APPENDIX E: PERFORMANCE v. SCHEDULED SOUNDING FREQUENCY

This appendix contains results graphs of the simulation study. The graphs present the measured (by the simulation) network performance criteria at the sixth and eighteenth hour of simulation, 0600 and 1800 Universal Time (UT), as the frequency of scheduled soundings increases. The performance criteria presented is only for the sixth and eighteenth hours of the simulation and is not a composite of any previous hours.

Each page of graphs is for a single traffic rate at one propagation condition. Results are presented for propagation conditions 1, 3, 5, and 8, See Table 4. Data rates are presented in order: 5, 10, 15, 30, and 45 messages per hour for propagation conditions 1 and 3. For propagation conditions 5 and 8 the data rates presented are 5, 10, 15 and 30 messages per hour.

The vertical scales for link and call success represent rates (between zero and one inclusive). The vertical scale for the average delay is in minutes. The horizontal scale represents the traffic rate in messages per hour.

A more detailed description of these results graphs along with interpretations and results is given in Section 4.2.1.

CONTENTS OF APPENDIX E

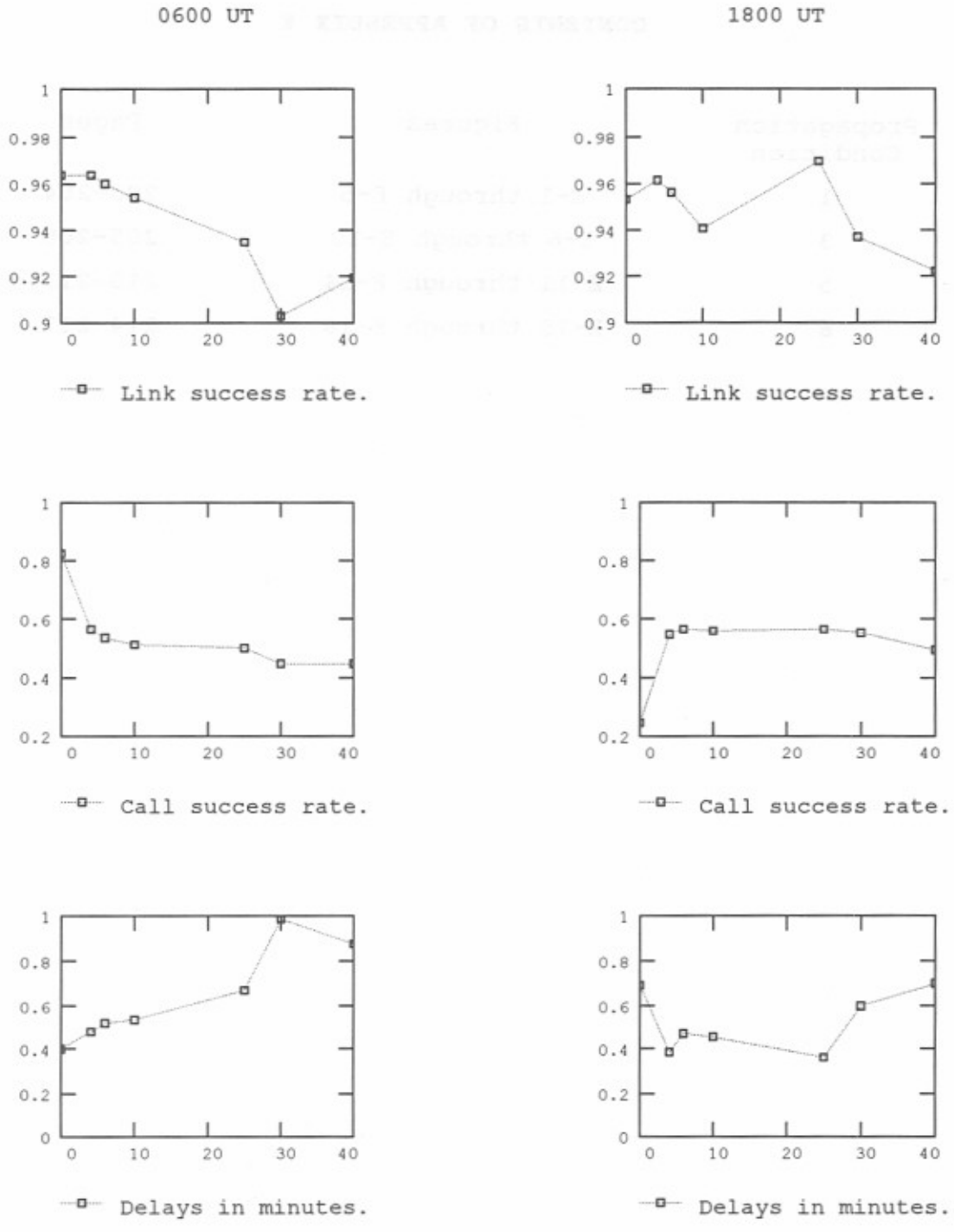

Figure E-1. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 1 - 5 messages per hour.

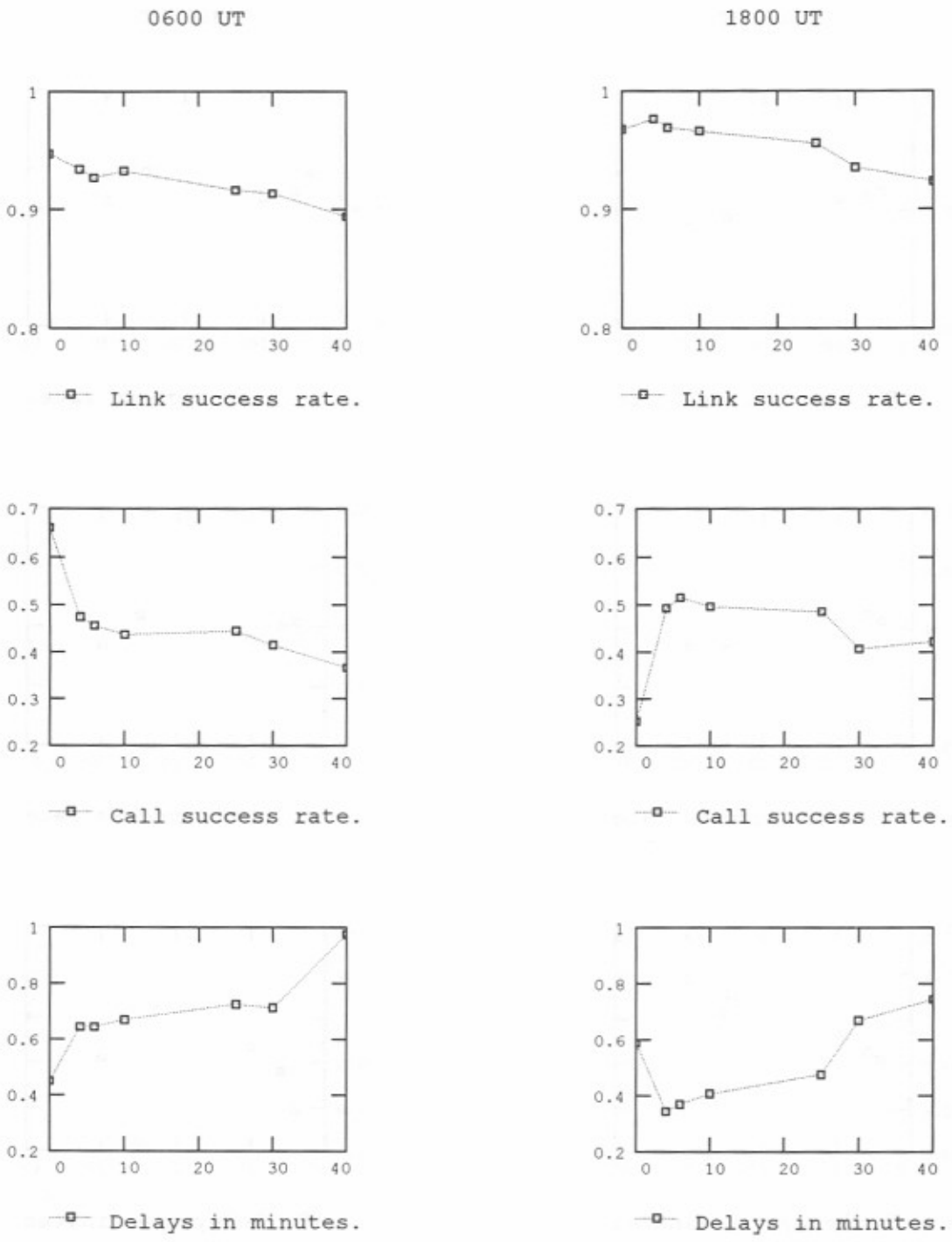

Figure E-2. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 1 - 10 messages per hour.

