Acme Inc.

Bugcrowd Plus Pen Test (PPT)
Acme Device – Wireless Internet Thing (WIT)

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Contents

Executive Summary

Acme Inc., based in San Francisco, California, is a large importer/exporter of numerous products. As a requirement of their business, Acme Inc. maintains their device that is sold to small and medium sized business owners that performs the task of transferring and storing all types of data. Acme Inc. has a requirement and obligation to ensure that this device is resilient to cyber-attack in order to protect the privacy of their customers. To assist with this, Acme Inc. employed Bugcrowd to perform a Plus Pen Test (PPT) which took place from February 20, 2023, through February 25, 2023.

The purpose of this engagement was to identify security vulnerabilities in the assets listed under Targets and Scope. Once identified, each vulnerability was rated for technical impact defined in the Findings Summary section of the report.

To perform this test, our researcher leveraged several common tools to help identify and exploit vulnerable findings in the environment.

Manual testing of the scope was performed, evaluating the assets for weaknesses as per the Bugcrowd methodology. In support of this, active scanners and scripts were used in an attempt to identify any commonly found, known vulnerabilities.

At the time of this report, 5 findings were identified, including 1 Critical, 1 High, 1 Medium, 1 Low and 1 Informational vulnerability.

The highest priority vulnerabilities include:

- Insecure OS/Firmware where a library contains a hardcoded password to decrypt the certificate file. The password and certificate file can both be recovered.
- Sensitive Data Exposure where the SSH Login Passwords are Revealed in AP Logs

Bugcrowd has rated the overall risk to Acme Inc. – Wireless Internet Thing (WIT) as Critical based on the Insecure OS/Firmware, and the Sensitive Data Exposure. Our rating is based on the severity of the findings disclosed within this report.

It is recommended that Acme Inc. focus on critical and high severity issues first, with medium, low and informational findings being fixed once all high and critical issues are remediated.

Bugcrowd recommends that all critical, high and medium severity findings are retested once remediation activities are completed.

If not already implemented, Bugcrowd recommends taking the following high-level actions to further improve the overall security posture of the organization:

- Implement a secure development lifecycle such as Microsoft Secure Development Lifecycle (MSDL).
- Implement a static code analysis (SAST) tool into the development lifecycle to minimize the introduction of vulnerabilities in code.
- Provide regular secure development training to developers to ensure that they are aware of secure development practices and emerging threats.

The continuation of this document contains technical details of the specific vulnerabilities that were discovered throughout the PTS engagement. It should be noted that many of the details, including comments, up-to-date remediation status, images and additional contexts are not present in this document and are only available in the Bugcrowd Customer Portal.

If you have any questions or concerns as you move to remediate the items raised in this report, please do not hesitate to contact us. Bugcrowd would like to thank Acme Inc. for this engagement and look forward to working together in the future.

This report is just a summary of the information available and is a 'snapshot' in time of the state for the tested environment.

All details of the program's findings (comments, code, and any researcher provided remediation information) can be found in the Bugcrowd Crowdcontrol platform.

Reporting and Methodology

Bugcrowd Plus Pen Test (PPT) is an on-demand methodology-driven penetration test that delivers real-time results and 24/7 reporting in support of a variety of compliance initiatives. A pay-per-project model powered by CrowdMatch technology enables Bugcrowd to draw from a global network of continuously vetted pentesters to deliver faster setup without compromising on skill or experience. To support accelerated remediation and streamline integrated business processes, vulnerabilities discovered during the methodology are viewable live in the Bugcrowd Customer Console as soon as they are submitted by the pentester. Bugcrowd's in-house team of Security Engineers works in parallel to validate, prioritize, and push streaming vulnerabilities through customer-chosen SDLC integrations like GitHub, JIRA, or ServiceNow.

The Bugcrowd Pen Test service was designed and independently assessed by a leading QSA to ensure alignment with key compliance and regulatory standards.

Our unique BugHunter testing methodology blends key organizational and operational elements of leading industry standards to create a unified methodology that satisfies auditor and reviewer requirements.

By leading with a best-in-class testing approach, our methodology provides enhanced risk reduction while supporting critical compliance initiatives. A review of these standards follows.

Organizational Methodology Standards

Executing a penetration test involves a proven workflow that is split into phases. Each of these phases is run in a cyclical manner allowing penetration testers to build upon findings and potentially uncover significant risk. An organizational methodology also ensures that high-level coverage of testing is done. When reviewing common organizational methodologies, Bugcrowd found similarities in the general workflow.

Bugcrowd pen testers adhere to these standards in a common workflow as shown:

Reviewed Organizational Methodology Standards:

- PCI DSS Requirement 11.2, 11.3.1, 11.3.3, 11.3.4
- NIST 800-115 - Technical Guide to Information Security Testing and Assessment 2.1 “Information Security Assessment Methodology”
- Open Source Security Testing Methodology Manual (OSSTMM)
- Penetration Testing Execution Standard (PTES)

Operational Methodology Standards

Many penetration testing models fail to provide both results and coverage. To bring value to the customer, Bugcrowd has reviewed the most common and in-depth operational Pen Test methodologies. Operational methodologies provide details on what exactly needs to be tested in a security assessment, for each endpoint.

