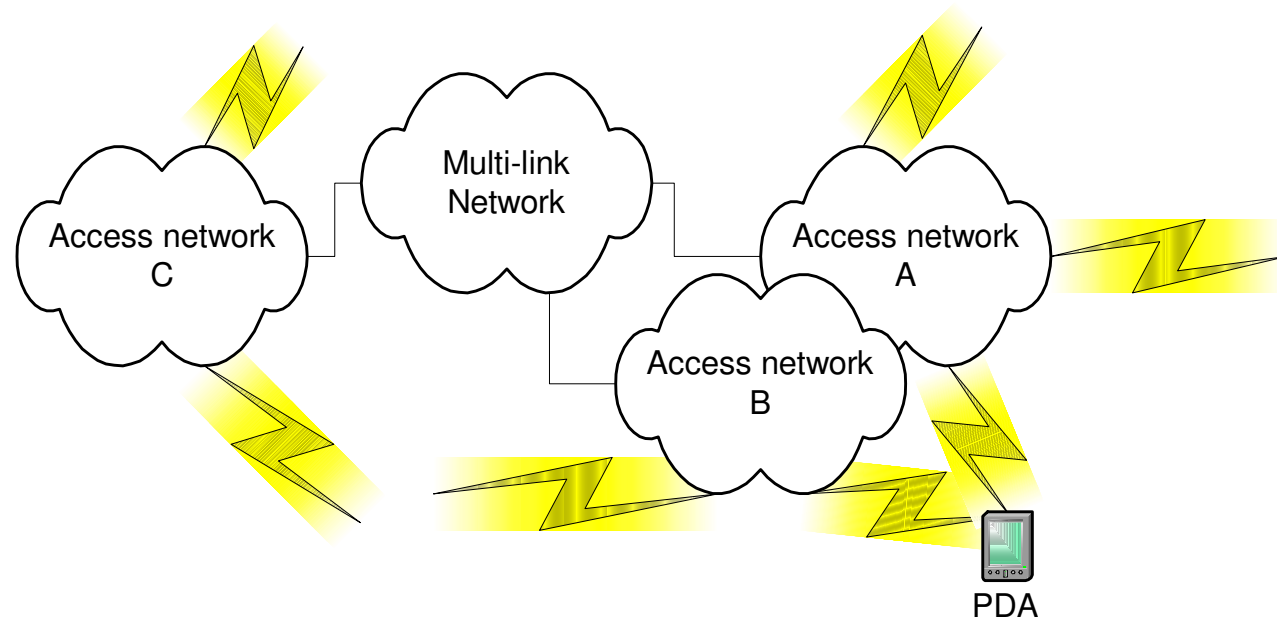
Several Initiatives (IEEE, 3GPP) in order to standardized the roaming model

- Always connected
- Through the Best access technology according to:
 - User preferences
 - Terminal capabilities
 - Application requirement (qos)
 - security
 - Network resources
 - Network policy



