Voice Over ATM (VOA)

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Overview

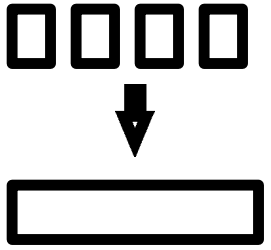
- **Importance of Traffic Management**
- **Simulation Results**
- **OSU Scheduling Algorithm**
- **Recent Developments: New AAL for Voice**

Why No Voice on ATM?

- **Incomplete standards**
- **No appropriate AAL**
- **Cheaper alternatives**
- **Traffic Management and Scheduling**
  Standard committees will not work on internal switch/NIC mechanisms

Delay Issue

- **48 bytes at 64 kbps = 6 ms**
  $\Rightarrow$ Need Echo cancelers
- **48 bytes at 16 kbps = 24 ms $\Rightarrow$ too long**
- **Can't fill a cell completely**
- **Current AALs allow segmentation (long packets to multiple cells).**
- **Do not allow blocking (short packets in one cell)**

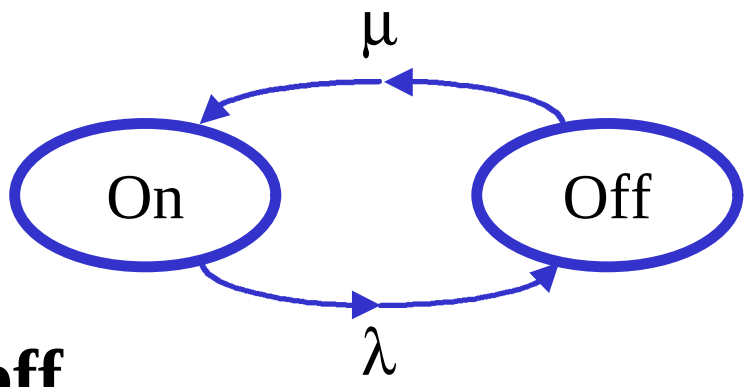


Simulation Results

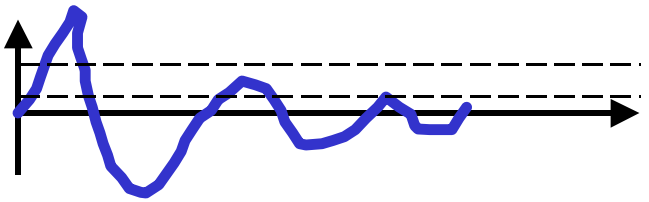
- **Voice Traffic Model**
- **Performance Metrics**
- **Network configuration**
- **Simulation results**