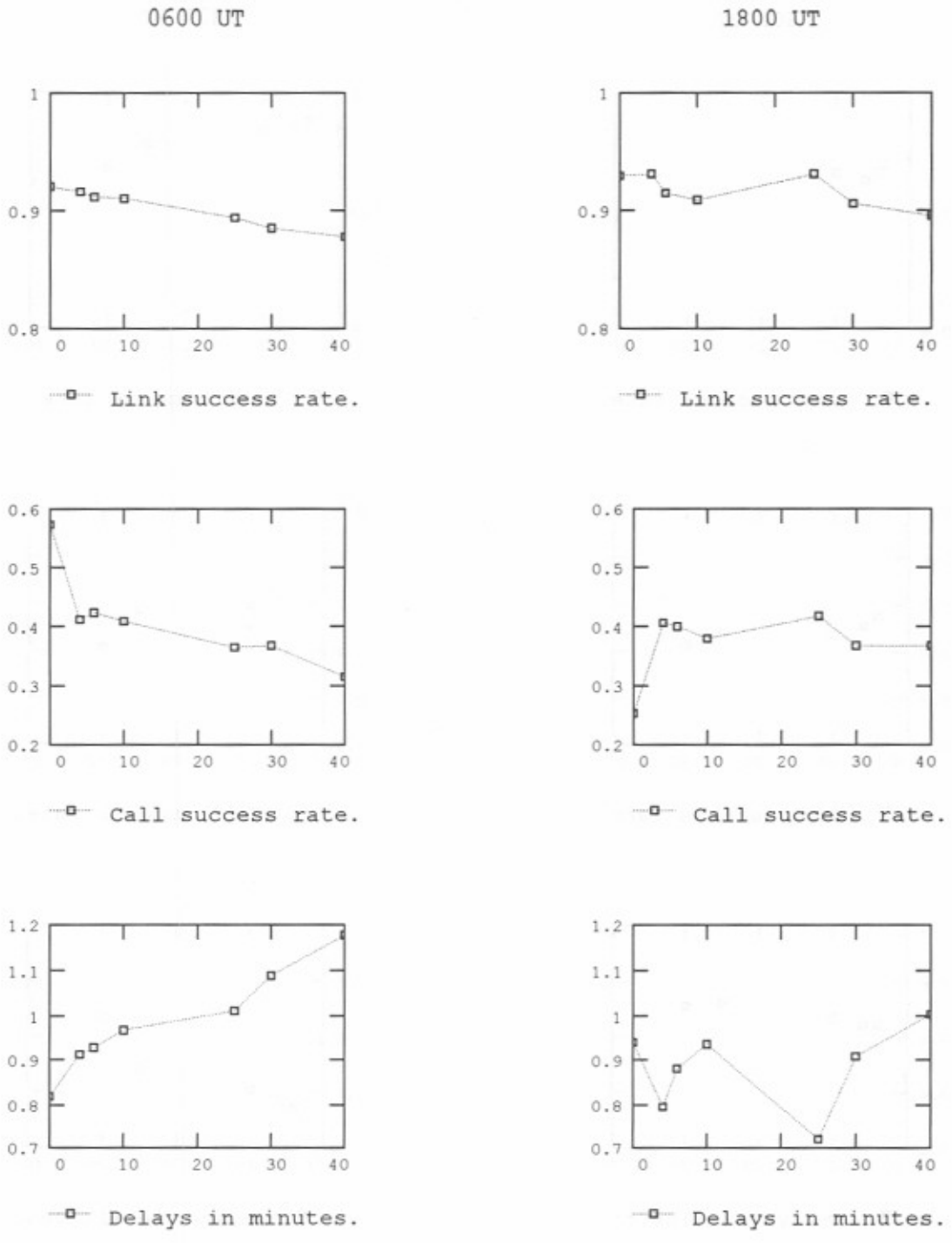

Figure E-3. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 1 - 15 messages per hour.

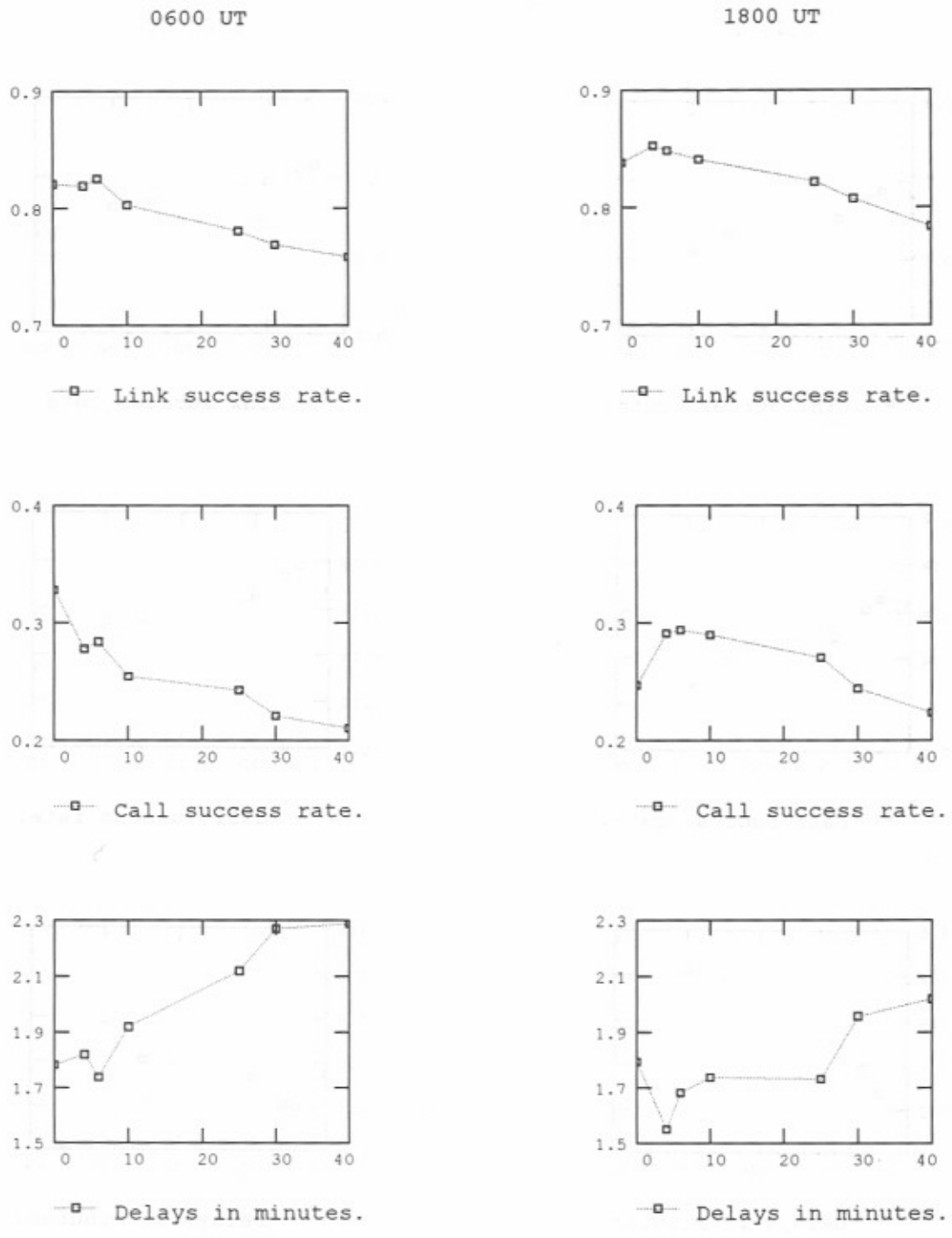

Figure E-4. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 1 - 30 messages per hour.

