ATM_Forum/98-0830 Packing Density of Voice Trunking using AAL2

Chunlei Liu, Sohail Munir, Raj Jain,

The Ohio State University

Sudhir Dixit, Nokia Research Center

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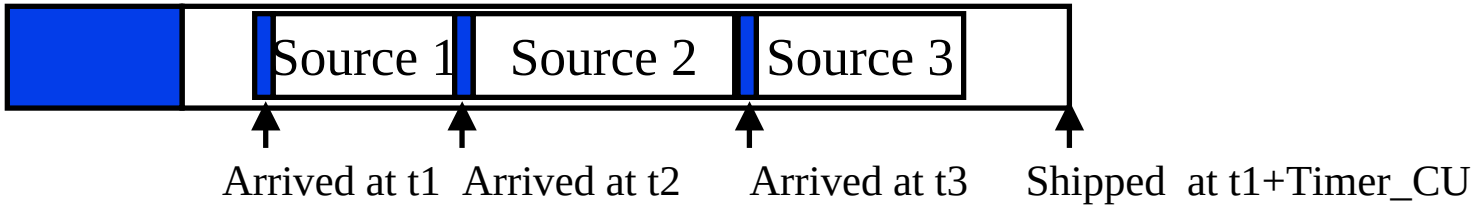
http /

Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/

Overview

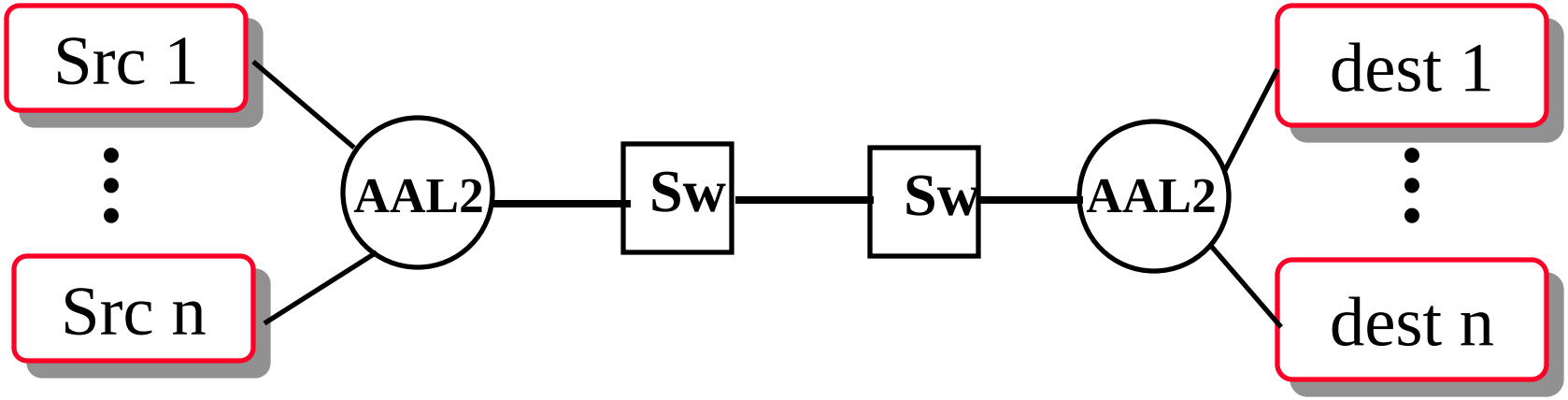
- AAL2 Voice Trunking and Timer_CU
- Voice Model and Packet Arrival Pattern
- Markov Chain Analysis
- Comparison with Simulation Results
- Conclusion