Voice Traffic Model

- **On-off Model:**

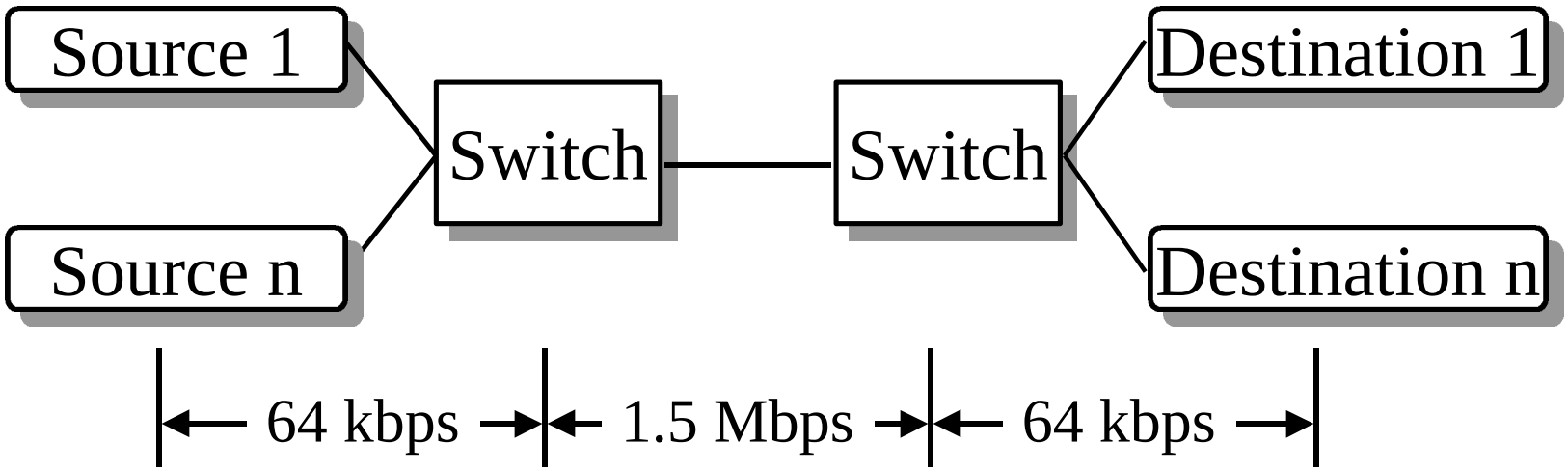


- **352 ms on, 650 ms off**
- **Times depend upon the sensitivity of the detector**

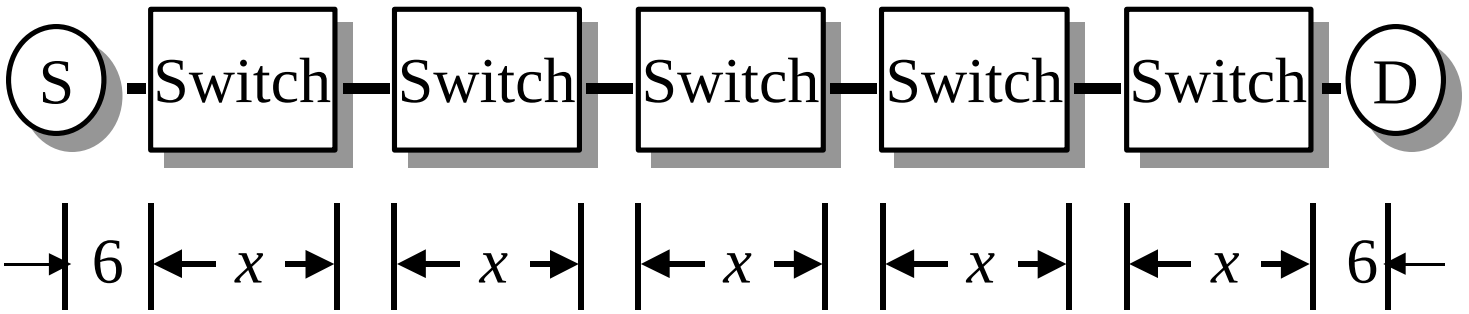


Network Configuration

- **n voice sources sharing a T1 link**



Max Acceptable Delay



- **Cross-country propagation delay = 24 ms**
- **Total delay = $5x + 6 + 6 + 24 \leq 100$**