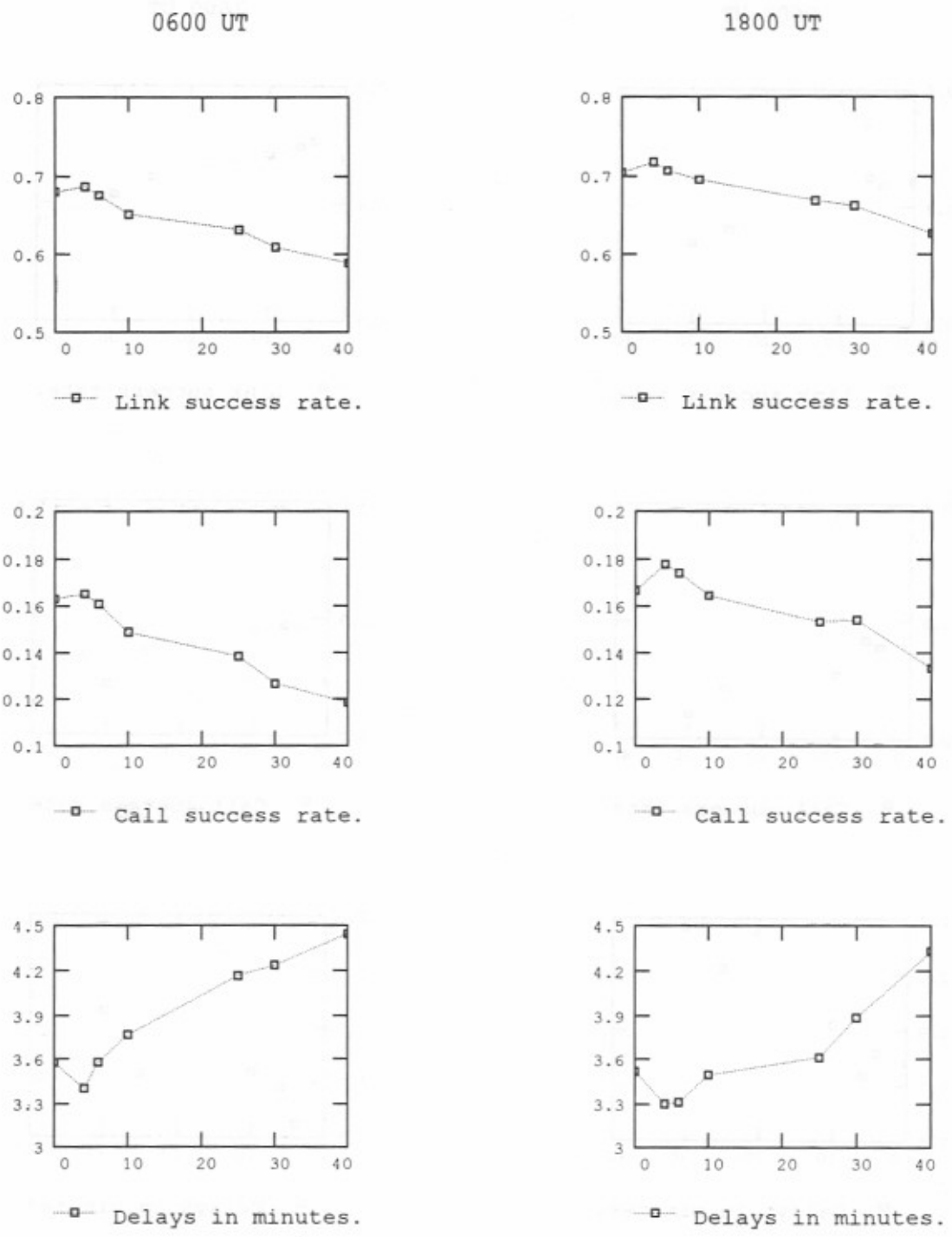

Figure E-5. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 1 - 45 messages per hour.

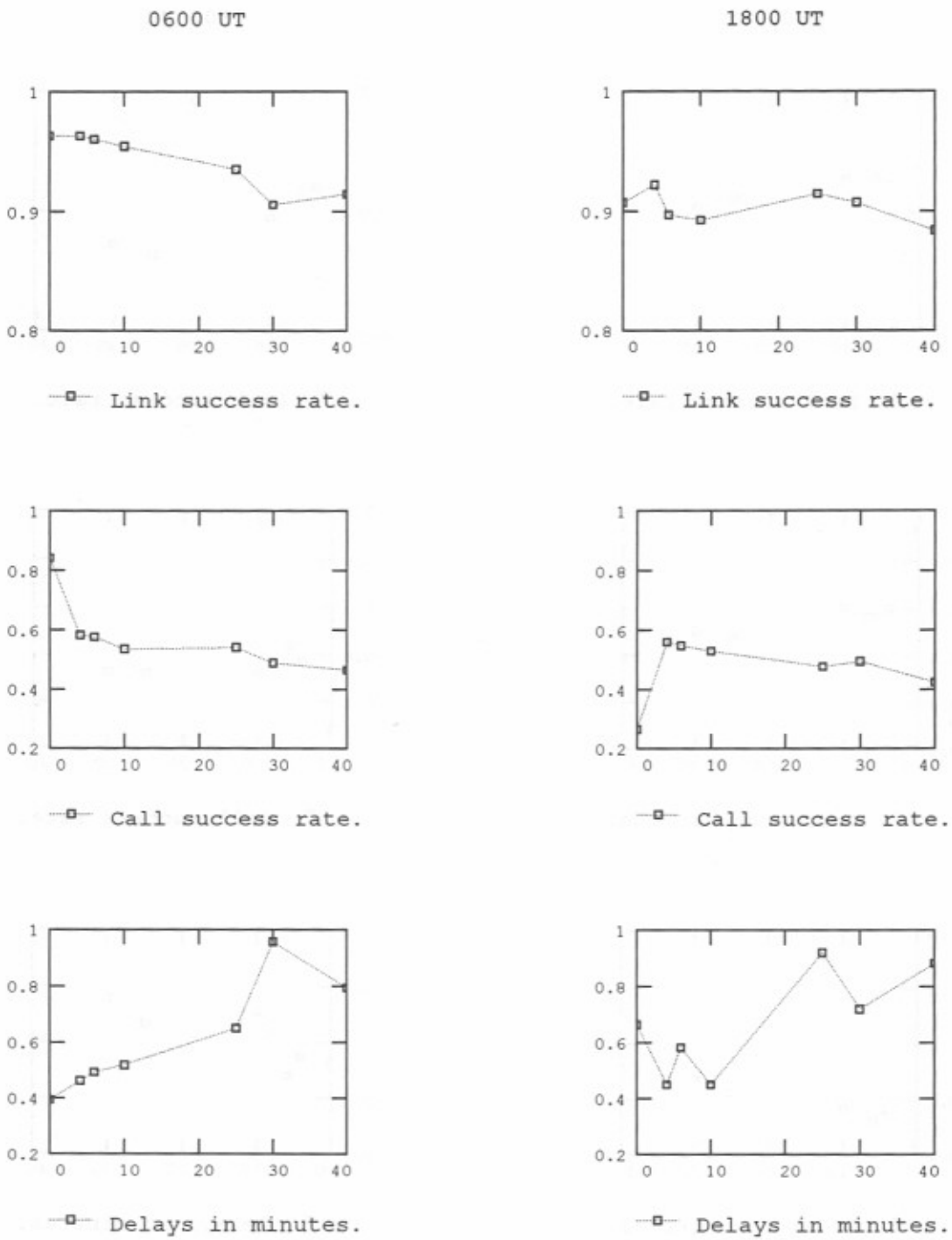

Figure E-6. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 3 - 5 messages per hour.

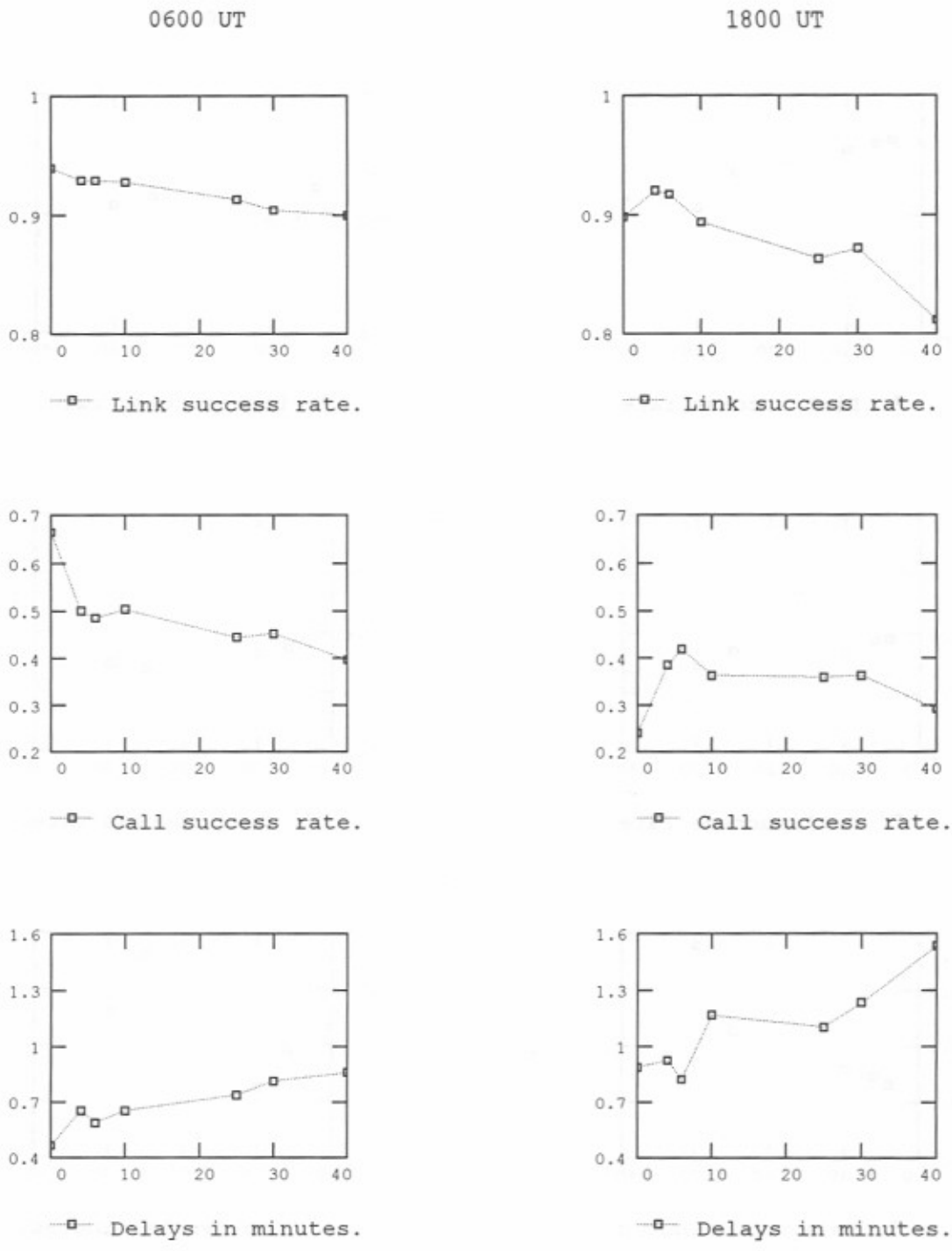

Figure E-7. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 3 - 10 messages per hour.