ABC Model

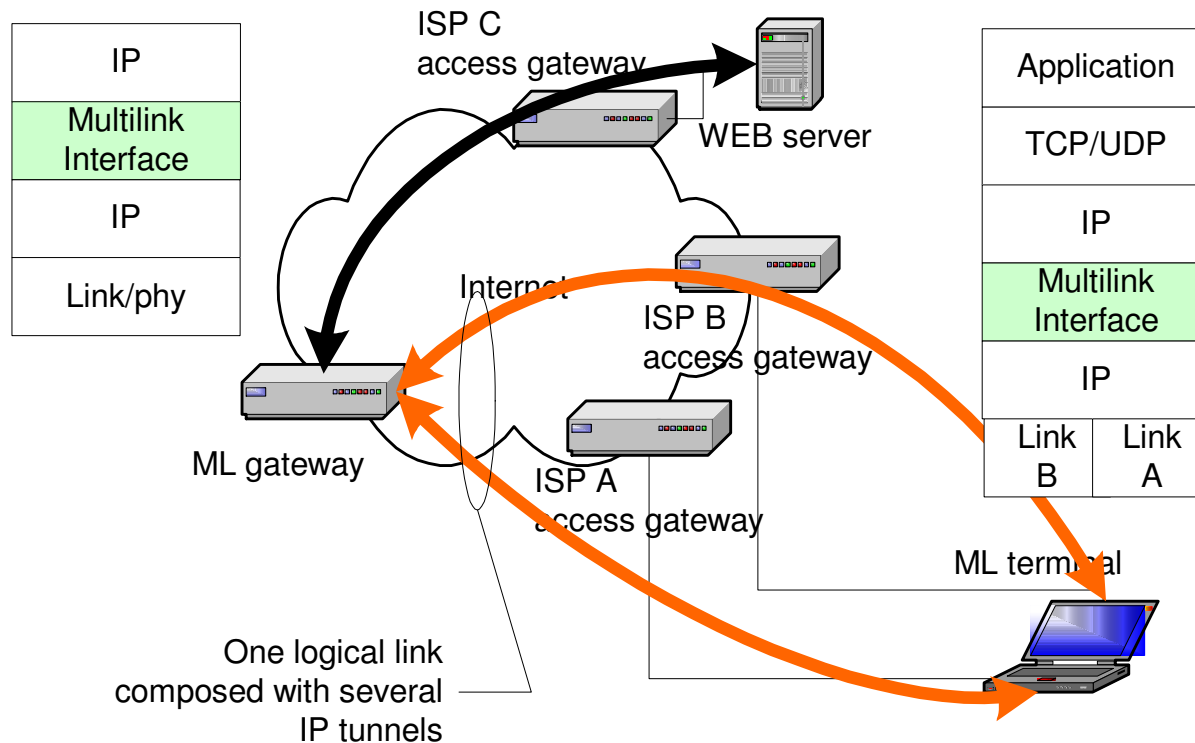
A MultiLink Service



Combining state of the art multilink technologies lead to a new network service

The MultiLink Gateway

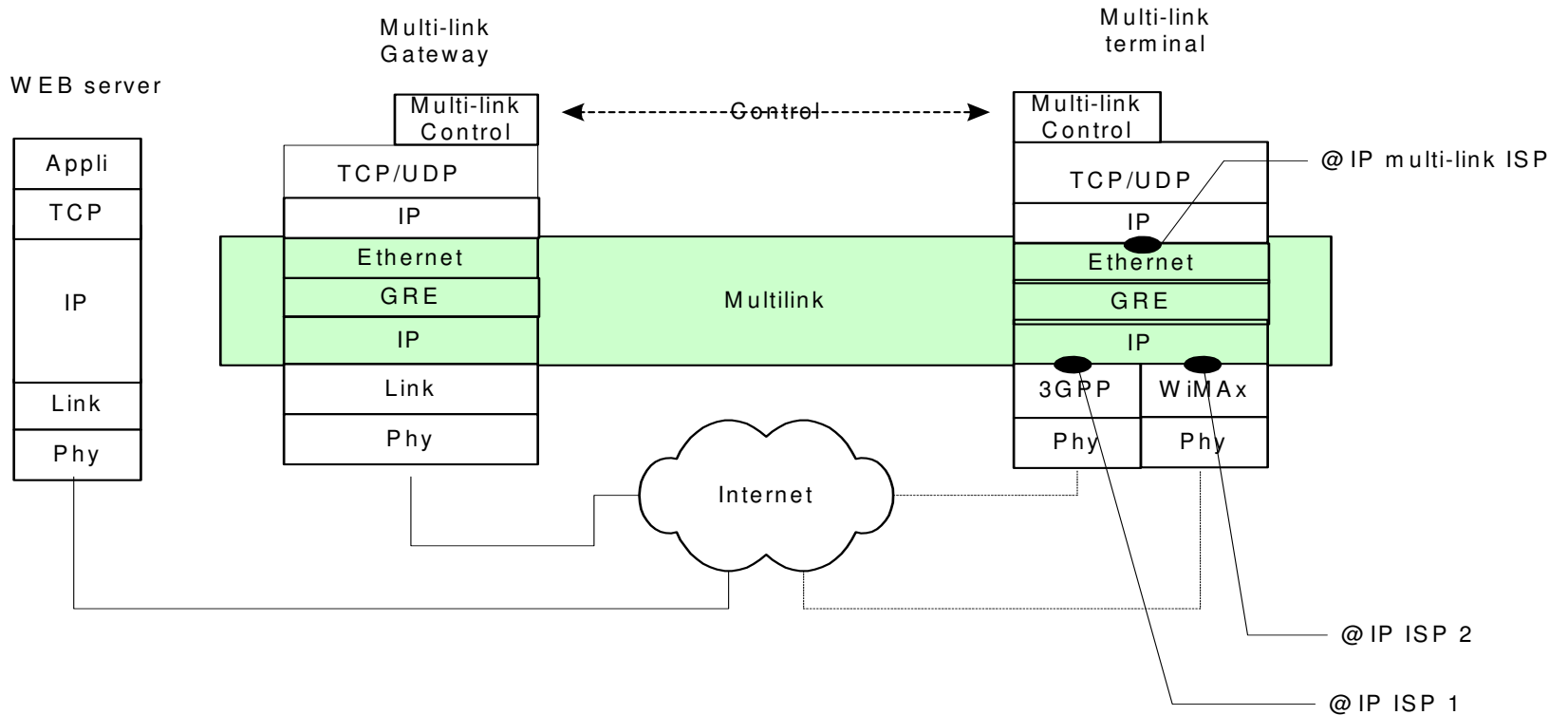
The ML Gateway provides tunnel selection mechanism for downlink traffic