The methodology assigned to researchers includes application and infrastructure level testing domains. Each domain contains several tests for the tester to cover in both manual and automated methods.

In order to create a complete testing methodology, Bugcrowd has pulled from the following industry standard operational methodologies:

- OWASP Testing Guide (OTG)
- Web Application Hacker Handbook Methodology (WAHHM)
- Others where applicable (SANS Top 25, CREST, WASC, PTES)

Findings Summary

Targets and Scope

Prior to penetration test launching, Bugcrowd worked with Acme Inc. to define the rules of the engagement, commonly known as the program brief, which includes the scope of work.

The following targets were considered explicitly in scope for testing:

- Acme Inc. - Wireless Internet Thing (WIT)

Focus Areas:

- Compromising the device over WIFI or web interface

All details of the program scope and full program brief are available in the Program Brief found on the Bugcrowd Crowdcontrol platform.

Risk and Priority Key

The following priority keys are used to explain how Bugcrowd rates valid vulnerability submissions and their technical severity. As a trusted advisor, Bugcrowd provides common next steps for program owners per severity category.

Priority	Technical Severity	Example Vulnerability Types
P1	Critical Severity vulnerabilities are escalated as soon as they are validated. These issues warrant the highest security consideration and should be addressed immediately.	• Remote Code Execution • Vertical Authentication Bypass • SQL Injection • Insecure Direct Object Reference for a critical function
P2	High Severity vulnerabilities should be slated for a fix very soon. These issues still warrant prudent consideration but are often not availability or "breach level" submissions.	• Lateral Authentication Bypass • Stored Cross-Site Scripting • Cross-Site Request Forgery for a critical function • Insecure Direct Object Reference for an important function
P3	Medium Severity vulnerabilities should be slated for remediation in a major release cycle.	• Reflected Cross-Site Scripting • Cross-Site Request Forgery for an important function • Insecure Direct Object Reference for an unimportant function
P4	Low Severity vulnerabilities should be considered for remediation within the next six months.	• Cross-Site Scripting with limited impact • Cross-Site Request Forgery for an unimportant function • External Server-Side Request Forgery
P5	Informational findings are environmental information, best practices or potential accepted business risk.	• All open ports • Lack of Code Obfuscation • Autocomplete enabled • Non-exploitable SSL issues

Findings Table

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F001	Hardcoded Password for Update Backup Certificate Chain - Private Key Included	Insecure OS/Firmware	P1
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F003	Insecure Boot Process Allows Root Password Reset	Insecure OS/Firmware	P3
F004	UBoot Bootloader Not Locked	Insecure OS/Firmware	P4
F005	Mediatek Testmode Images Contained in the Firmware Package	Sensitive Data Exposure	P5

Vulnerability Details

This section outlines the full submission data for each valid finding. These findings are rarely altered from their original state from the researcher. Due to the nature of crowd-sourced security assessments, some typos or grammar errors may occur. Each finding is headlined with the submission title and priority followed by more detailed vulnerability information based on the type of finding submitted. Several other fields may appear based on the context and Vulnerability Rating Taxonomy (VRT) classification selected by a researcher.

The details may include the following:

Description

This section appears after the "Bug URL" as a free form area for the researcher to describe the context of the submission.

Bug URL

This is the specific URL path or IP target location where the vulnerability was found.

Submission Reference Number

The unique identifier for the submission visible to researchers.

CVSS Rating

The CVSS vector string for this submission, if provided, and the score calculated from that vector string.

Vulnerability Rating Taxonomy (VRT)

The Vulnerability Rating Taxonomy is the baseline guide used for classifying technical severity.

Additional Details

Several other fields may appear based on the context and VRT classification selected by a researcher, such as but not limited to Bugcrowd Application Security Engineer (ASE) curated proof of concepts, comments to the researcher or Bugcrowd, assignees, attachments, and state change metadata. These can be viewed in the Crowdcontrol platform.

F001 - Hardcoded Password for Update Backup Certificate Chain - Private Key Included

P1

Submission Reference Number
Dc61db1253b1a6887c52fb923c58923c81d602f10fc272a8ddb

Vulnerability Rating Taxonomy (VRT)
Insecure OS/Firmware

Description

The library libfwk.lib located at /usr/lib/ contains a hardcoded password to decrypt the certificate file xxsdx.pfx located at /usr/share/standby_key/xxsdx.pfx. The certificate and it's secret key are recoverable.

The certificate in question is use by the library if no other key is explicitly passed to the RSA processing part of the library. The password is obfuscated and retrieved using the function UTIL_bufferMessUp but it can also be easily decrypted using emulation or a debugger.

