Efficiency Issues in MPLS Transport for the UMTS Access Network

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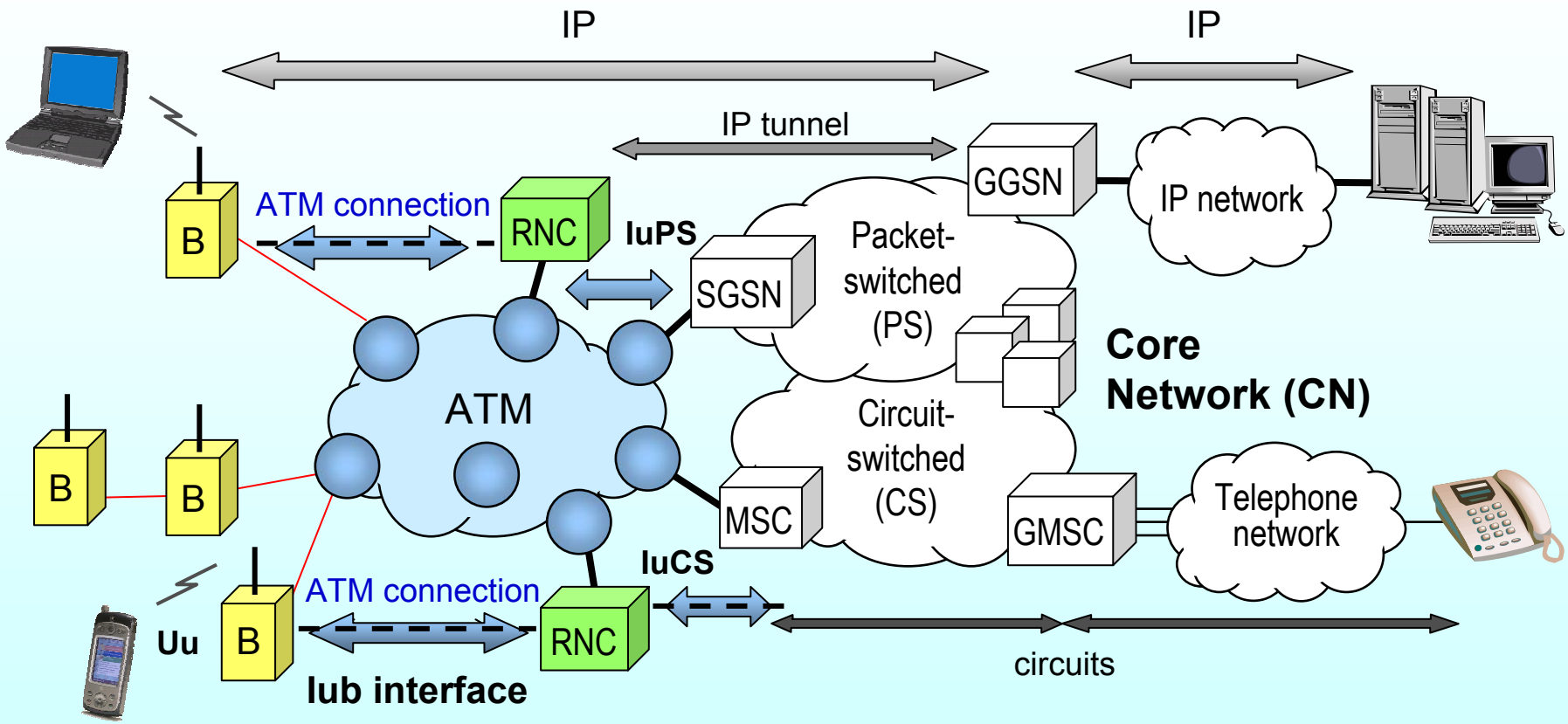
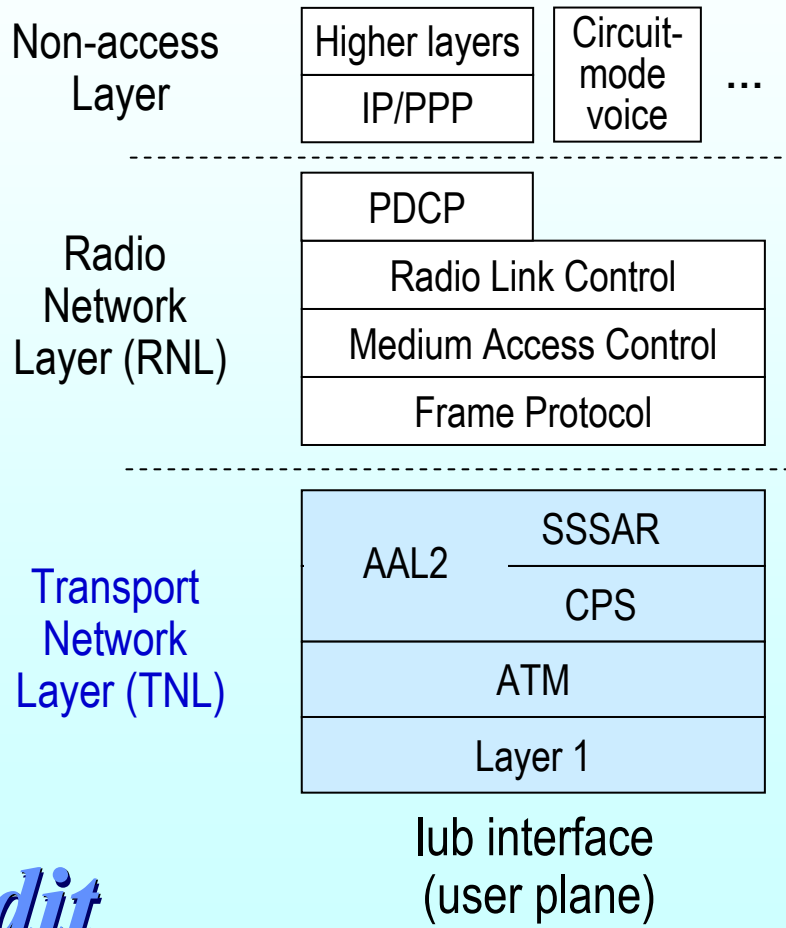
Outline