- **Per-switch delay $x \leq 12.8$ ms**
- **1-hop network delay $x + 24 \leq 36.8$ ms $\approx$ 40 ms**

Performance Metrics

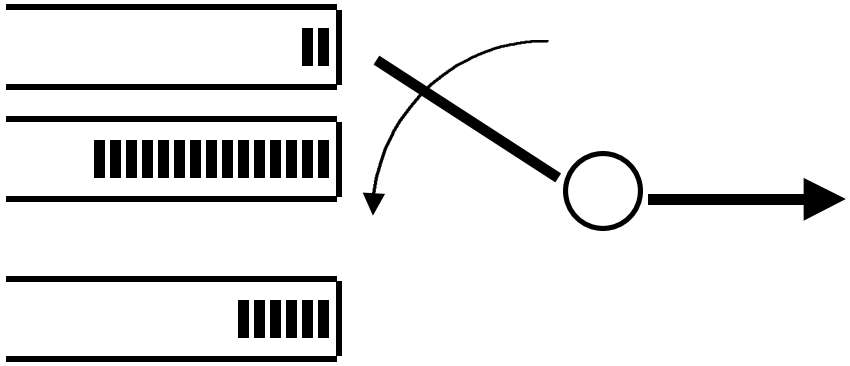
- **Cell Loss Ratio (CLR)**
- **Delayed Cells: Network delay $\geq$ 40 ms**
- **Degradation of Voice Quality =**
  DVQ = (Lost cells + Delayed cells)/Cells sent
- **Useful cell ratio = 1 - DVQ**
- **Fairness**