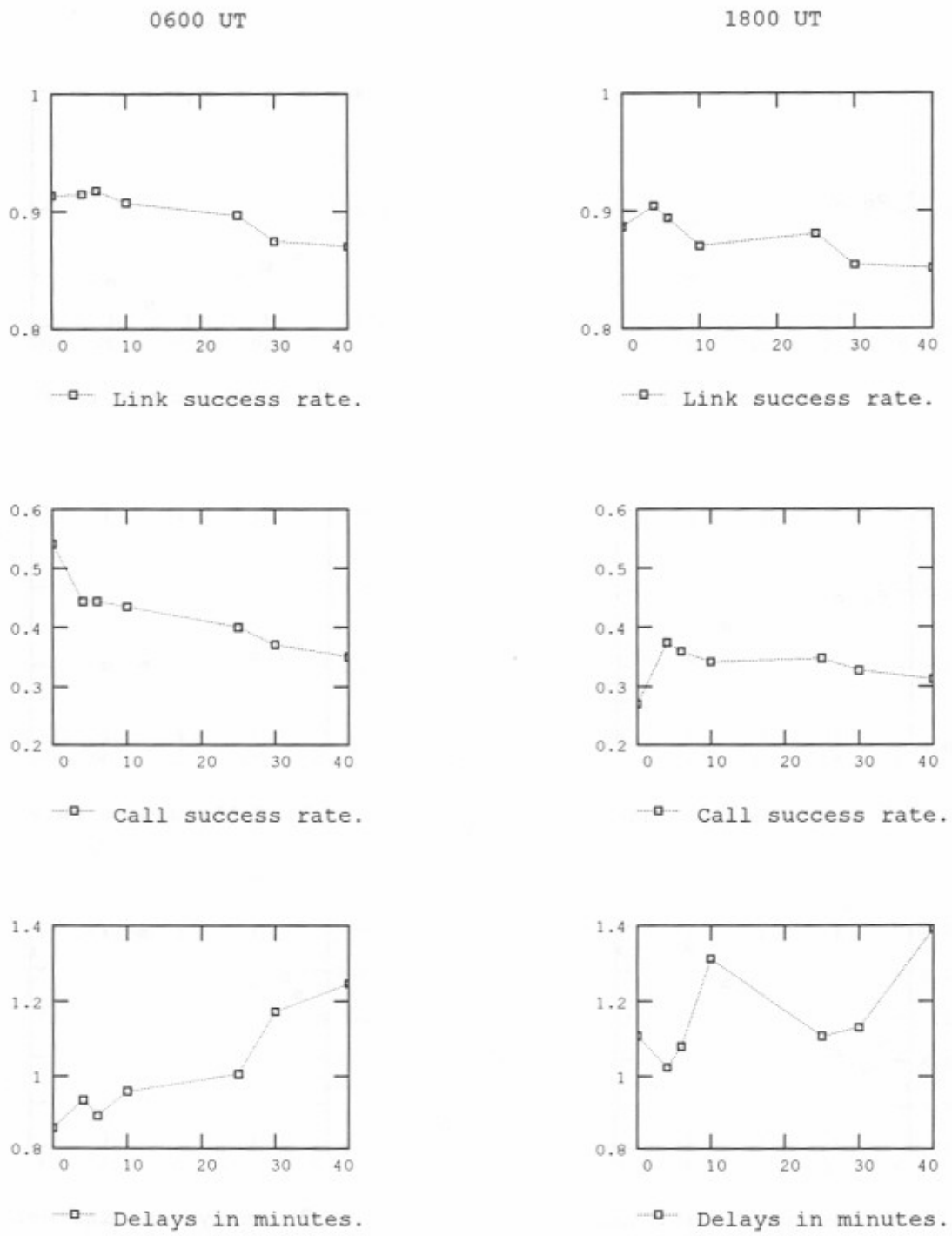

Figure E-8. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 3 - 15 messages per hour.

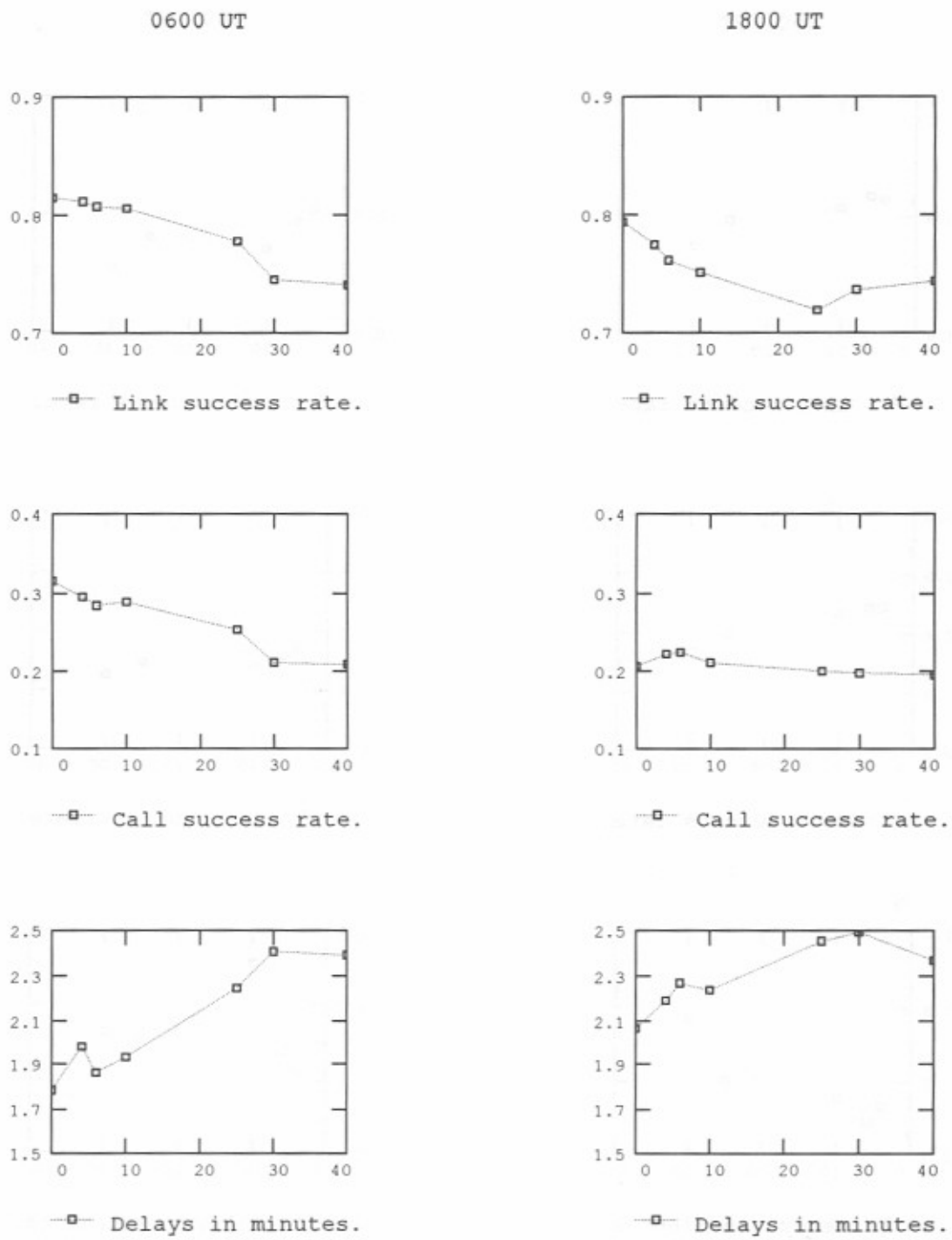

Figure E-9. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 3 - 30 messages per hour.