- **Introduction**
- Transport options in the access network
- Analysis of efficiency
- Simulation model and results
- Conclusions

UMTS (Release 99)

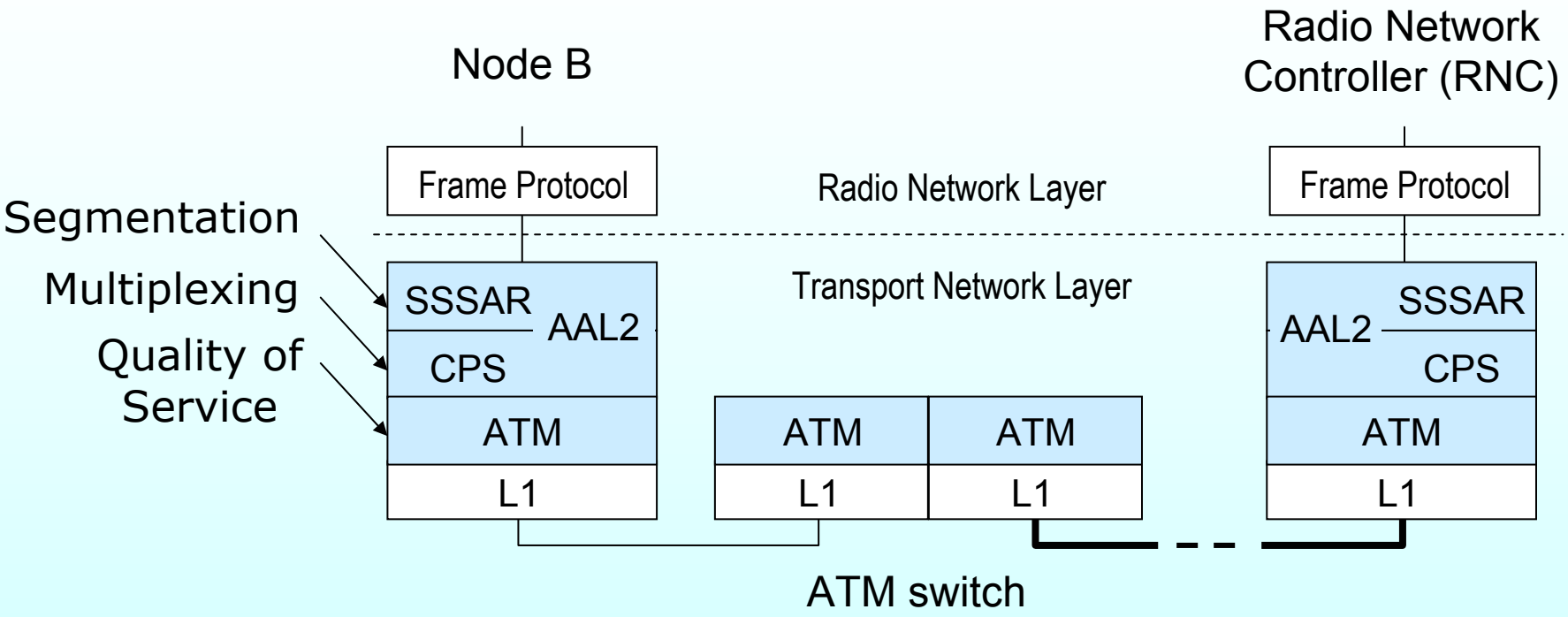


Protocol stack in Iub interface



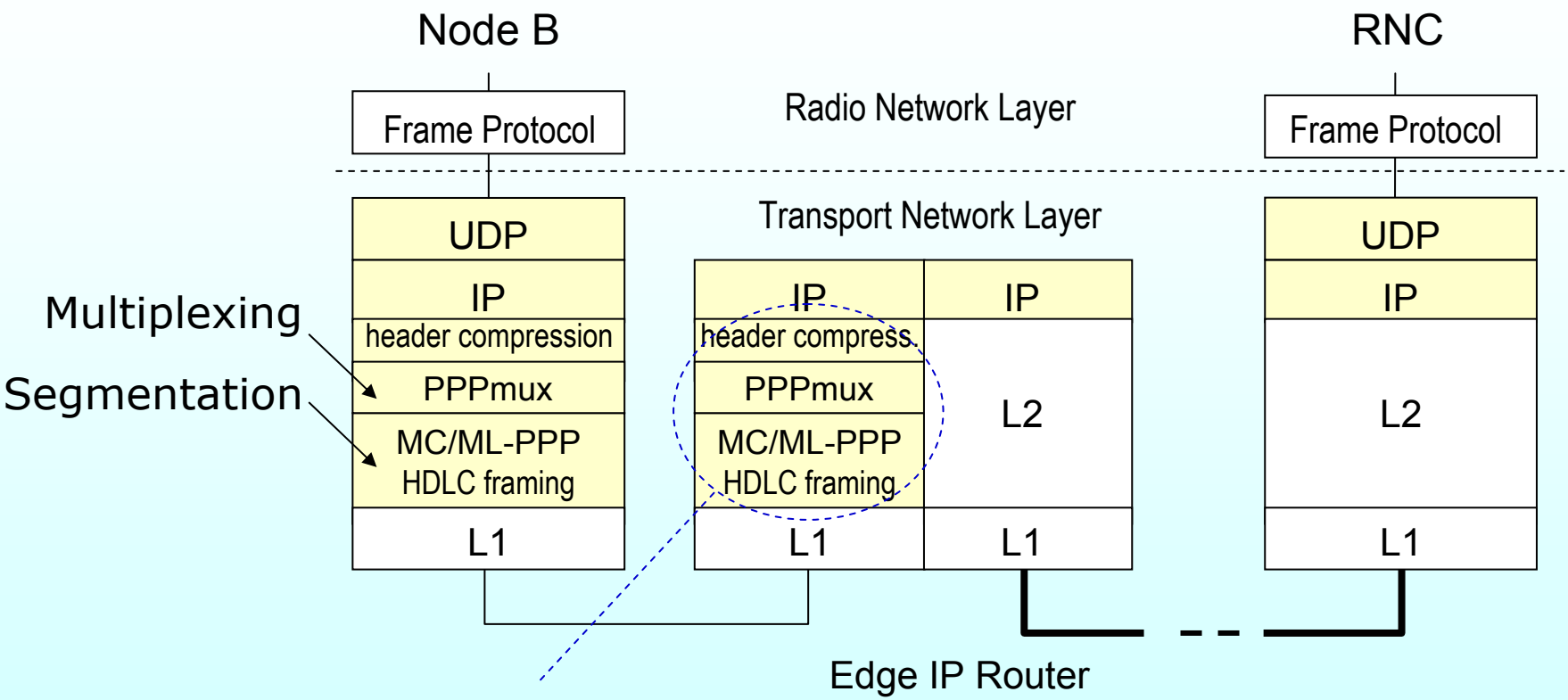
- Circuit-mode and packet-mode services
- New UMTS protocols, standardized by 3GPP
- Reuse of existing protocols
  - Release 99: ATM
  - Release 5 (2002): ATM or UDP/IP

AAL2/ATM transport option



SSSAR (Service Specific Segmentation and Reassembly) ITU-T I.366.1
CPS (Common Part Sublayer) ITU-T I.363.2

