indications as to how to proceed on to the next step as well as the grade until that point. The project can be attempted in three ways: 1. Without seeking any sort of help 2. Using some provided hints 3. Using exact directions The IRC includes the files needed for this project: 1. Web Security project 2. Web Hacking exercises (XSS and Script-attacks) covering client-side and server-side vulnerability exploitations, respectively 3. Documentation for installation and use for the above 4. A PowerPoint file describing Web hacking. This file is crucial to understanding how to use the exercises since it clearly explains the operation using screen shots. This project was designed and implemented by Professor Sreekanth Malladi of Dakota State University. B.3 Programming Projects The programming project is a useful pedagogical tool. There are several attractive features of stand-alone programming projects that are not part of an existing security facility. 1. The instructor can choose from a wide variety of cryptography and network security concepts to assign projects. 2. The projects can be programmed by the students on any available computer and in any appropriate language; they are platform and language independent. 3. The instructor need not download, install, and configure any particular infrastructure for stand-alone projects. 440 Appendix B / Projects for Teaching Network Security There is also flexibility in the size of projects. Larger projects give students more sense of achievement, but students with less ability or fewer organizational skills can be left behind. Larger projects usually elicit more overall effort from the best students. Smaller projects can have a higher concepts-to-code ratio, and because more of them can be assigned, the opportunity exists to address a variety of different areas. Again, as with research projects, the students should first submit a proposal. The student handout should include the same elements listed in Section B.1. The IRC includes a set of twelve possible programming projects. The following individuals have supplied the research and programming projects suggested in the instructor's manual: Henning Schulzrinne of Columbia University; Cetin Kaya Koc of Oregon State University; and David M. Balenson of Trusted Information Systems and George Washington University. B.4 Laboratory Exercises Professor Sanjay Rao and Ruben Torres of Purdue University have prepared a set of laboratory exercises that are part of the IRC. These are implementation projects designed to be programmed on Linux but could be adapted for any Unix environment. These laboratory exercises provide realistic experience in implementing security functions and applications. B.5 Practical Security Assessments Examining the current infrastructure and practices of an existing organization is one of the best ways of developing skills in assessing its security posture. The IRC contains a list of such activities. Students, working either individually or in small groups, select a suitable small-to-medium-sized organization. They then interview some key personnel in that organization in order to conduct a suitable selection of security risk assessment and review tasks as it relates to the organization's IT infrastructure and practices. As a result, they can then recommend suitable changes, which can improve the organization's IT security. These activities help students develop an appreciation of current security practices and the skills needed to review these and recommend changes. Lawrie Brown of the Australian Defence Force Academy developed these projects. B.6 Firewall Projects The implementation of network firewalls can be a difficult concept for students to grasp initially. The IRC includes a Network Firewall Visualization tool to convey and teach network security and firewall configuration. This tool is intended to teach and reinforce key concepts including the use and purpose of a perimeter firewall, the use of separated subnets, the purposes behind packet filtering, and the shortcomings of a simple packet filter firewall. B.9 / Reading/Report Assignments 441 The IRC includes a .jar file that is fully portable and a

series of exercises. The tool and exercises were developed at U.S. Air Force Academy. B.7 Case Studies Teaching with case studies engages students in active learning. The IRC includes case studies in the following areas: ■■ Disaster recovery ■■ Firewalls ■■ Incidence response ■■ Physical security ■■ Risk ■■ Security policy ■■ Virtualization Each case study includes learning objectives, case description, and a series of case discussion questions. Each case study is based on real-world situations and includes papers or reports describing the case. The case studies were developed at North Carolina A&T State University. B.8 Writing Assignments Writing assignments can have a powerful multiplier effect in the learning process in a technical discipline such as cryptography and network security. Adherents of the Writing Across the Curriculum (WAC) movement (http://wac.colostate.edu/) report substantial benefits of writing assignments in facilitating learning. Writing assignments lead to more detailed and complete thinking about a particular topic. In addition, writing assignments help to overcome the tendency of students to pursue a subject with a minimum of personal engagement—just learning facts and problemsolving techniques without obtaining a deep understanding of the subject matter. The IRC contains a number of suggested writing assignments, organized by chapter. Instructors may ultimately find that this is an important part of their approach to teaching the material. I would greatly appreciate any feedback on this area and any suggestions for additional writing assignments. B.9 Reading/Report Assignments Another excellent way to reinforce concepts from the course and to give students research experience is to assign papers from the literature to be read and analyzed. The IRC includes a suggested list of papers, one or two per chapter, to be assigned. A PDF copy of each of the papers is available at https://app.box.com/netsec6e. The IRC also includes a suggested assignment wording. 442 References Abbreviations ACM Association for Computing Machinery IBM International Business Machines Corporation IEEE Institute of Electrical and Electronics Engineers NIST National Institute of Standards and Technology ALVA90 Alvare, A. "How Crackers Crack Passwords or What Passwords to Avoid." Proceedings, UNIX Security Workshop II, August 1990. ANDE80 Anderson, J. Computer Security Threat Monitoring and Surveillance. Fort Washington, PA: James P. Anderson Co., April 1980. ANDE95 Anderson, D., et al. Detecting Unusual Program Behavior Using the Statistical Component of the Next-generation Intrusion Detection Expert System (NIDES). Technical Report SRI-CSL-95-06, SRI Computer Science Laboratory, May 1995. www.csl.sri.com/ programs/intrusion. ANTE06 Ante, S., and Grow, B. "Meet the Hackers." Business Week, May 29, 2006. AROR12 Arora, M. "How Secure is AES against Brute-Force Attack?" EE Times, May 7, 2012. AXEL00 Axelsson, S. "The Base-Rate Fallacy and the Difficulty of Intrusion Detection." ACM Transactions and Information and System Security, August 2000. AYCO06 Aycock, J. Computer Viruses and Malware. New York: Springer, 2006. BALA98 Balasubramaniyan, J., et al. "An Architecture for Intrusion Detection Using Autonomous Agents." Proceedings, 14th Annual Computer Security Applications Conference, 1998. BARD12 Bardou, R., et al. "Efficient Padding Oracle Attacks on Cryptographic Hardware," INRIA, Rapport de recherche RR-7944, Apr. 2012. http://hal.inria.fr/hal-00691958. BASU12 Basu, A. Intel AES-NI Performance Testing over Full Disk Encryption. Intel Corp. May 2012. BAUE88 Bauer, D., and Koblentz, M. "NIDX—An Expert System for Real-Time Network Intrusion Detection." Proceedings, Computer Networking Symposium, April 1988. BELL90 Bellovin, S., and Merritt, M. "Limitations of the Kerberos Authentication System." Computer Communications Review, October 1990. BELL94a Bellare, M., and Rogaway, P. "Optimal Asymmetric Encryption—How to Encrypt with RSA." Proceedings, Eurocrypt '94, 1994. BELL94b Bellovin, S., and Cheswick, W.

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