AAL2 Voice Trunking



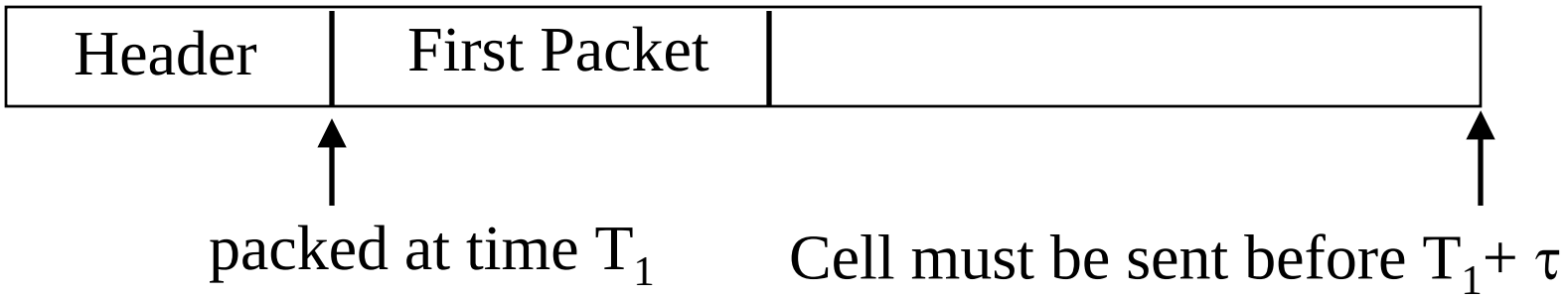
- In AAL2 voice trunking, voice packets from different sources are packed into one cell.
- Problems:
  - When a cell waits for other packets to arrive, the first packet may suffer prolonged delay.
  - If partially filled cells are sent, the link efficiency may become low.
- Solution: Choose an appropriate Timer_CU value.

Simulation Model



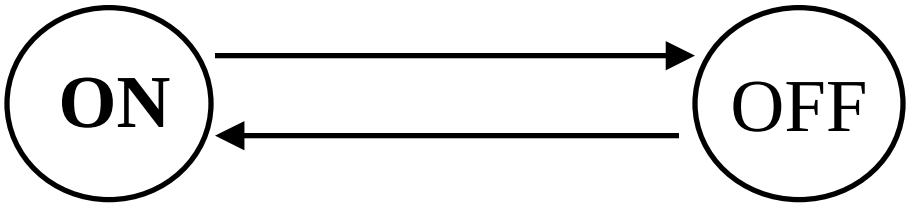
- Voice sources send G.723.1 packets to AAL2.
- AAL2 packs voice packets into cells and send them to the switch. Destination AAL2 will unpack the cell and dispatch each packet to its destination.
- AAL2 keeps a Timer_CU to avoid prolonged delay.

Timer_CU



- Timer_CU value τ determines the time after which a cell has to be sent.
- Large Timer_CU value leads to large packing delay.
- Small Timer_CU value leads to more partial cells, and low link efficiency.

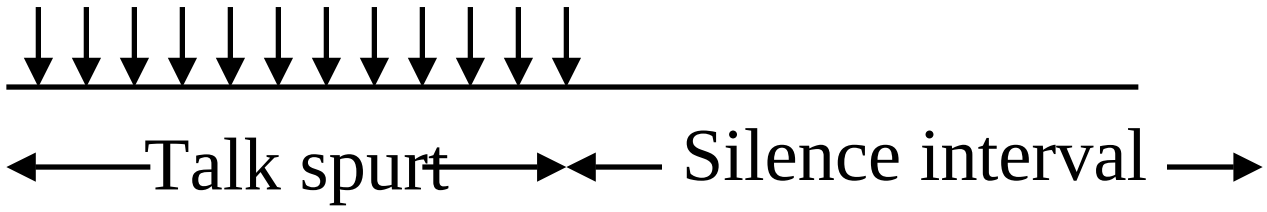
Voice Model



352 ms 650 ms

- ON-OFF model
- Talk spurt: Exponential distribution, mean = 352 ms
- Silence: Exponential distribution, mean = 650 ms