Example of IP transport option

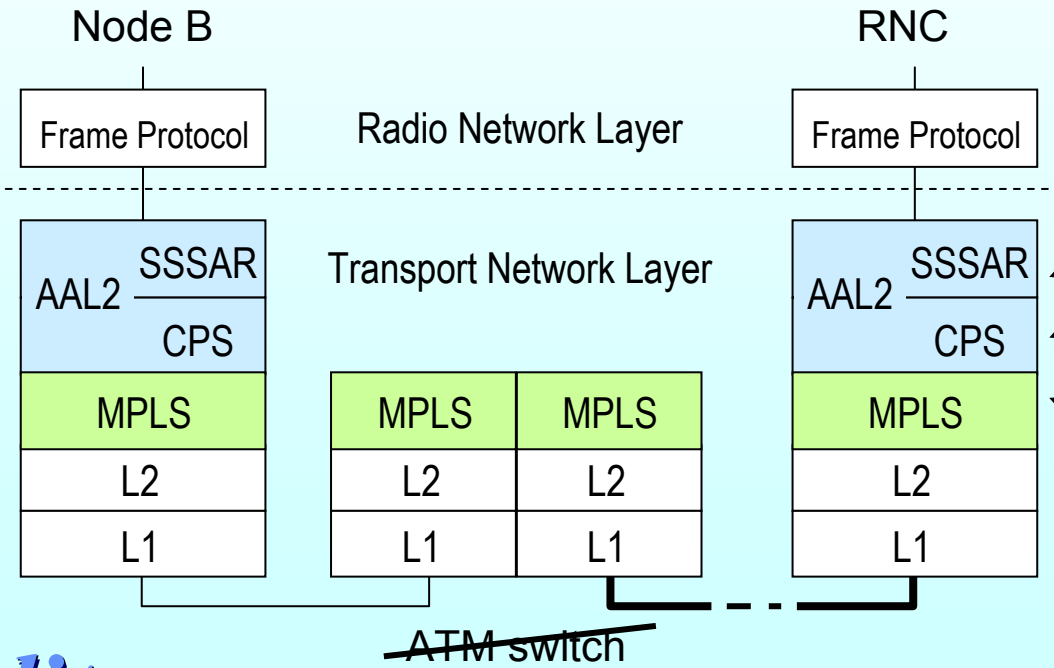


These protocols may also be terminated in the RNC by using a tunnel between Node-B and RNC

DiffServ may be used for QoS

AAL2 over MPLS

- Keep AAL2 for segmentation and multiplexing (easy migration and interworking with AAL2/ATM nodes)
- Replace ATM cells and switches by MPLS (less overhead and cost)
  - MPLS Label Switched Paths (LSPs) instead of ATM VCC/VPP



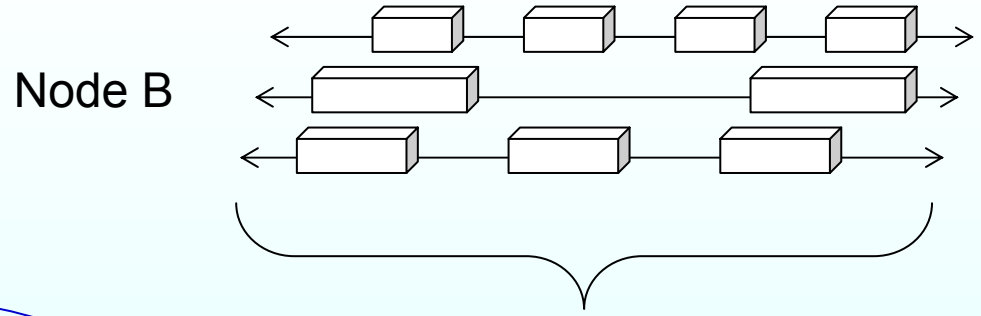
SSSAR does not change

CPS optimized for encapsulation without ATM cells

Traffic engineering and QoS with MPLS-TE and DiffServ

No header compression

AAL2 over MPLS

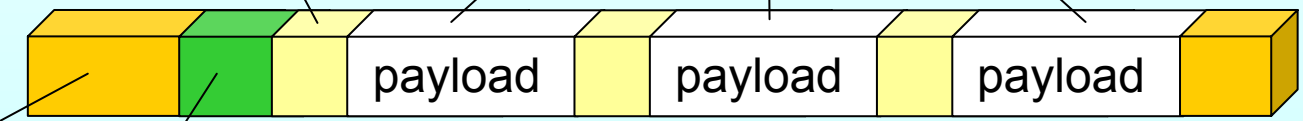


overhead per packet

Channel identifier and segment length in CPS header (3 bytes)

Packets to be transported, segmented if necessary by SSSAR

overhead per group of packets



Layer 2 overhead (ej. 5 bytes for PPP/HDLC)