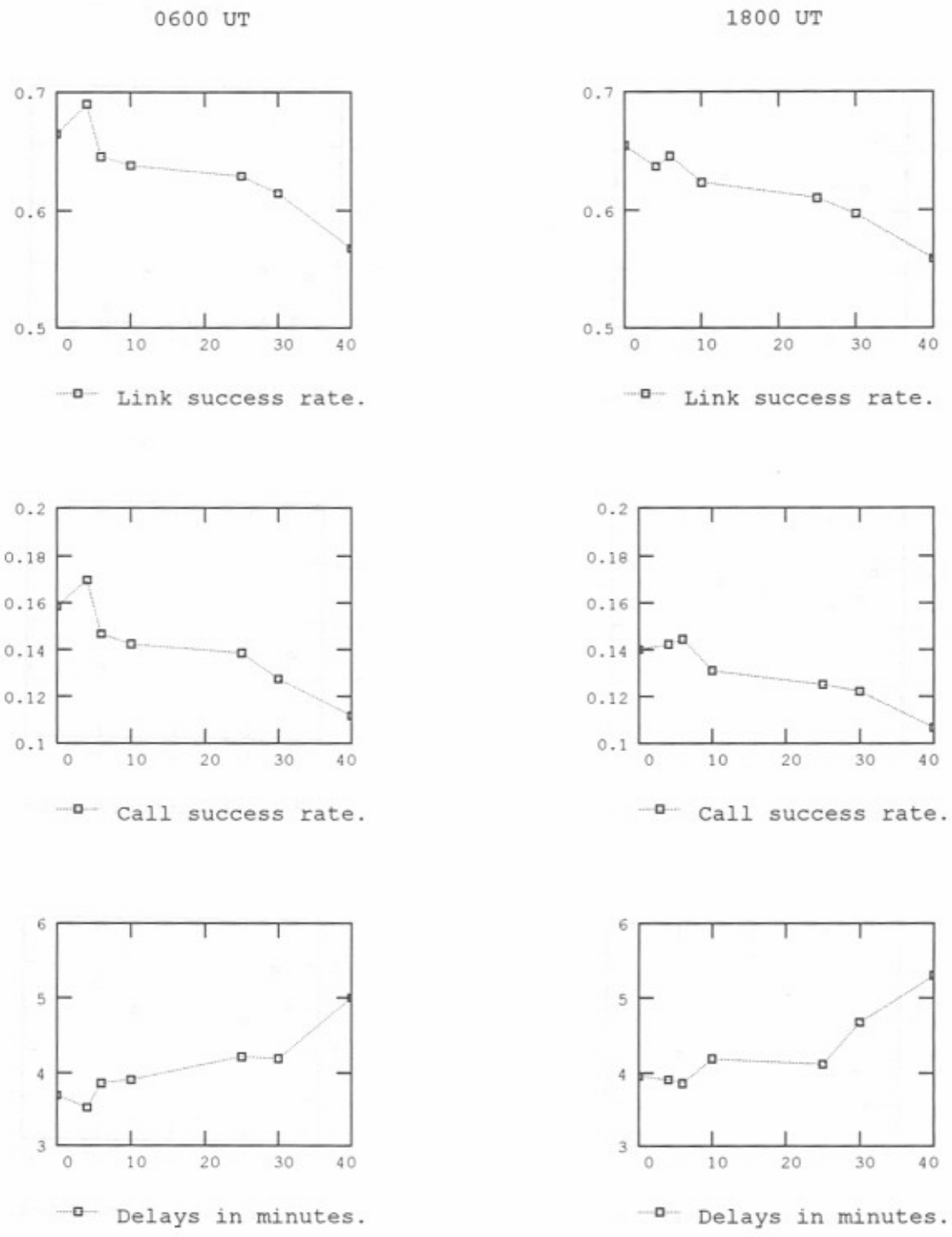

Figure E-10. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 3 - 45 messages per hour.

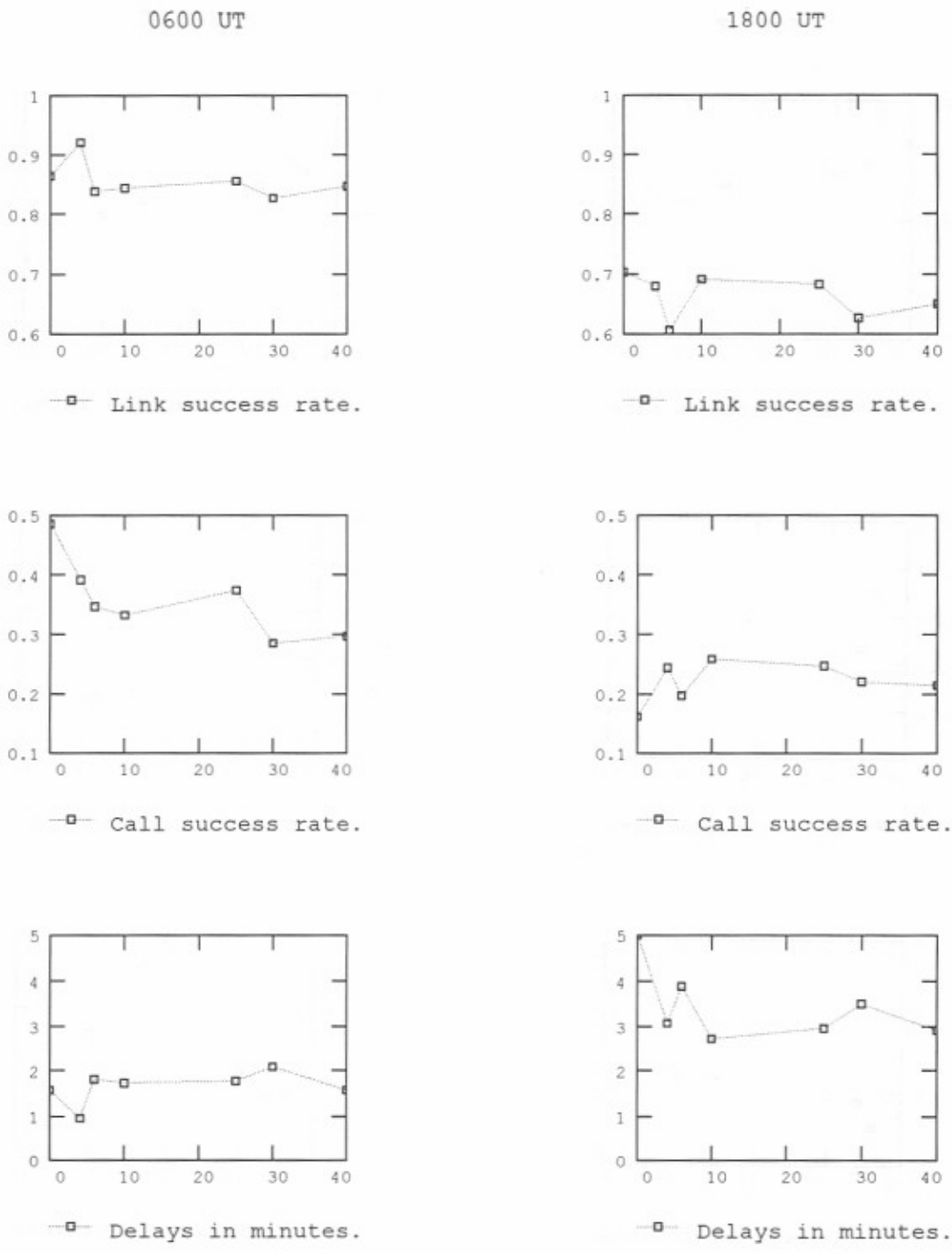

Figure E-11. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 5 - 5 messages per hour.