Steps to Reproduce:

1. Obtain the firmware from the device using the UART access available on the mainboard (marked)
2. Disassemble the file with IDA Pro
3. Find the function UTIL_bufferMessUp
4. Use flare emu with IDA Pro to emulate the function and decrypt the password

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F002 - SSH Login Passwords are Revealed in AP Logs

P2

Submission Reference Number
727992fe76d053e67d68fcaeb77fa88ec280b1190ee935ed

Vulnerability Rating Taxonomy (VRT)
Sensitive Data Exposure

Description

SSH login passwords are revealed in AP logs

Steps to Reproduce:

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F003 - Insecure Boot Process Allows Root Password Reset

P3

Reference Number
4e7b75cbf48b0ffcf89e5ba098b85e7c1b134c186afafc06a

VRT
Insecure OS/Firmware

Description

The device is offering failsafe boot mode while booting, this allows an attacker to bypass the password prompt during normal boot and access the device and the configuration directly.

Using the UART access which is available on the board it's possible to directly access the console of the device while booting. As the device runs on OpenWRT it offers failsafe boot as an option. While normal booting is protected by a login prompt, failsafe will bypass it and allows resetting of the root password. Once a proper root password is set, it's possible to bypass the login shell in normal mode.

This is a misconfiguration in the boot configuration of OpenWRT. The failsafe option should be disabled by default.

Steps to Reproduce:

- Connect to onboard UART
- Verify the UART is locked with a password in normal boot mode
- Reboot the device
- Wait for the device to boot and you see the failsafe question to popup
- Press f and enter to enter failsafe mode

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F004 - UBoot Bootloader Not Locked

P4

Submission Reference Number
dacba07473fe7c26e8dc6a626f7da6a79e5d9be31d07b61f

Vulnerability Rating Taxonomy (VRT)
Insecure OS/Firmware

Vulnerability

The bootloader is directly accessible via UART. It offers a menu including the well documented uboot command prompt. The options include booting external kernel caches, nand dumping and network operations. This allows an attacker to boot old firmware versions with known vulnerabilities, boot images from entwork or install tampered packages.

This is a misconfiguration in the bootloader configuration of the productions image. The bootloader menu should be disabled by default as it is not required for normal customer operation. Securing the bootloader of IoT devices is a pillar of security as an open bootloader as present in the current product, enables an attacker to tamper the entire system pre-boot and skip any system security control. Leaving the bootloader unlocked voids any system security deployed.

Steps to Reproduce:

- Connect to onboard UART
- Boot the device and wait for the menu to appear
- Use the available options or enter the uboot command line mode to perform unauthenticated actions

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F005 - Mediatek Testmode Images Contained in the Firmware Package

P5

Submission Reference Number
D773d2e03558533a3e4f7c4dd7d4335bbc4f07499eb8e5a18

Vulnerability Rating Taxonomy (VRT)
Sensitive Data Exposure > Disclosure of Secrets > For Publicly Accessible Asset

Vulnerability

Installing the latest update will place testmode images on the device. The system is a Mediatek based router, "testmode" images for Mediatek chipsets are only for performance validation, production testing and regulatory certification. These images contain interfaces for QA-Tool or Combo-Tool and allow connection sniffing and packet capture with pcap. They are not meant to be shipped in consumer firmware images and are considered internal builds.

Shipping these images might be considered as a leak, as the files are not meant to be publicly distributed with a impact to the confidentiality of the vendor. Furthermore, they can be used by an attacker to enable the debug stubs and capture wireless traffic.

Steps to Reproduce:

- Dump the firmware from the device using the existing UART on the board or extract a firmware image, alternatively use the debug menu (*https://<deviceip\>/debug.htm*) to enable ssh
- Navigate to /tmp/.firmware
- Use ls to list the content

Finding Truncated for Display Purposes

Closing Statement

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Summary

This report shows testing of Acme Inc. – Wireless Internet Thing (WIT)from February 20, 2023, to February 25, 2023. The purpose of this assessment was to identify security issues that could adversely affect the integrity of Acme Inc. – Wireless Internet Thing (WIT). The assessment was performed under the guidelines provided in the statement of work between Acme Inc. and Bugcrowd. This document provides a high-level overview of the testing performed and the test results.

Pen Test Portfolio Overview

The Bugcrowd Pen Test portfolio provides organizations with the power of the Crowd, through two unique engagement styles designed to fit a range of security workflows and objectives. Max Pen Test (MPT), Plus Pen Test (PPT) and Standard Pen Test (SPT) are all powered by the Bugcrowd platform, enabling rapid setup, launch, and real-time results.

While Bugcrowd offers both continuous and on-demand penetration testing options, it is important to note that this document represents a point-in-time evaluation of security posture. Security threats and attacker techniques evolve rapidly, and the results of this assessment are not intended to represent an endorsement of the adequacy of current security measures against future threats. This document contains information in summary form and is therefore intended for general guidance only; it is not intended as a substitute for detailed research or the exercise of professional judgment. The information presented here should not be construed as professional advice or service.

Testing Methods

This security assessment leveraged researchers that used a combination of proprietary, public, automated, and manual test techniques throughout the assessment. Commonly tested vulnerabilities include code injection, cross-site request forgery, cross-site scripting, insecure storage of sensitive data, authorization/authentication vulnerabilities, business logic vulnerabilities, and more.

The summary of Bugcrowd's findings are as follows:

1 Critical **1 High** **1 Medium** **1 Low** **1 Informational**