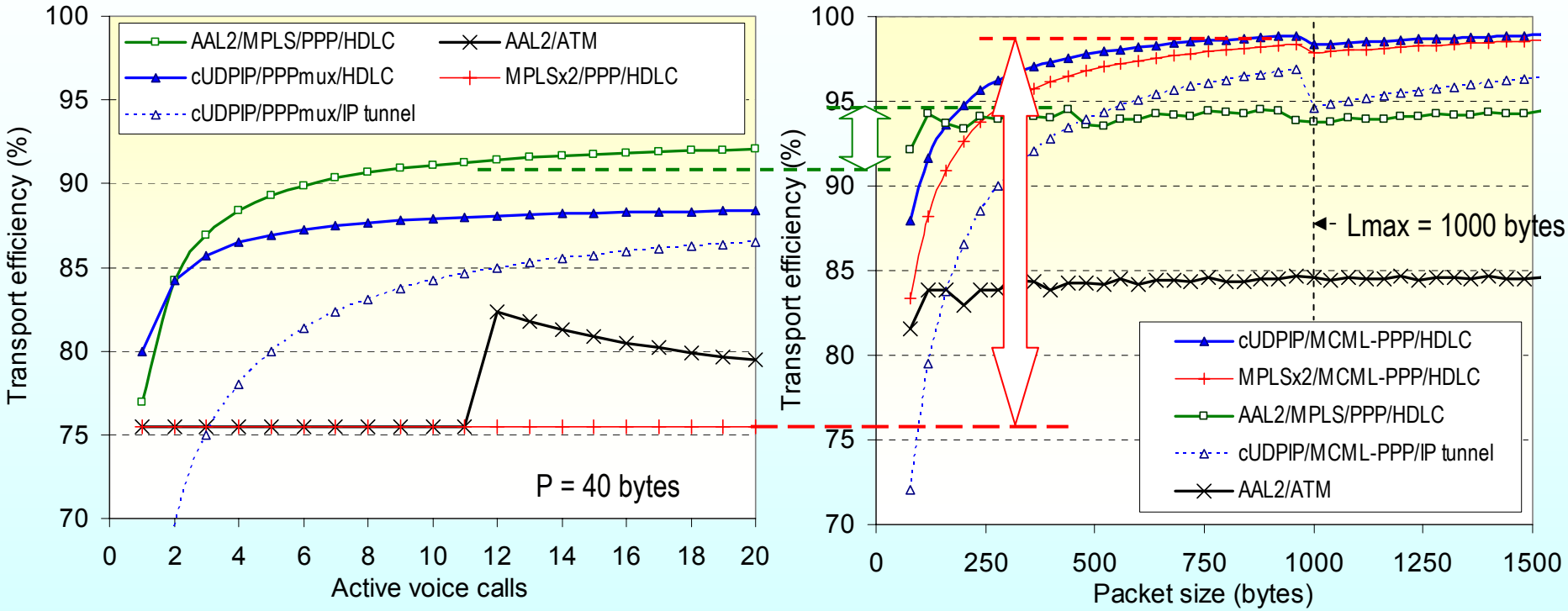
MPLS label (4 bytes)

Limited by maximum waiting time ("Timer_CU") and maximum frame length (Lmax)

Performance analysis

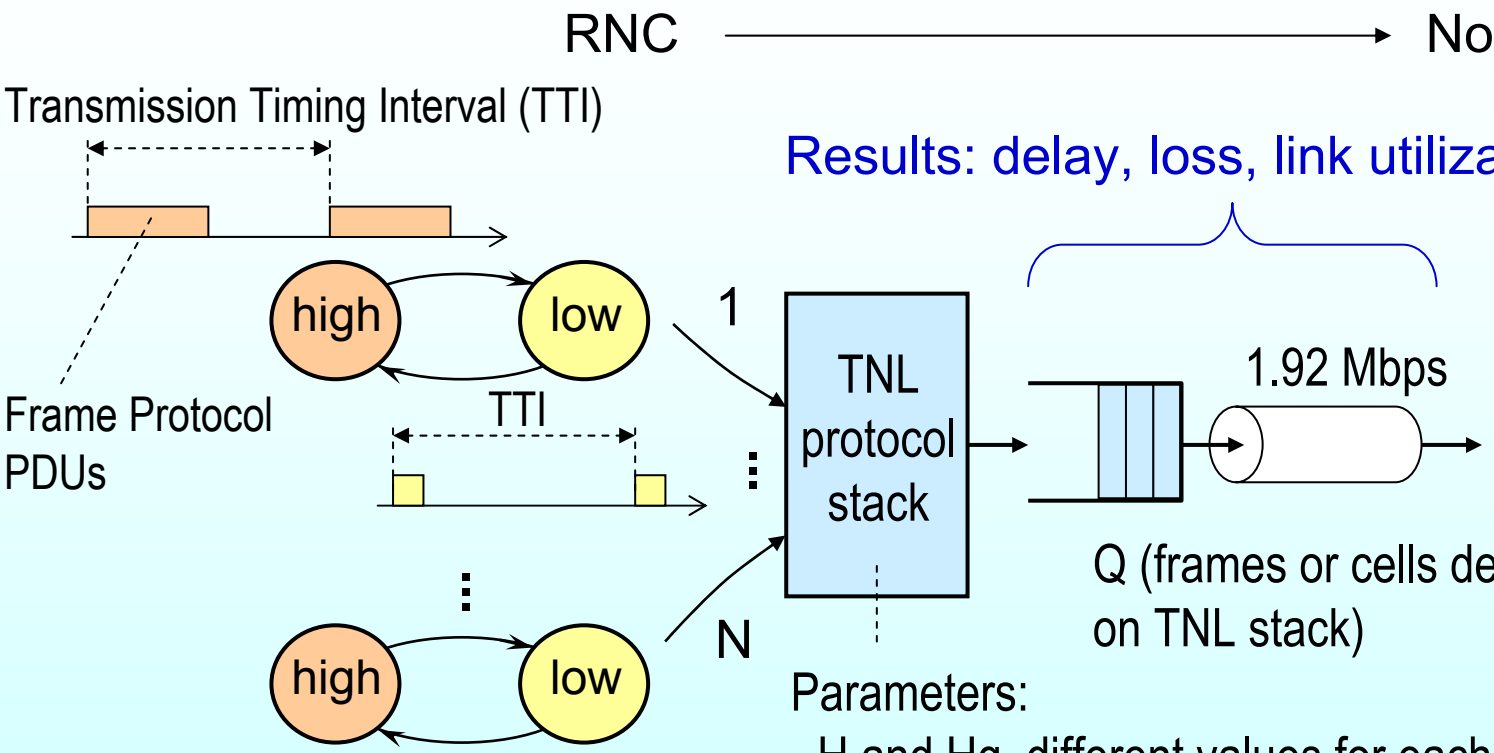
- Different transport options analyzed to determine protocol header overheads per packet (H) and per group (Hg)
- Parameters
  - Packet length (P)
  - Number of packets per group (N)
- Conditions
  - Packet segmented if P+H > Lmax
  - N x (P+H) ≤ Lmax
    - Timer_CU not considered
- Efficiency = bytes from RNL / bytes passed to layer 1

