

REPORT OF THE INDEPENDENT ACCOUNTANT

To the management of Internet Security Research Group (ISRG):

Scope

We have examined ISRG's [assertion](#) that for its Certification Authority (CA) operations at its Salt Lake City, Utah, USA, and Centennial, Colorado, USA, locations, for its CAs as enumerated in Appendix A, ISRG has:

- disclosed its business, key lifecycle management, certificate lifecycle management, and CA environmental control practices in its certification practice statement and certificate policy as follows:
 - [Certification Practice Statement \(v4.1, v4.2, v4.3\)](#); and
 - [Certificate Policy \(v3.1, v3.2, v3.3\)](#)
- maintained effective controls to provide reasonable assurance that:
 - ISRG's Certification Practice Statement is consistent with its Certificate Policy; and
 - ISRG provides its services in accordance with its Certificate Policy and Certification Practice Statement
- maintained effective controls to provide reasonable assurance that:
 - the integrity of keys and certificates it manages is established and protected throughout their lifecycles; and
 - subscriber information is properly authenticated (for the registration activities performed by ISRG)
- maintained effective controls to provide reasonable assurance that:
 - logical and physical access to CA systems and data is restricted to authorized individuals;
 - the continuity of key and certificate management operations is maintained; and
 - CA systems development, maintenance, and operations are properly authorized and performed to maintain CA systems integrity

throughout the period September 1, 2021, to August 31, 2022 based on the [WebTrust Principles and Criteria for Certification Authorities v2.2.2](#).

ISRG does not escrow its CA keys and does not provide subscriber key generation services, subscriber key management services, certificate rekeys, subscriber key storage and recovery services, integrated circuit card lifecycle management, certificate suspension, or subordinate CA and cross certificate lifecycle management services. Accordingly, our examination does not extend to controls that would address those criteria.

Certification Authority's Responsibilities

ISRG's management is responsible for its assertion including the fairness of its presentation, and the provision of its described services in accordance with the [WebTrust Principles and Criteria for Certification Authorities v2.2.2](#).

Practitioner's Responsibilities

Our responsibility is to express an opinion on ISRG's management's assertion based on our examination. Our examination was conducted in accordance with attestation standards established by the American Institute of Certified Public Accountants. Those standards require that we plan and perform the examination to obtain reasonable assurance about whether management's assertion is fairly stated, in all material respects. An examination involves performing procedures to obtain evidence about management's assertion. The nature, timing, and extent of the procedures selected depend on our judgment, including an assessment of the risks of material misstatement of management's assertion, whether due to fraud or error. We believe that the evidence we obtained is sufficient and appropriate to provide a reasonable basis for our opinion.

We are required to be independent and to meet our other ethical responsibilities in accordance with relevant ethical requirements relating to the engagement.

The relative effectiveness and significance of specific controls at ISRG and their effect on assessments of control risk for subscribers and relying parties are dependent on their interaction with the controls and other factors present at individual subscriber and relying party locations. Our examination did not extend to controls at individual subscriber and relying party locations and we have not evaluated the effectiveness of such controls.

Inherent Limitations

There are inherent limitations in the effectiveness of any system of internal control, including the possibility of human error and the circumvention of controls. For example, because of their nature, controls may not prevent, or detect unauthorized access to systems and information, or failure to comply with internal and external policies or requirements. Also, the projection to the future of any conclusions based on our findings is subject to the risk that controls may become ineffective.

Opinion

In our opinion management's assertion, as referred to above, is fairly stated, in all material respects.

This report does not include any representation as to the quality of ISRG's services other than its CA operations at its Salt Lake City, Utah, USA, and Centennial, Colorado, USA, locations, nor the suitability of any of ISRG's services for any customer's intended purpose.

Emphasis of Matters

ISRG has disclosed that during the period September 1, 2021, to August 31, 2022, the following incidents were identified and disclosed to the Web PKI community as follows:

- Mozilla Bug ID 1729567: On September 5, 2021, ISRG was made aware via their internal monitoring systems that the system responsible for updating OCSP responses (ocsp-updater) had fallen two (2) hours behind the target 3-day update schedule. A warning alert was fired, but not received by the on call personnel due to being configured as a working-hours-only alert. ISRG signs and publishes OCSP responses with a validity interval of 7 days. Automated systems are configured to produce updates for all OCSP responses whose this Update field is three (3) or more days in the past. ISRG fixed the proximate cause by updating their production configuration files to now use the correct "serialSuffixShards" key and their ocsp-updater instances are not performing duplicate work.
- Mozilla Bug ID 1735247: On October 11, 2021, ISRG was notified via their cert-prob-reports e-mail that their software was potentially violating SC48v2 and ISRG had mis-issued certificates. On October 1, 2021, a new Baseline Requirements revision (Ballot SC48v2) went into effect stating that "the Fully-Qualified Domain Name or the FQDN portion of the Wildcard Domain Name MUST consist solely of Domain Labels that are P-Labels or Non-Reserved LDH Labels". ISRG had reviewed the requirement before the effective date, but missed a case to forbid a Reserved LDH Label when a hyphen is its second character. The code incorrectly allowed domains like a---foo.example.com but correctly forbade names like ab--foo.example.com. ISRG verified the claim and stopped CA issuance while a fix was deployed. An audit of certificates issued since October 1, 2021, revealed 7 affected certificates. The certificates were revoked within 24 hours of the report.
- Mozilla Bug ID 1751984 and 1753123: On January 25, 2022, ISRG was notified of an instance of non-compliance in their implementation of the TLS-ALPN-01 challenge type (RFC 8737), which is the basis of the TLS Using ALPN validation method (BRs Section 3.2.2.4.20). ISRG's TLS-ALPN-01 client code was not setting a specific minimum TLS version, and was therefore using Go's default minimum TLS version, which is TLS 1.0. While it is likely that many if not most validations were performed over TLS 1.2 or higher, ISRG does not log the negotiated TLS version as part of the validation data, so it must be assumed that all validations conducted using this method could have been affected. Both issues were fixed and all unexpired certificates which contained identifiers validated using the TLS-ALPN-01 challenge type prior to the fix were revoked by January 30, 2022, five days from when ISRG was made aware that they were not issued in accordance with the Baseline Requirements. In addition, as part of the remediation process for Bug 1751984, ISRG discovered a small number of entries in their database for which pre-certificate data was stored but did not have corresponding certificate status (particularly, OCSP response) data stored. These certificates never had OCSP data available. As no authoritative records for these certificates were

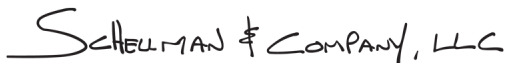
available, all requests for their OCSP responses resulted in an “unauthorized” response, as required by RFC 5019, Section 2.2.3 and RFC 6960, Section 2.3. ISRG populated OCSP responses for all affected certificates and fixed the error which allowed certificates without corresponding OCSP responses to be stored in their database.

- Mozilla Bug ID 1752670: On January 28, 2022, ISRG was notified that their TLS ALPN validation implementation did not match the specification. In particular, RFC 8737 states that “The ACME server verifies that...the certificate returned contains...a subjectAltName extension containing the dNSName being validated and no other entries.” The Let’s Encrypt implementation validated that only one dNSName was present, but did not ensure that there were no entries of other types, such as IP addresses. The issue was resolved and affected certificates were revoked by February 2, 2022.

During our assessment, Schellman performed testing of certificate issuance, on a sample basis, and noted that there were no certificate deficiencies identified in any of the samples tested. As a result, our opinion is not modified with respect to these matters.

Use of the WebTrust Seal

ISRG’s use of the WebTrust for Certification Authorities Seal constitutes a symbolic representation of the contents of this report, and it is not intended, nor should it be construed, to update this report or provide any additional assurance.



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November 08, 2022

ISRG MANAGEMENT'S ASSERTION

Internet Security Research Group (ISRG) operates the CA services known as Let's Encrypt and provides the following CA services:

- Subscriber registration
- Certificate issuance
- Certificate distribution
- Certificate revocation
- Certificate validation

The management of ISRG is responsible for establishing and maintaining effective controls over its CA operations, including its CA business practices disclosure on its website, CA business practices management, CA environmental controls, CA key lifecycle management controls, and certificate lifecycle management controls. These controls contain monitoring mechanisms, and actions are taken to correct deficiencies identified.

There are inherent limitations in any controls, including the possibility of human error and the circumvention or overriding of controls. Accordingly, even effective controls can provide only reasonable assurance with respect to ISRG's Certification Authority operations. Furthermore, because of changes in conditions, the effectiveness of controls may vary over time.

ISRG management has assessed its disclosures of its certificate practices and controls over its CA services. Based on that assessment, in ISRG management's opinion, in providing its CA services at its Salt Lake City, Utah, USA, and Centennial, Colorado, USA, locations, throughout the period September 1, 2021, to August 31, 2022, ISRG has:

- disclosed its business, key lifecycle management, certificate lifecycle management, and CA environmental control policies and practices in its:
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throughout the period September 1, 2021, to August 31, 2022 based on the [WebTrust Principles and Criteria for Certification Authorities v2.2.2](#), including the following:

CA Business Practices Disclosure

- Certification Practice Statement (CPS)
- Certificate Policy (CP)

CA Business Practices Management

- Certification Practice Statement Management
- Certificate Policy Management
- CP and CPS Consistency