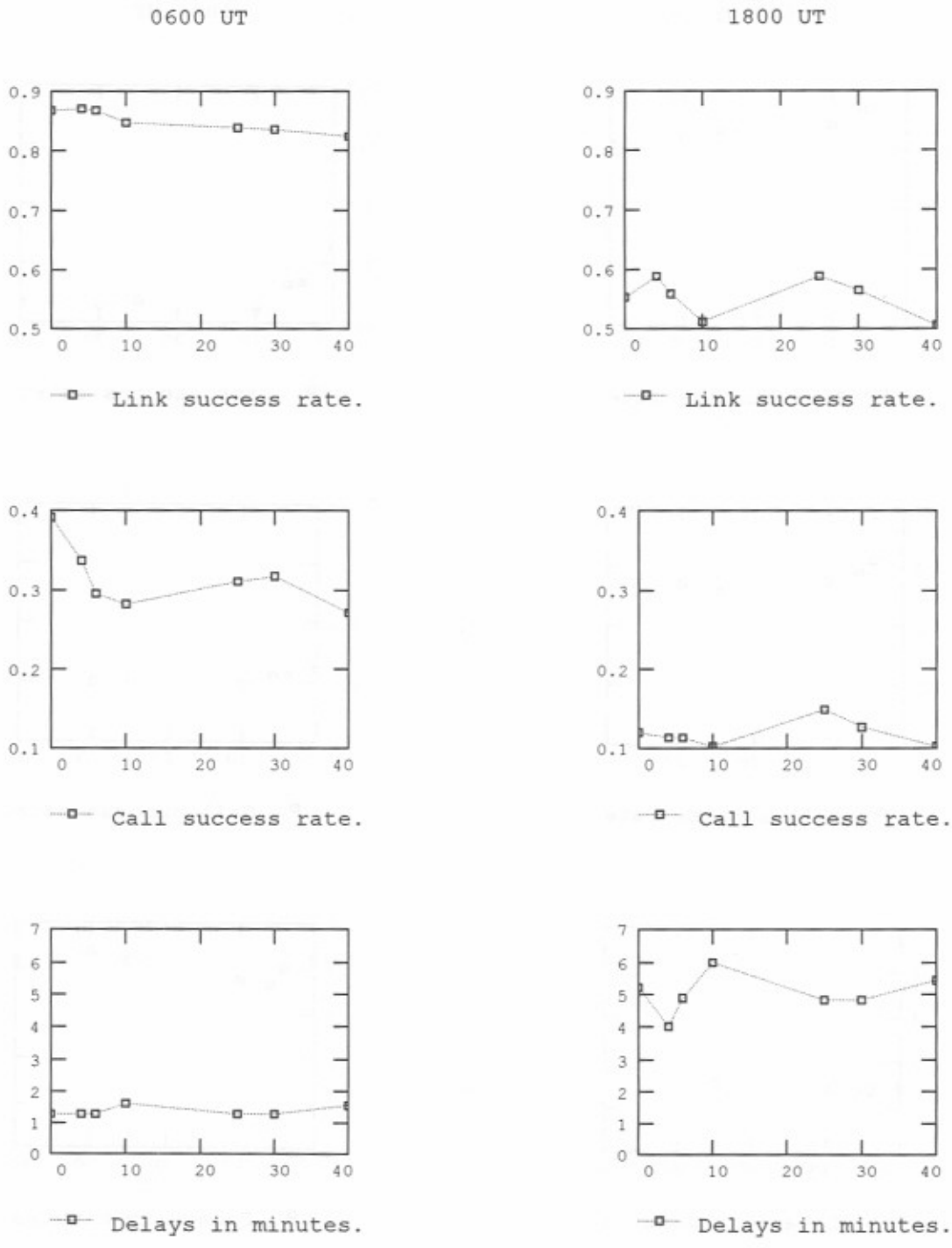

Figure E-12. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 5 - 10 messages per hour.

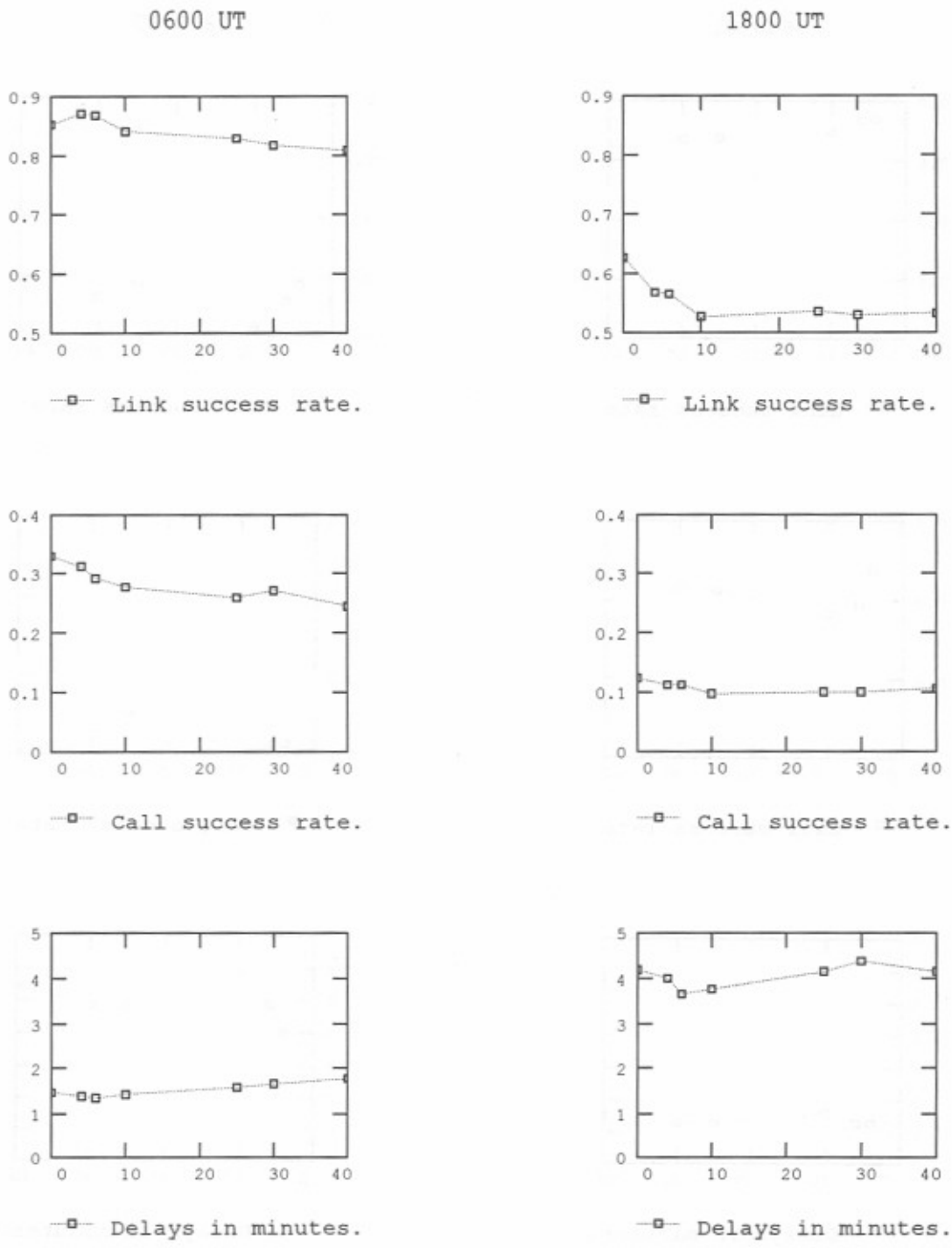

Figure E-13. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 5 - 15 messages per hour.