Fairness Index

$$f(x) = \frac{\sum x_i^2}{n\sum x_i^2}$$

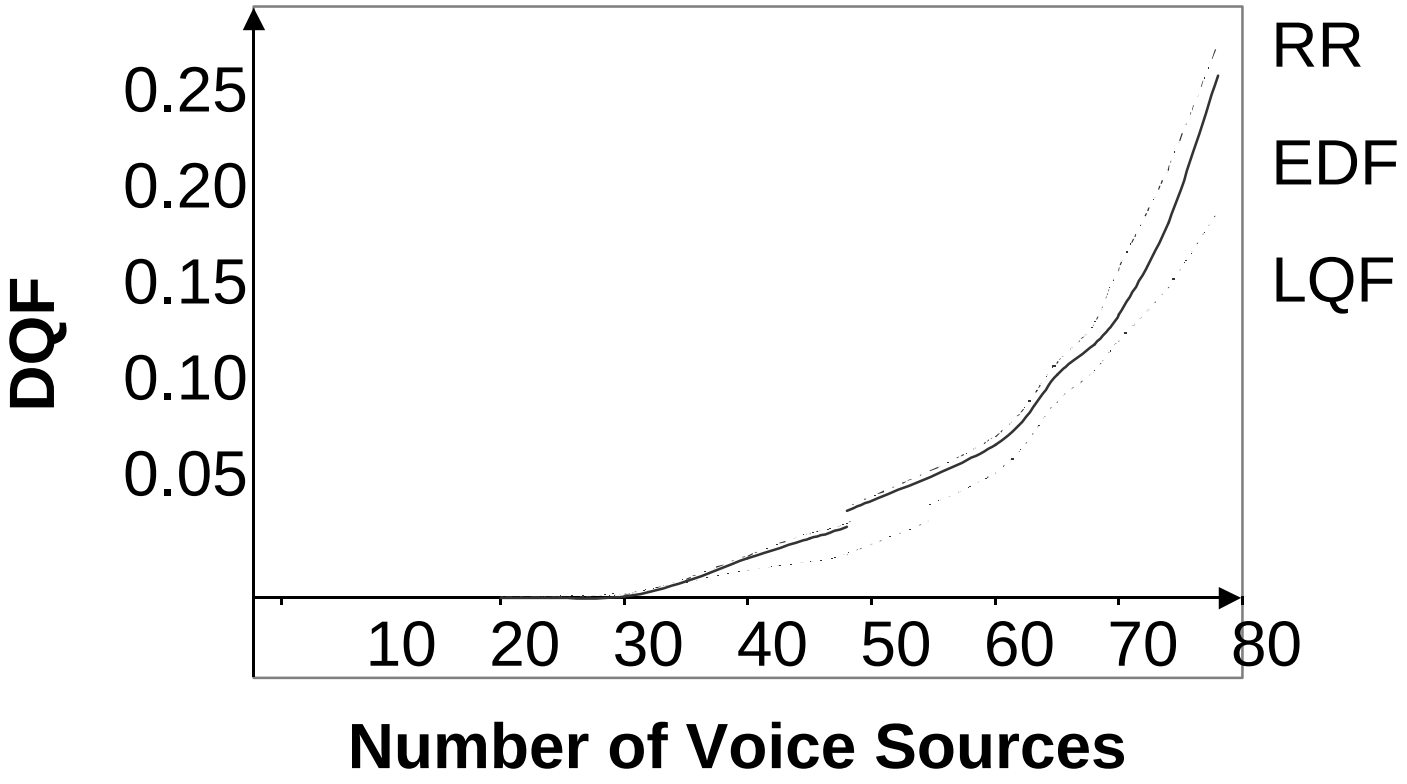
- **Always lies between 0 and 1**
- **If k out of n users get k/n, others get 0, fairness index is k/n**
- **Independent of scale**

