Throughput Performance of Multiwavelength Shufflenet with/without Wavelength Conversion

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Abstract The throughput performance of multi-wavelength shufflenet (MWSN) employing dynamic wavelength routing with/without wavelength conversion is presented and is compared with that of conventional shufflenet running on m colors indepedently (M-SN) for both hot potato (HP) and single buffer deflection routing (DF)

I. Introduction

Shufflenet is one of regular topologies that has been well studied both analytically and by simulation but for single channel operation[1,2].Very recently, blocking performance of circuit-switched multi-wavelength regular and random topologies with wavelength conversion have been evaluated [3,4,5] In the present paper we consider the throughput performance of multiwavelength shufflenet topology designated by MWSN.Two modes of operation leading to MWSN(p,k,m) and the conventional SN running on m multiple colors,the m-SN,are distinguished depending on the packet injection srategy.In m-SN every node has m numbers of independenty driven fixed-wavelength transmitters and a packet from the ith generator is sent on wavelength λ_i, independently of other transmitters, if there is a free λ_i wavelength slot at the node; i.e, there are m copies of conventional SNs corresponding to m wavelengths being used and the throughput will be just m times the throughput of a conventional SN.In MWSN every node will have m number of generators/transmitters, such that a packet ready for transmission from the ith generator can be assigned a wavelength λ_k, k=1,2,...m for the desired output link after scrutinizing the inputs to avoid wavelength conflicts.Both MWSN and m-SN, however, use 2m fixed receivers at each routing node.

II. System model

We consider two connected 64-node MWSN(2,4,m) as the physical topology in which the wavelength-routing nodes are connected by optical fibres, and each link carries a maximum of m wavelengths. Each routing node consists of 2 demultiplexers at the input side, 2 multiplexers at the output, 2m receivers, m transmitters and m number of 3x3 optical switches.All the major node operations viz. absorption, injection, space switching and routing with/without

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wavelength conversion for each wavelength are done in m seperate sub-modules under a common control.

III. Results and Conclusions

The simulation study reveals that the throughput of MWSN scales almost linearly with m as in m-SN at lower load with both HP and DF routing.At higher load, the difference in throughput performance between MWSN and m-SN with DF routing is marginal (Table 1) .

m	HP Routing				DF Routing			
	$g = 0.1$		$g = 1$		$g = 0.1$		$g = 1$	
	MWSN	m-SN	MWSN	m-SN	MWSN	m-SN	MWSN	m-SN
1	0.095	0.1	0.224	0.227	0.097	0.1	0.356	0.364
2	0.198	0.2	0.432	0.454	0.2	0.2	0.674	0.727
4	0.400	0.4	0.789	0.908	0.399	0.4	1.322	1.455
8	0.801	0.8	1.409	1.816	0.798	0.8	2.617	2.911

Although, m-SN provides always a higher throughput compared to that of MWSN, MWSN provides a better approach in realizing the best throughput for a given number of wavelengths, m, with fewer number of transmitters per node compared to m-SN (about m/2 transmitters for MWSN versus m transmitters for m-SN).Finally, with the facility of wavelength conversion at each node, MWSN provides significant improvement per-node-throughput compared to MWSN without wavelength conversion and m-SN with buffering at nodes.For example, the gain in throughput with wavelength conversion for MWSN (2,4,m) using HP routing at unity load (with respect to throughput without wavelength conversion) is about 2.8, 7.6 and 18.8 for m=2,4 and 8 respectively.

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