Acts as the access network multiplexer
Aggregates IP tunnels

One Tunneling Method

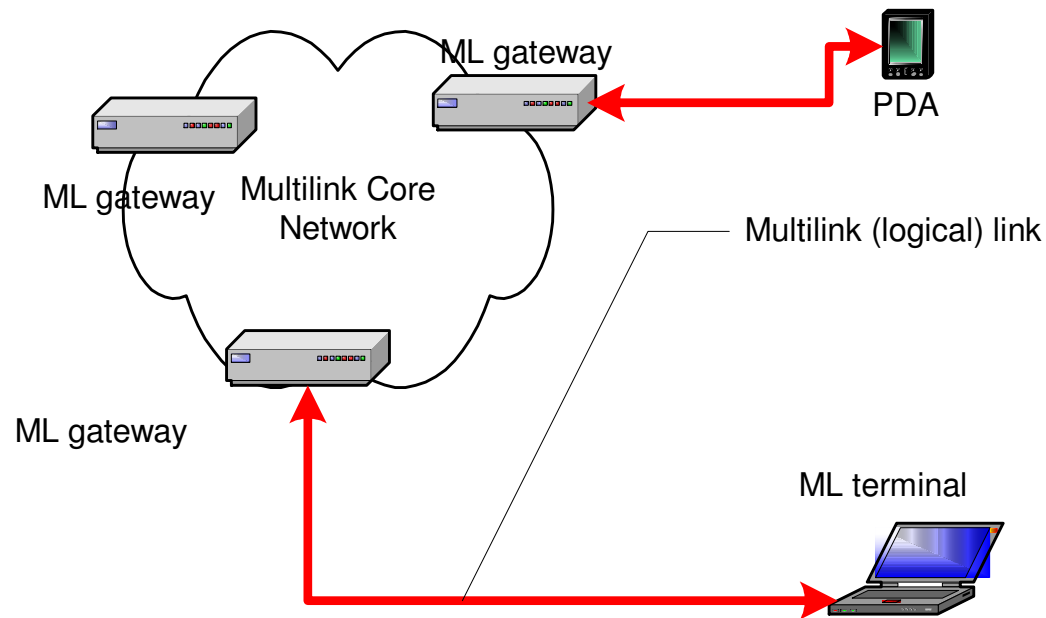
GRE (Generic Routing Encapsulation) provides a pseudo Ethernet link over several access links



The tunneling method is based on LLTM

- Authentication, Authorization Accounting
 - May be distributed over access networks based on a global AAA inter-working framework
- Address assignment
 - Multilink service provider (home)IP address
- Security material
 - Encryption
- Backup multilink gateway
- Link discovery
 - Availability and performance testing
 - User profile (preferences)

Provides scalability and reliability
Enhanced efficiency (e.g. ML gateway located
in ISP networks)



The ML gateways are interconnected through either dedicated links or Internet

- Link selection
 - Real inbound and outbound path selection possible
 - On a packet or session basis
 - Driven by
 - User profile
 - links availability and QOS
 - Application type
- Operates any access networks
 - PAN (bluetooth)
 - LAN (WiFi)
 - WAN (WiMAX, 3GPP)
- Multi-homing and Mobility
 - Inherently solved

- Distributed AAA
- ABC selection mechanism
 - May be complicated to develop
- Tunneling method
 - Efficiency (overhead)
- Service continuity
 - Vertical handover

- A multilink network architecture
 - ISP neutral
 - Access network transparent
- Automatic link selection
 - For outbound as well inbound traffic
 - Provides bandwidth gain
 - QOS friendly
 - Always Best Connected
- Particularly suited for wireless (mobile) connectivity
 - A wireless (mobile) device should gather several interfaces
 - E.G. Bluetooth, WiFi, cellular (3GPP), WiMAX

- Multilink
 - « Inverse multiplexing over ATM» - Quick Eagle Networks
 - « Multilink technology white paper » - Stonesoft
 - « The PPP Multilink protocol » – IETF RFC 1990
- UDLR
 - « A link layer tunneling mechanism for unidirectional links (LLTM)» - IETF RFC 3077
- Multihoming
 - « Integrating security, mobility and multi-homing in a HIP way » - Pekka Nikander, Jukka Ylitalo, Jorna Wall – Ericsson Research
- Always Best Connected (ABC)
 - « Always Best Connected » - Eva Gustafsson, Amika Johson – Ericsson Research
- Cellular (3GPP) WLAN (WiFi) interworking
 - « Interworking techniques and architectures for WLAN/3G integration towards 4G Mobile data networks » – Apostolis K. Salkintzis
- Broadwan FP6 project - <http://www.telenor.no/fou/prosjekter/broadwan/>