Scheduling Policies



- **Earliest deadline first**
- **Longest queue first**
- **Round robin**

Simulation Results



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Simulation: Conclusions

- **Scheduling policy does affect voice quality and fairness**
- **Voice traffic should only partially use the link. Remaining capacity used by data.**
- **Average delay is not a good measure of voice quality.**
- **Need a scheduling algorithm better suited for ATM.**

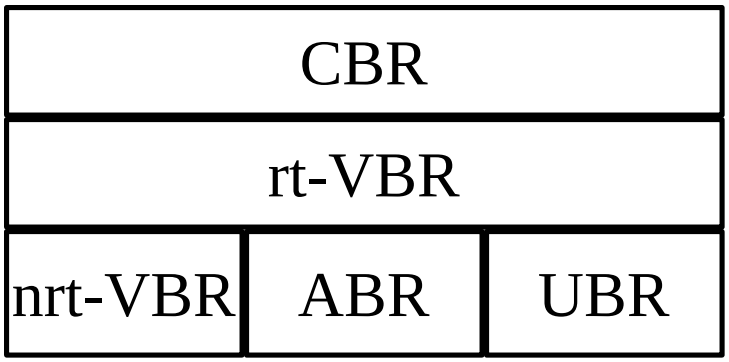
OSU Scheduling Algorithm

- **Conventional algorithms do not provide quantitative delay or bandwidth guarantees**
- **Not ideal fit for ATM networks**

Two-Class Algorithm

Time	CBR Credit	ABR Credit	Sched-uled	CBR Credit	ABR Credit
0	0.6	0.4	-		
1	1.2	0.8	CBR	0.2	0.8
2	0.8	1.2	ABR	0.8	0.2
3	1.4	0.6	CBR	0.4	0.6
4	1.0	1.0	ABR	1.0	0.0
5	1.6	0.4	CBR	0.6	0.4

n-Class Scheduler



- **Ensures *no-starvation* for all classes even under overload.**
- **Each class has an *allocation***
  $\Rightarrow$ Guaranteed under overload

n-Class (Cont)

- **Some classes need minimum delay**
  $\Rightarrow$ have *priority*.
- **Some classes are greedy: They will send more than allocated and will want to use all left-over. *No left-over* capacity.**
- **Left-over capacity must be *fairly* allocated.**
- **ERICA scheduler achieves all these goals.**

New AAL: Requirements

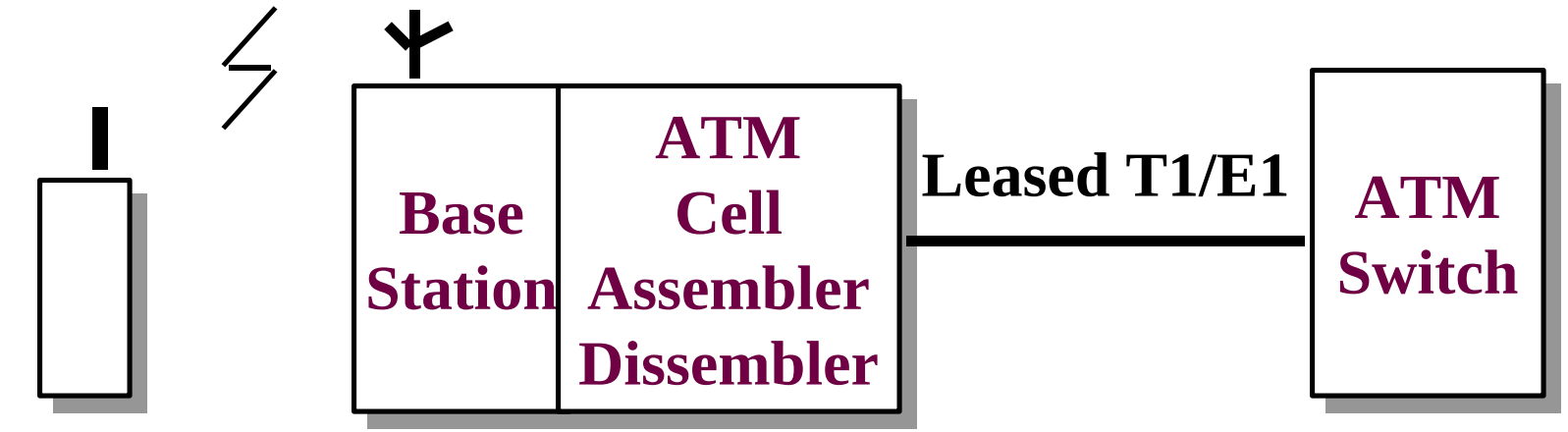
- **Allow transfer of short variable length packets**
- **Allow packets with variable inter-arrival times**
- **Allow packets to cross ATM cell boundaries**
- **Allow for partially filled cells**
- **Allow multiple connections to be multiplexed on one VC**