Transport efficiency



- AAL2/MPLS gives an efficiency between 90-95% in most cases
  - is the most efficient option for packets smaller than 160 bytes
- MPLS efficiency is very sensitive to the packet length (75-98%)

Simulation model overview



Two applications:
- Voice at 12.2 kbps
- Web at 64 kbps

Traffic parameters

- Based on 3GPP TR 25.933 and [5]

TTI values fixed by UMTS radio interface

Includes RNL protocol overhead

	Voice 12.2 kbps	Web 64 kbps
TTI (ms)	20	40
Packet size (bytes)	**40**	**331**
Mean duration (s)	3	1,65
Transm. rate (kbps)	16	66,2
Packet size (bytes)	13	0
Mean duration (s)	3	12
Transm. rate (kbps)	5.2	0
Average traffic (kbps)	10.6	8

high

low

Mean file size 13.2 kbytes

Silence Insertion Descriptors

Mean reading time

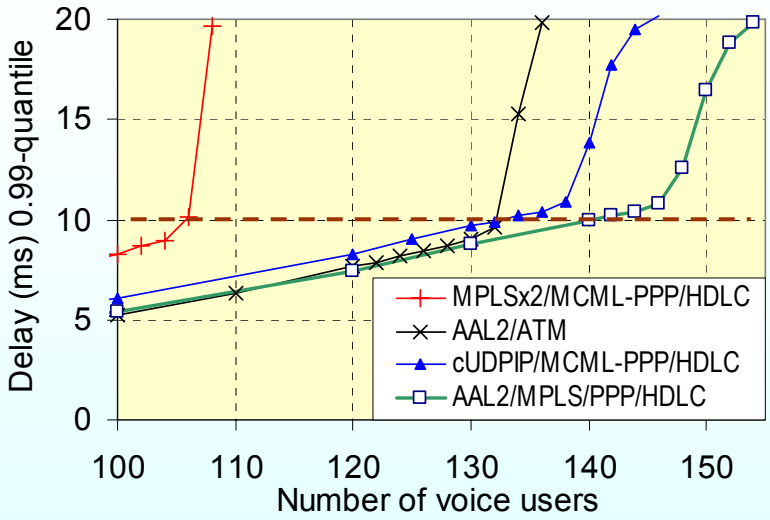
Transport parameters

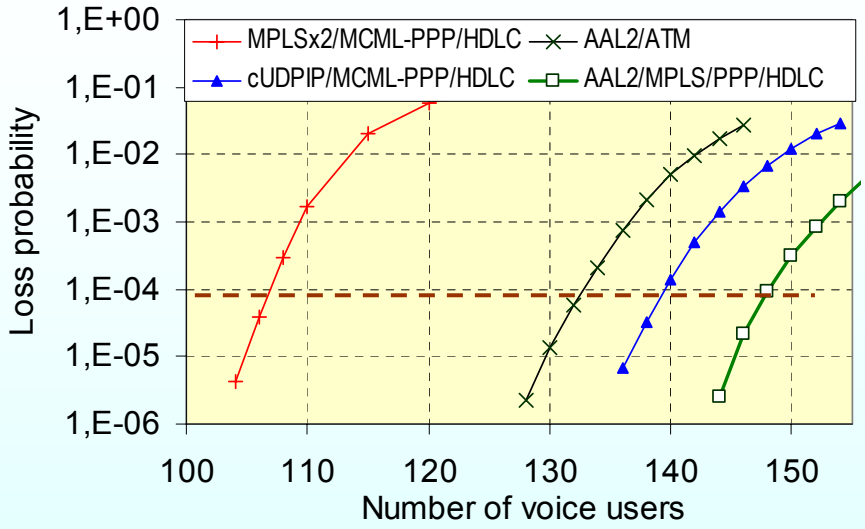
- Protocol overheads H and Hg, same values as before
- QoS requirements in Iub interface
  - obtained from "end to end" UTRAN requirements (Radio Access Bearer), see [5]

Iub	Voice	Web
Loss	$< 9.5\ 10^{-5}$	$< 4.0\ 10^{-5}$
Delay (ms)	< 10 (99%)	< 15 (95%)