Packet Arrival Pattern

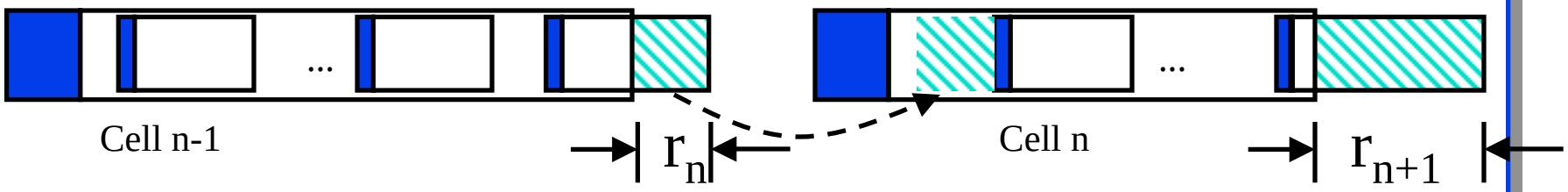


Arrival pattern in one cycle

- This is the arrival pattern from one source.
- Voice sources are independent.
- R_i = Probability of receiving i packets within τ ms.
- From packet arrival pattern, we can calculate R_0, R_1, R_{2+}

Markov Chain Analysis

- The packing process can be described with a Markov chain.
- Let r_n be the remainder length from cell *n-1*.
- Then r_{n+1} depends on r_n and the number of packets received in τ ms.
- The transition matrix *P* depends on the packet receiving probabilities R_0, R_1, R_{2+}.



Analysis Results

- $\pi = \pi P$ gives the stationary distribution π, the long run probability distribution of remainder length.
- From π and R_0, R_1, R_{2+}, we can calculate the average number of bytes in a cell, and then the average packing density.