CA Environmental Controls

- Security Management
- Asset Classification and Management
- Personnel Security
- Physical and Environmental Security
- Operations Management
- System Access Management
- Systems Development, Maintenance, and Change Management
- Disaster Recovery, Backups, and Business Continuity Management
- Monitoring and Compliance
- Audit Logging

CA Key Lifecycle Management Controls

- CA Key Generation
- CA Key Storage, Backup, and Recovery
- CA Public Key Distribution
- CA Key Usage
- CA Key Archival
- CA Key Destruction
- CA Key Compromise
- CA Cryptographic Hardware Lifecycle Management

Certificate Lifecycle Management Controls

- Subscriber Registration
- Certificate Issuance
- Certificate Distribution
- Certificate Revocation
- Certificate Validation

Subordinate CA Certificate Lifecycle Management Controls

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Joshua Aas
Executive Director
Internet Security Research Group
November 08, 2022

APPENDIX A – ISRG ROOT AND ISSUING CAs

Distinguished Name	Certificate SHA-256 Fingerprint
Subject: C = US, O = Internet Security Research Group, CN = ISRG Root X1	96BCEC06264976F37460779ACF28C5A7CFE8A3C0AAE11A8FFCEE05C0BDDF08C6
Subject: C = US, O = Internet Security Research Group, CN = ISRG Root X2	69729B8E15A86EFC177A57AFB7171DFC64ADD28C2FCA8CF1507E34453CCB1470
Subject: C = US, O = Internet Security Research Group, CN = ISRG Root X2	8B05B68CC659E5ED0FCB38F2C942FBFD200E6F2FF9F85D63C6994EF5E0B02701
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X3	731D3D9CFAA061487A1D71445A42F67DF0AFCA2A6C2D2F98FF7B3CE112B1F568
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X4	5DE9152BED31FA0515DD1FC746133F1327562EF72A84CF2D2403E748A604D0D4
Subject: C = US, O = Let's Encrypt, CN = R3	67ADD1166B020AE61B8F5FC96813C04C2AA589960796865572A3C7E737613DFD
Subject: C = US, O = Let's Encrypt, CN = R4	1A07529A8B3F01D231DFAD2ABDF71899200BB65CD7E03C59FA82272533355B74
Subject: C = US, O = Let's Encrypt, CN = E1	46494E30379059DF18BE52124305E606FC59070E5B21076CE113954B60517CDA
Subject: C = US, O = Let's Encrypt, CN = E2	BACDE0463053CE1D62F8BE74370BBAE79D4FCAF19FC07643AEF195E6A59BD578

The following certificates were signed by IdenTrust for ISRG.

Distinguished Name	Certificate SHA-256 Fingerprint
Subject: C = US, O = Internet Security Research Group, CN = ISRG Root X1	6D99FB265EB1C5B3744765FCBC648F3CD8E1BFFAFDC4C2F99B9D47CF7FF1C24F
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X1	7FDCE3BF4103C2684B3ADBB5792884BD45C75094C217788863950346F79C90A3
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X1	23D29B9707396BCCA317F9EF1B1E6A626C4E481283CD85F74A516FF6CAB997ED
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X2	EC0C6CA496A67A13342FEC5221F68D4B3E53B1BC22F6E4BCCC9C68F0415CDEA4
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X2	2F45659D64DC74CCEC9E2A4290715828F95FA8CC7A6C8800D3968F14DFCF1DB7
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X3	25847D668EB4F04FDD40B12B6B0740C567DA7D024308EB6C2C96FE41D9DE218D

Distinguished Name	Certificate SHA-256 Fingerprint
Subject: C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X4	A74B0C32B65B95FE2C4F8F098947A68B695033BED0B51DD8B984ECAE89571BB6
Subject: C = US, O = Let's Encrypt, CN = R3	FEE765DA4CACF53C71AF202F89F3612420FD930D804E204FEEFEC9D78084BB7B
Subject: C = US, O = Let's Encrypt, CN = R3	730C1BDCD85F57CE5DC0BBA733E5F1BA5A925B2A771D640A26F7A454224DAD3B
Subject: C = US, O = Let's Encrypt, CN = R4	8E510575F07A97D5FADA3BFDA6187E03E77D3392318457EA8718A9D28B43396B
Subject: C = US, O = Let's Encrypt, CN = R4	5A8F16FDA448D783481CCA57A2428D174DAD8C60943CEB28F661AE31FD39A5FA

APPENDIX B– OTHER INCIDENTS DISCLOSED BY ISRG

The following incident(s) occurred prior to the audit period and disclosed because the associated Mozilla Bugzilla ticket was open at some point during the audit period.

Mozilla Bugzilla ID	Date	Title
1715672	2021.06.09	Let's Encrypt: Failure to revoke for Certificate Lifetime Incident
1715455	2021.06.09	Let's Encrypt: certificate lifetimes 90 days plus one second