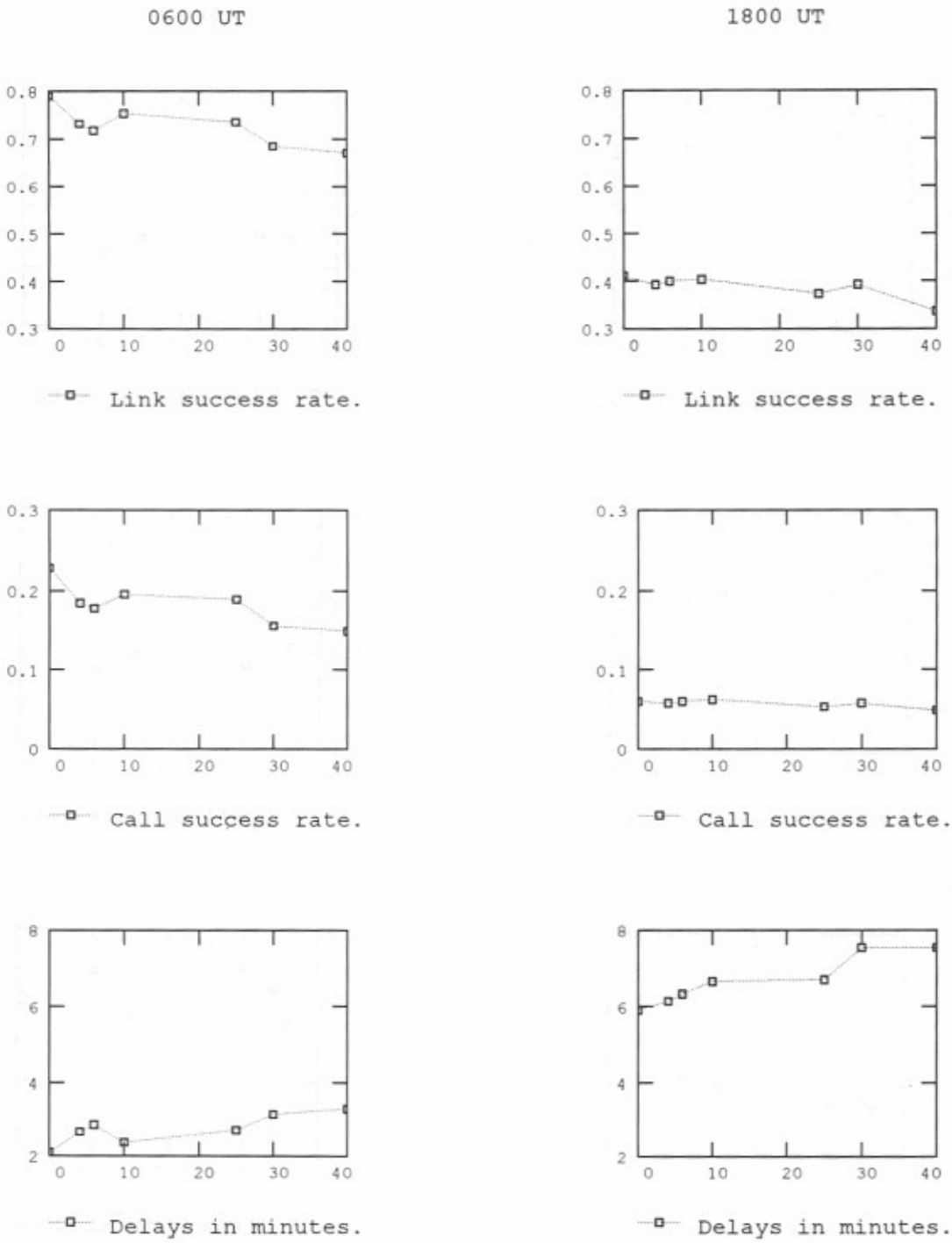

Figure E-14. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 5 - 30 messages per hour.

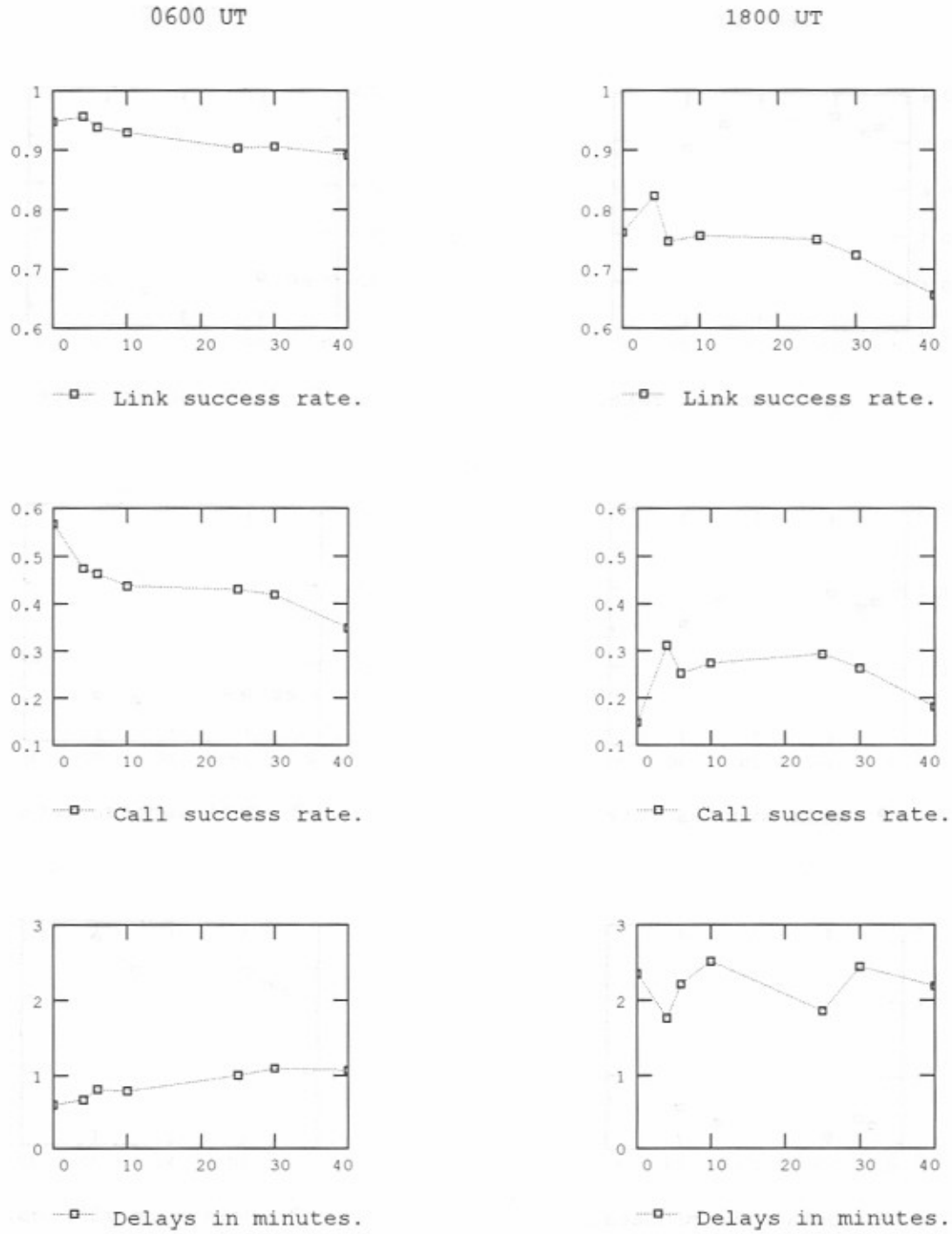

Figure E-15. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 8 - 5 messages per hour.

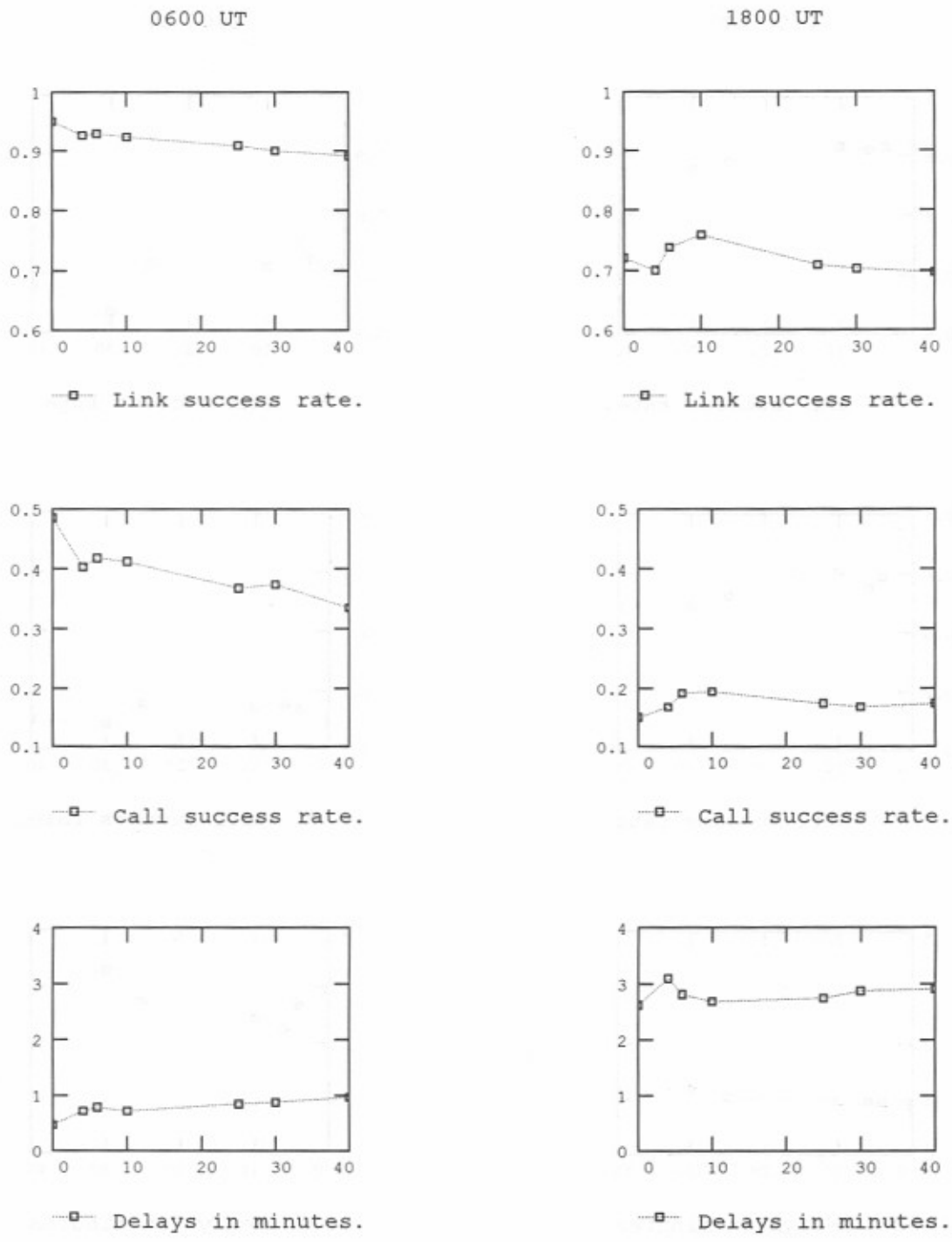

Figure E-16. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 8 - 10 messages per hour.