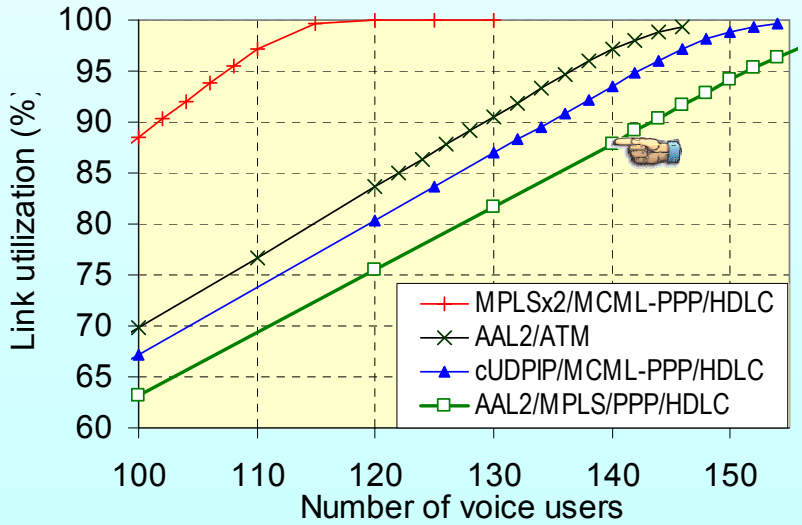
- Values obtained from pilot simulations, see [24]
  - Maximum waiting time (Timer_CU): 1 ms
  - Maximum length (Lmax): 500 bytes
  - Buffer size (Q): 10 – 50 frames

Simulation results (1): voice

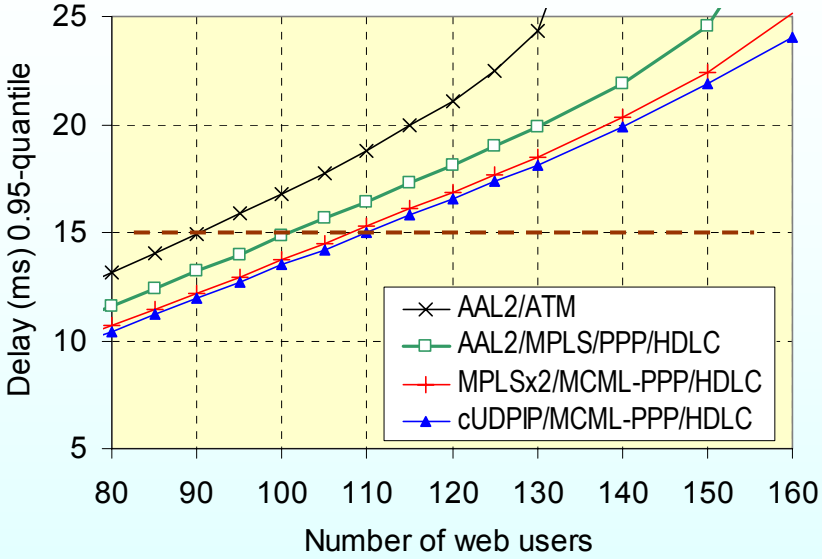


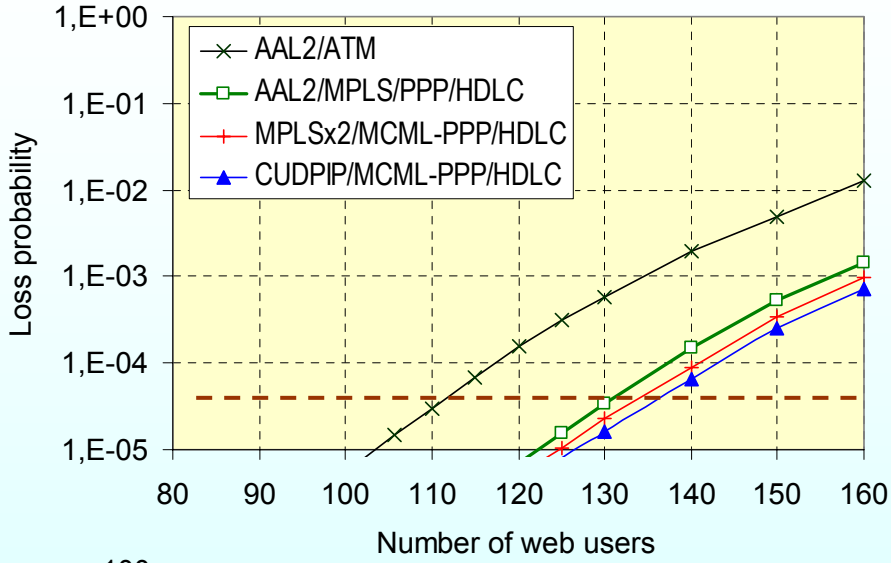


- AAL2/MPLS gives the lowest delay and loss
- MPLS alone is the worst option for short packets