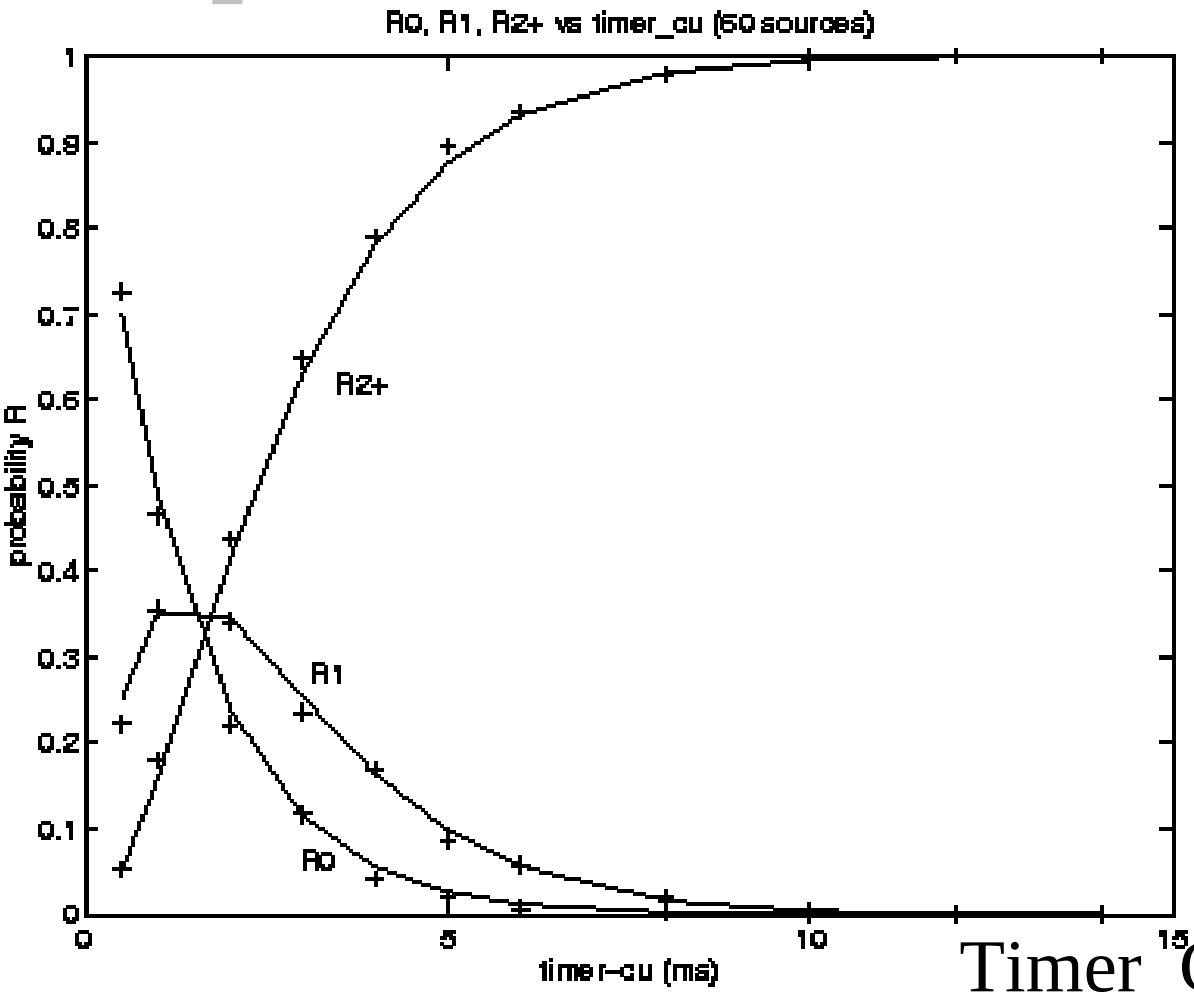
Simulation

- To verify the analysis, we wrote a simulation program to implement the AAL2 packing process.
- The simulation generates talk spurts and silence intervals according to the ON-OFF model.
- Assume G.723.1 is used for voice encoding.
- Actual density is computed from the total number of voice bytes and the number of cells sent.
- The simulation results are summarized as follows.

Simulation Results

τ	celles	Recv 0	Recv 1	Recv 2	Density %
0.5	5621	4079	1246	296	46.93
1	5028	2339	1787	902	56.00
2	4286	949	1462	1875	64.78
4	3705	154	626	2925	72.43
6	3587	26	206	3355	75.42
8	3470	8	66	3396	76.54
10	3716	0	10	3706	77.05
12	3779	0	0	3779	77.12