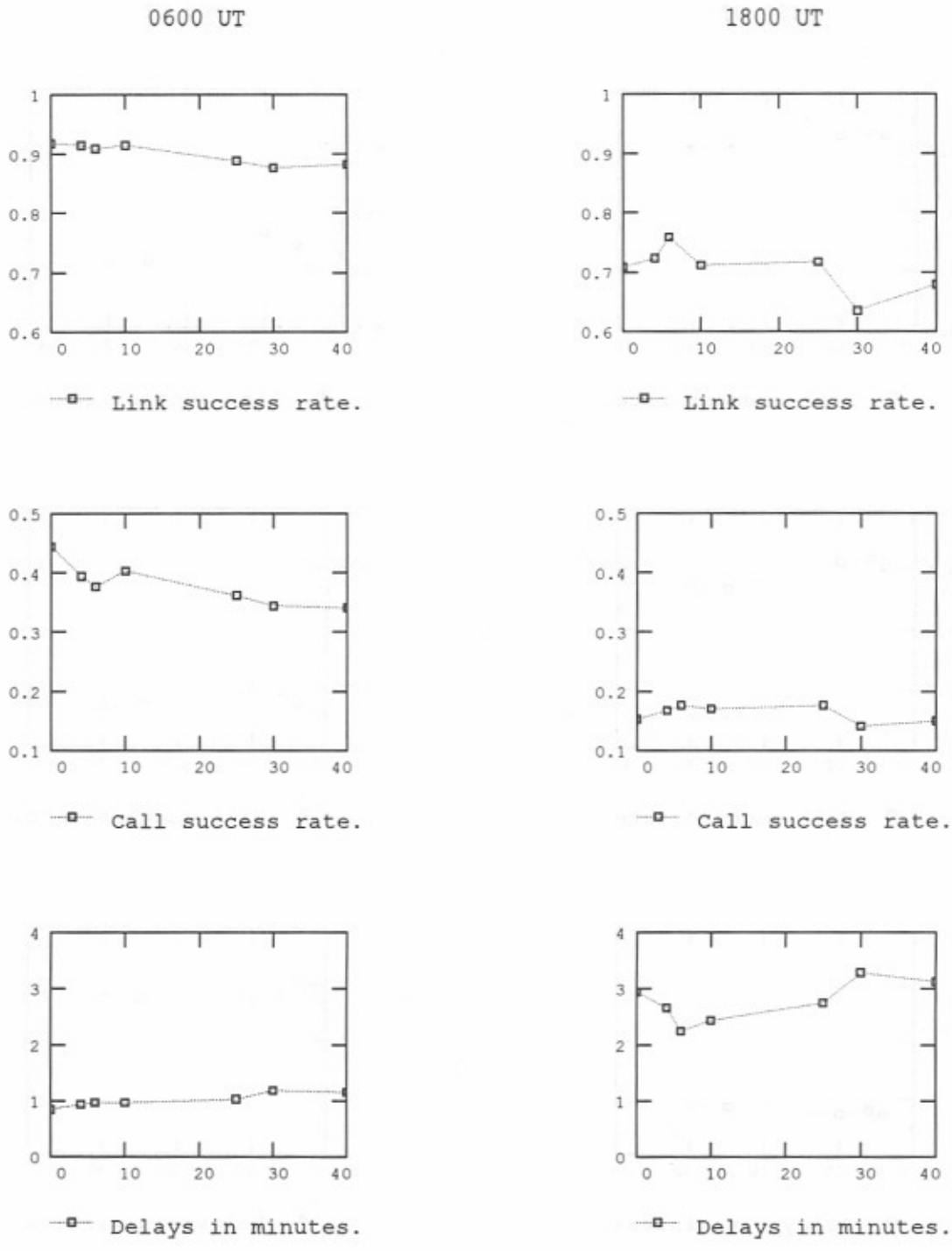

Figure E-17. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 8 - 15 messages per hour.

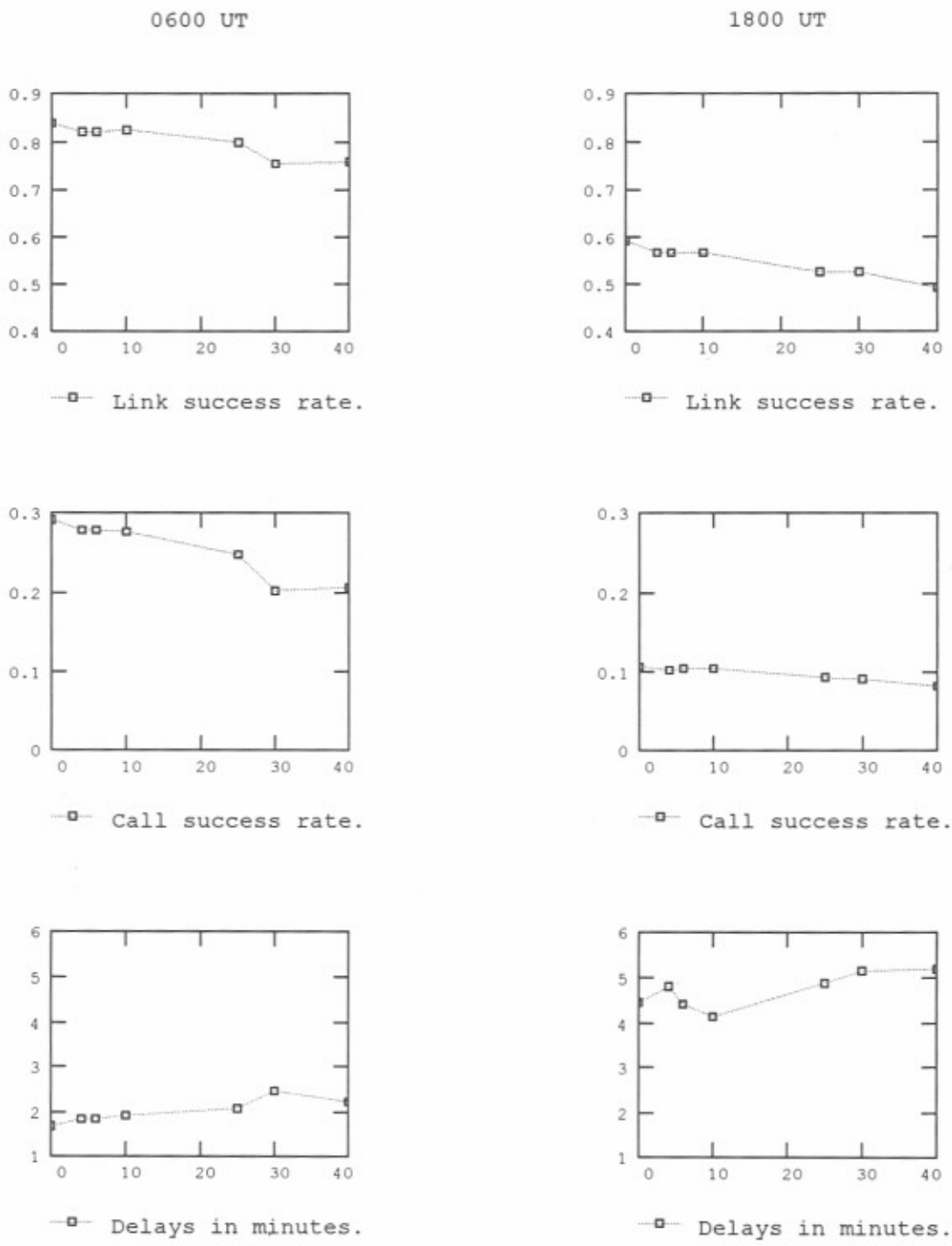

Figure E-18. Simulated network performance for 0600 and 1800 (UT) - 0, 4, 6, 10, 15, 30, and 40 scheduled sounds per hour - propagation condition 8 - 30 messages per hour.

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15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

A discrete event simulation model for an HF Automatic Link Establishment (ALE) radio network is described. The simulation model is based on Federal Standard 1045 "Telecommunications: HF Radio Automatic Link Establishment." The simulation is used to study the effects of sounding on the simulated network. Sounding is the periodic broadcast transmission of identification information by a radio station that may be monitored by other stations. Sounding is used to evaluate the propagation quality of the available HF radio channels (frequencies). The station and channel overhead associated with sounding is indicated by this simulation to be generally detrimental to network performance. The exception is that in poor propagation conditions, at low traffic rates, sounding may significantly enhance some aspects of network performance.

16. Key Words *(Alphabetical order, separated by semicolons)*
Automatic Link Establishment (ALE); Federal Standard 1045; HF radio; modeling; network; simulation; sounding

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