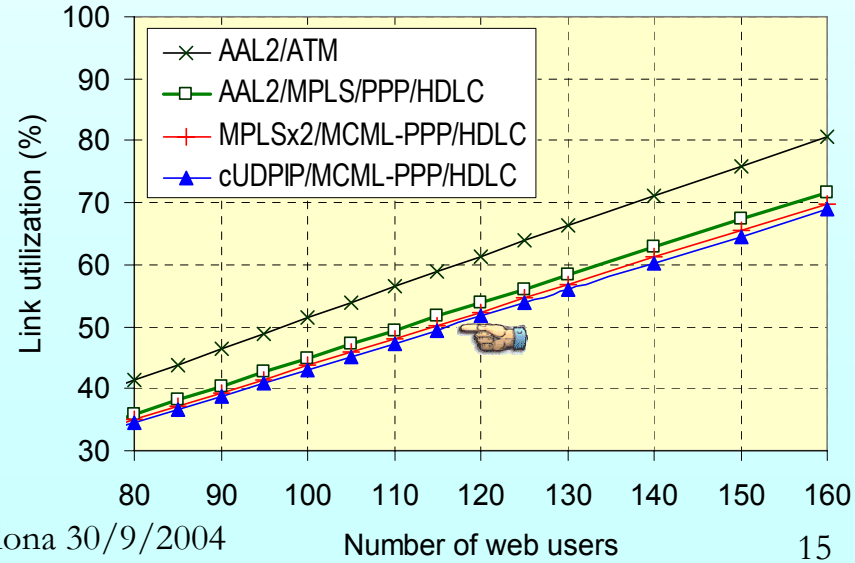


Simulation results (2): web



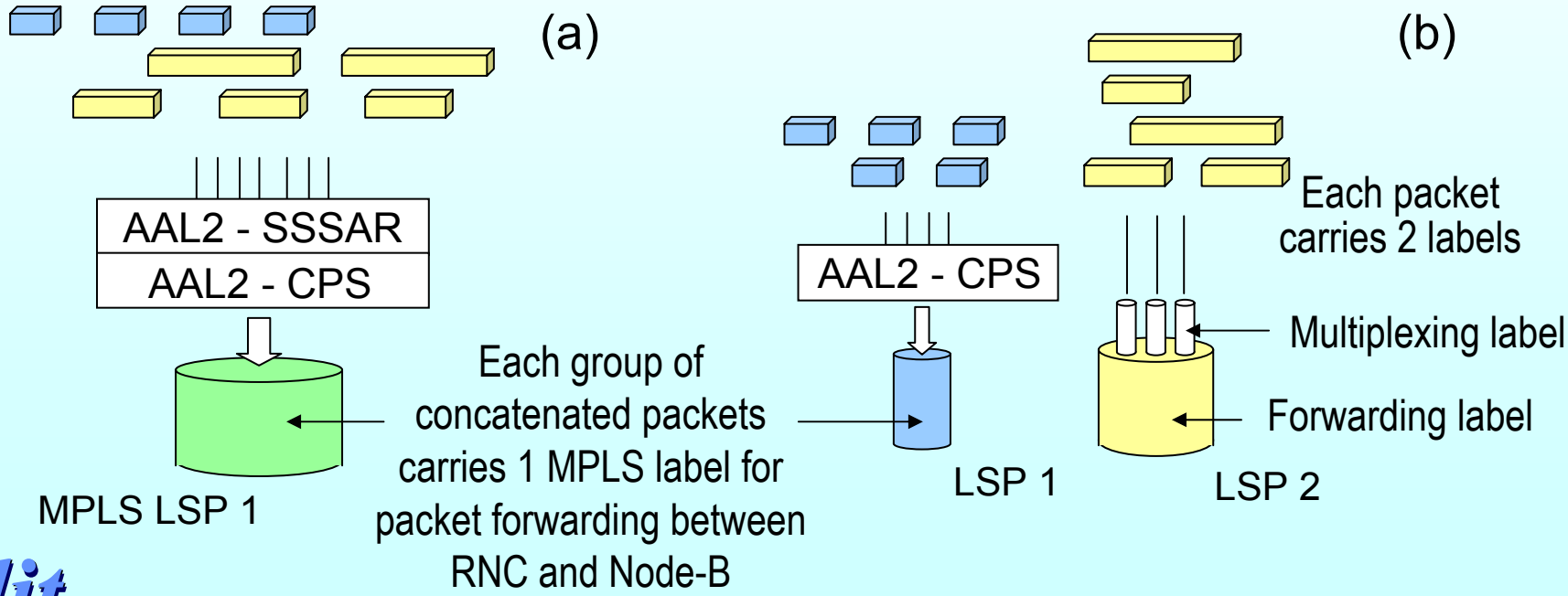


- Smaller differences among transport options
- Now MPLS is a good option because packets are longer
- Smaller link utilizations



Conclusion

- AAL2/MPLS similar to AAL2/ATM, but
  - No ATM switching needed
  - More efficient (10-15% improvement) → more users served
- For long packets AAL2 is not needed



Thank you

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