AAL2

- **Objective:**
  Support low bit rate (below 64 kbps) delay sensitive applications
  $\Rightarrow$ allows sending less than 48-byte payload
- **ITU-T SG13: ITU I.363.2**
- **Previously known as AAL-CU**
- **0 to 64-byte packets. Default 45 bytes.**

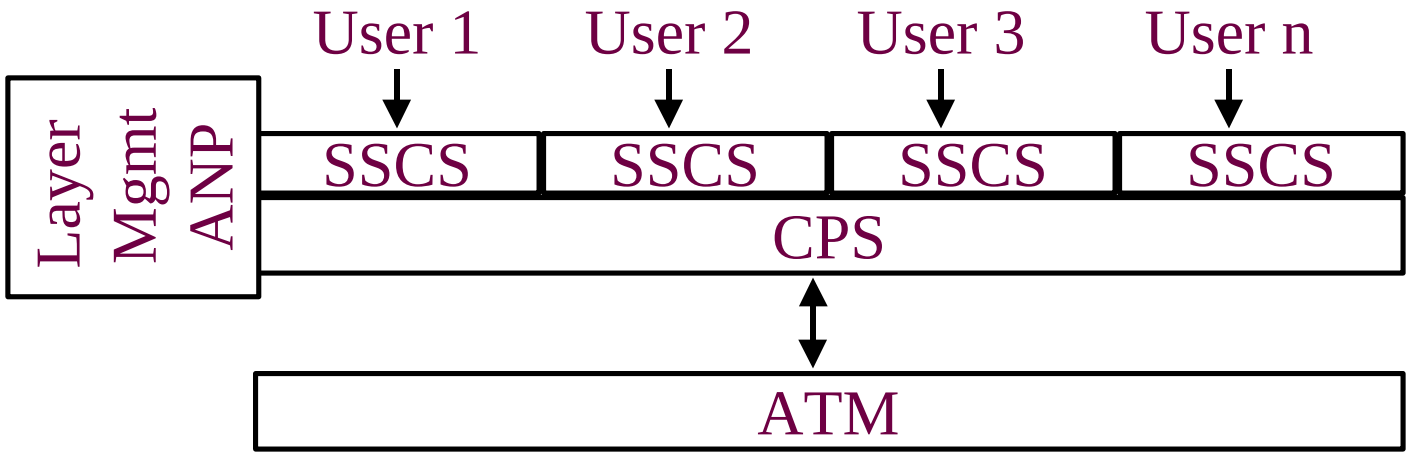
Low-Bit Rate Voice

- **Time to fill 48-byte payload @8 kbps = 48 ms**

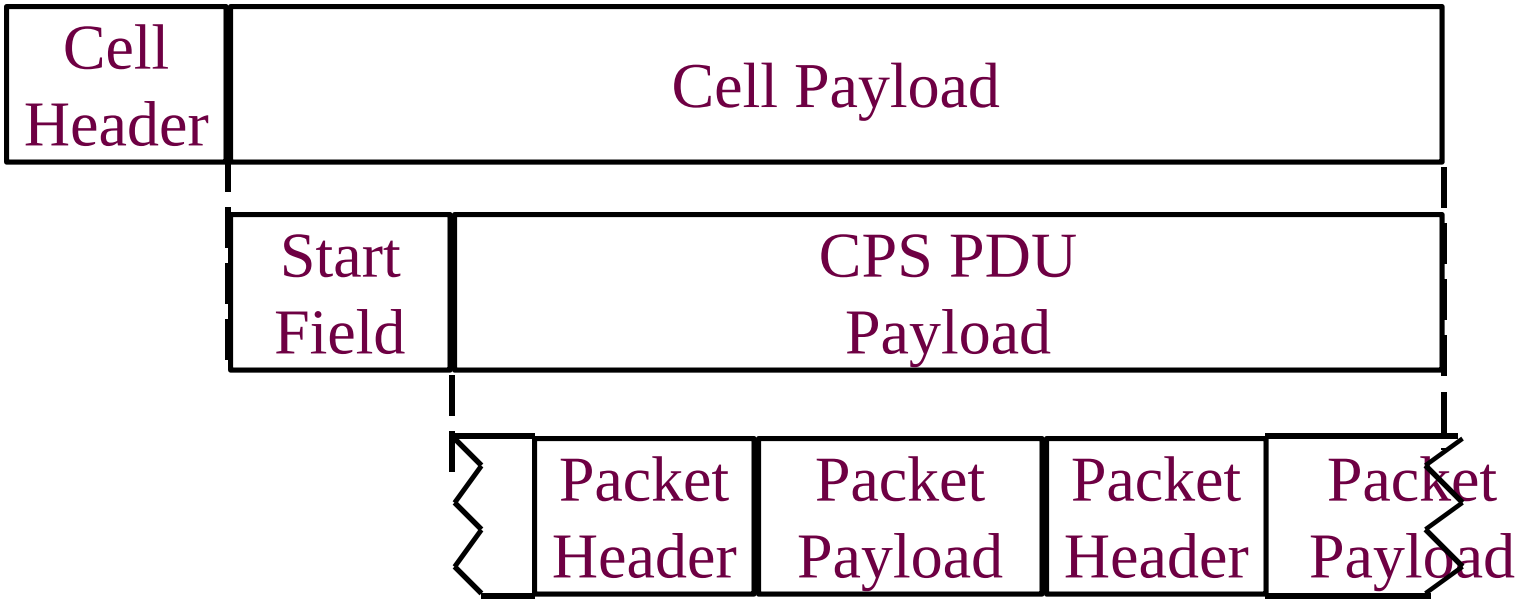


Protocol Structure

- **Common Part specification (CPS)**
- **AAL2 Negotiation procedure (ANP)**
- **Service Specific Convergence Sublayer (SSCS)**