Comparison: Probabilities

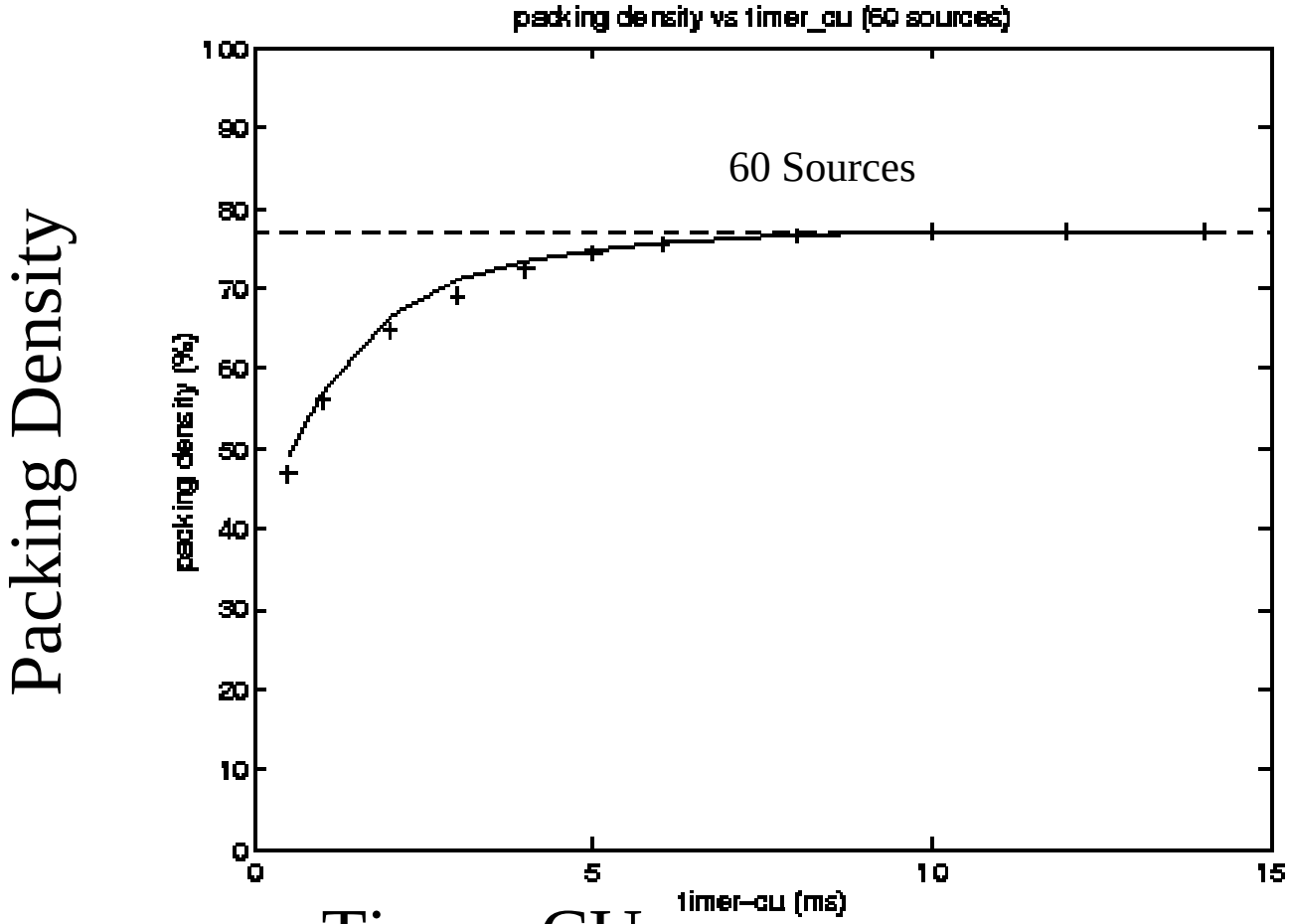


Probability R_i

Timer_CU

Analysis: solid lines, Simulation: "+".

