

**FIBER OPTIC CABLE DIG-UPS:
CAUSES AND CURES**

**Daniel E. Crawford
President - Network Services
MCI Telecommunications Corporation
1801 Pennsylvania Ave., NW
Washington, D. C. 20006
(202) 887-2235**

Table of Contents

	<u>Page</u>
1. Executive Summary	1
1.1 Overview and key messages	1
2. Background	2
2.1 The Fiber Cable Focus Group - motivation, goals, and objective	2
2.1.1 Focus Group motivation	2
2.1.2 Focus Group goals and objectives	3
2.2 Organization of this presentation	3
3. Team Membership	4
4. Data Collection and Analysis Methodology	4
4.1 Data collection emphasis and goals	4
4.2 Data collection period	5
4.3 Data collection procedure	5
4.4 Analytical methods	5
4.5 Results of fiber optic cable data analysis	5
4.5.1 Summary of findings	5
5. Causes of Fiber Optic Cable Damage	6
5.1 Detailed failure causes, definitions and root causes	6
5.2 Fiber optic cable dig-ups	10
5.2.1 Root causes of dig-ups	10
5.2.2 Effect of cable depth on dig-up probability	12
5.2.3 Effect of permanent marking on dig-up probability	13
5.2.4 Failure causes by installation	15
5.2.5 Causes of large outages	17
5.3 Comparison of relative failure probability among installations	17
5.3.1 Comparing aerial with sub-surface cable	18
5.3.2 Comparing direct buried with underground cable	18
5.3.3 Comparing public with private right-of-way	20
5.4 Repair data	20

6.	Key Lessons Learned and Recommended Best Practices	21
	6.1 Key lessons learned, best practices, new approaches	21
	6.1.1 Best practices to prevent fiber cable damage caused by digging	24
	6.1.2 Best practices to prevent fiber cable damage caused by other than digging	24
	6.1.3 Details - key lessons learned and best practices	25
	6.1.4 Effective countermeasures	26
7.	Metrics	29
	7.1 Metrics to measure the effectiveness of solution recommendations	29
8.	Path Forward	29
	8.1 Benchmarking	29
9.	Conclusions	30
	9.1 Call-before-you-dig as SOP (Standard Operating Procedure)	30
	9.2 Best practices	31
	9.3 Benchmarking	31
10.	Acknowledgements	31
11.	References	31
12.	Figures and Exhibits	31
13.	Appendices	32
	Appendix 1	33
	Appendix 2	37
	Appendix 3	39
	Appendix 4	49
	Appendix 5	53
	Appendix 6	67
	Appendix 7	71
	Glossary of Terms	77

List of Figures

- Fig. 1 Immediate Failure Causes
- Fig. 2 Root Causes of Fiber Optic Cable Dig-Ups
- Fig. 3 Burial Depth of Reported Dig-Up Failures
- Fig. 4 Immediate Causes of Aerial Fiber Optic Cable Damage
- Fig. 5 Distribution of Service Restoration Times
- Fig. 6 Fiber Optic Cable Complete Repair Time Distribution