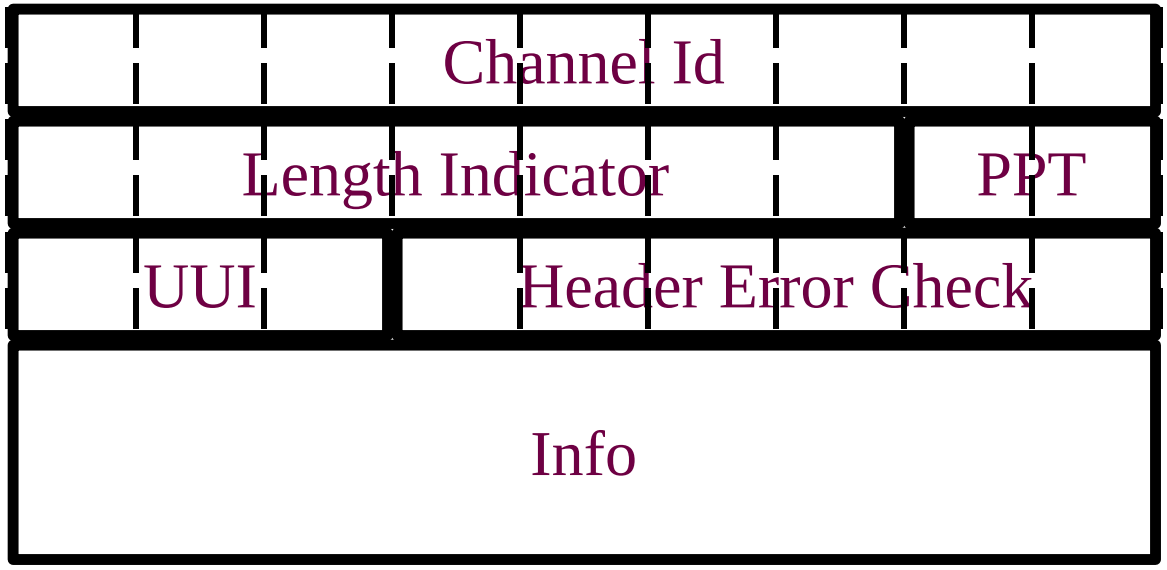


Packet Format



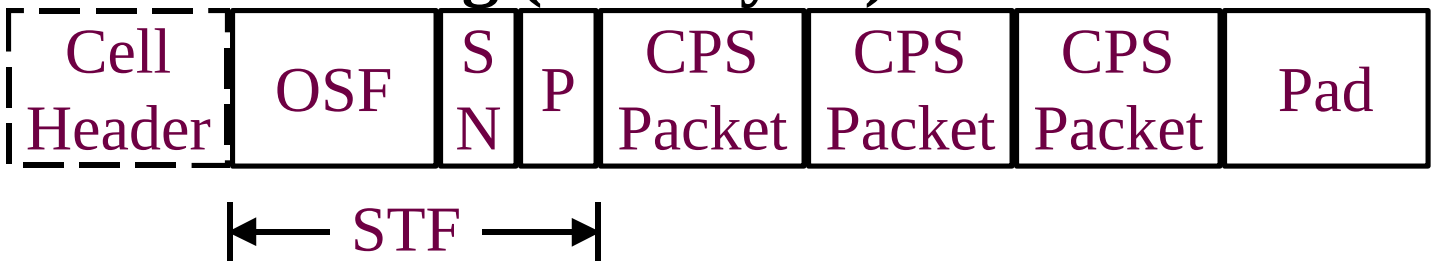
CPS Packet Format

- **3-byte header. UUI = User-to-user indication, PPT = Payload protocol type**



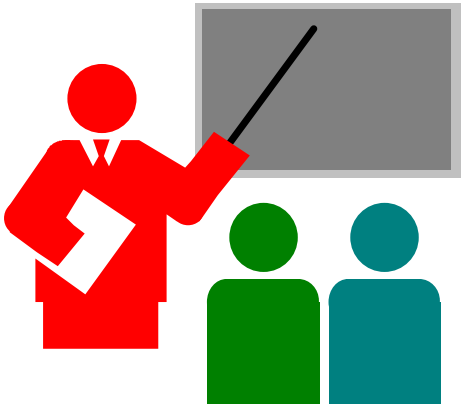
Cell Format

- **STF: Start field = CPS PDU header**
- **OSF: Offset of the first packet**
- **SN: Sequence number mod 2, 0 or 1**
- **P: Parity (odd) of start field**
- **Pad: Padding (0-47 bytes)**



Status

- **I.363.2 Text frozen, Feb 97**
- **Specifies CPS**
- **ANP, SSCS, OAM, to be done**



Summary

- **Traffic management and scheduling is an important component for QoS**
- **Scheduling makes a difference in quality of voice over ATM**
- **AAL2 is being designed for low-bit rate voice**

References

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- **ATM Forum, "Requirements for compressed voice to the desktop," LTD-VTOA-DSK-02.03, April 1997,**
- **Madge Networks, "Voice over ATM: A Sound Assessment," http://www.data.com/tutorials/atm_voice.html**

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- **Beth Gage and Liza Henderson, "Voice Over ATM," Network World, March 11, 1996.**
- **M. Jackson, "VTOA AAL5 format proposal," ATM Forum 96-955, August 1996.**
- **G. Leijonhufvud, "Timing of Voice Services to the desktop," ATM Forum/96-953, August 1996**
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