Comparison: Packing Density



Packing Density

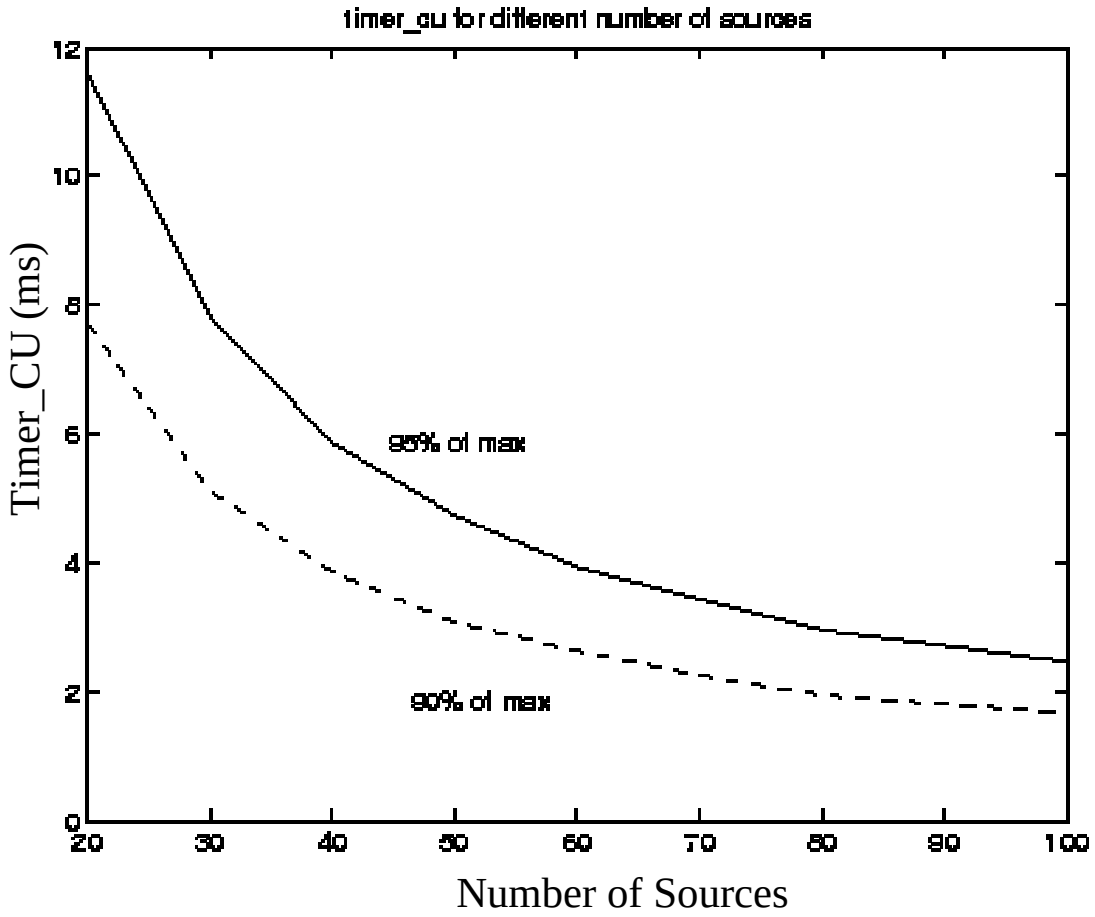
Timer_CU

Analysis: solid lines, Simulation: "+".

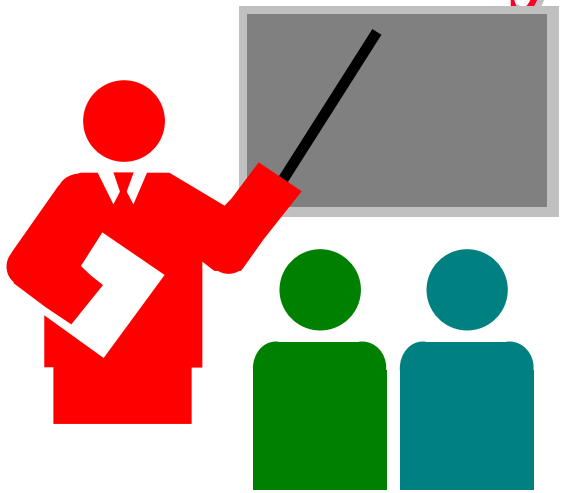
Conclusion

- Packing density can be calculated from the number of voice sources and the given Timer_CU value.
- The simulation results match the analytical results perfectly.
- Given the number of voice sources and the desired link efficiency, we can calculate the appropriate Timer_CU value.
- The next slide gives the Timer_CU values to achieve 90% and 95% of the maximum link efficiency for different number of voice sources.

Timer_CU values for Different Number of Users



Summary



- The Timer_CU value can significantly affect link efficiency.
- It should be set according to the number of sources and delay requirement.
- This contribution gives an algorithm to calculate a Timer_CU value to achieve desired link efficiency.