

(S//OC/NF) Network Operations Division Persisted DLL Specification

(S//OC/NF) NOD Specification 003: version 2



Classified By: 2343997

Derived From: CIA NSCG COL S-06, CIA NSCG MET S-06

Reason: 1.4(c)

Declassify On: 25X1, 20630403

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1. (U//FOUO) Overview

(U//FOUO) This specification exists to provide a common interface while preventing the use of other, more sensitive, execution specifications in persistence scenarios. It is not expected that this will be the only persistence interoperability mechanism implemented by the Sponsor, instead this specification provides a default.

(U//FOUO) Persistence modules consist of a loader which utilizes a persistence technique and a payload to launch after a reboot or other execution ending event. Both pieces are exposed and vulnerable to hostile scrutiny and so must be simple, lack any definite attribution indicators, and easy to replace.

(U//FOUO) Payload modules are Windows DLLs with at least one entry point defined, `DllMain`.

(S//OC/NF) This specification is classified SECRET//ORCON/NOFORN to avoid hostile Foreign Intelligence Operations, Law Enforcement, Incident Response, Reverse Engineering, or any other investigation of captured tools or techniques resulting in attribution to the United States Government or the Central Intelligence Agency. Separate from that attribution the techniques discussed here are UNCLASSIFIED//FOR OFFICIAL USE ONLY.

(U) The key words: MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL in this document are to be interpreted as described in RFC 2119. In addition, the key words: SHOULD CONSIDER, REALLY SHOULD NOT, OUGHT TO, WOULD PROBABLY, MAY WISH TO, COULD, POSSIBLE, and MIGHT in this document are to be interpreted as described in RFC 6919.

2. (U//FOUO) Loading and Invocation

1. (U//FOUO) The persistence loader gains execution through its persistence technique and causes the payload to be loaded into an appropriate process via `LoadLibrary` or equivalent technique.
 - a. (U//FOUO) The loader should apply the default memory page permissions for a module's sections (i.e., as would be set by `LoadLibrary`). This prevents a single large chunk of `PAGE_EXECUTE_READWRITE` memory which could easily be found by memory forensics.
2. (U//FOUO) From `DllMain` the payload spawns a new thread to execute its main code. `DllMain` otherwise behaves as per the MSDN documentation, to include return values. This is done to comply with the MSDN documentation of `DllMain`'s execution environment.
3. (U//FOUO) If possible the loader responds to `DllMain`'s exit status as per the MSDN documentation.
 - a. (U//FOUO) Loaders should collect the payload's exist status. Not all persistence techniques permit the loader to collect this exit status. If a particular technique does not make this feasible then the loader may ignore this return value and so leak it.

- b. (U//FOUO) Loaders should zero the memory allocated to hold the payload prior to freeing it during unloading. Not all persistence techniques permit the loader to zero the previously occupied memory. If a particular technique does not make this feasible then the loader may skip zeroing the unloaded memory.
- 4. (U//FOUO) If possible, the loader should release any open handles it has on the payload in order to permit the payload to self-delete or otherwise perform operations requiring an exclusive lock on its containing file.
 - a. (U//FOUO) Payloads should be aware that they may not be resident as a plain DLL on disk and that consequently attempts to access their backing file may fail or return unexpected results. Payloads must handle this situation gracefully. If no graceful continuation of execution is possible, payloads may exit with an error condition.

3. (U//FOUO) Arguments

(U//FOUO) No arguments are passed between the loader and the payload.

4. (U//FOUO) Structured Exception Handling

(U//FOUO) Loaders will not provide fix ups to allow payloads to use Structured Exception Handling (SEH). If a payload wishes to use SEH it must perform the fix ups itself.

5. (U//FOUO) Vectorized Exception Handling

(U//FOUO) Loaders will not provide fix ups to allow payloads to use Vectorized Exception Handling (VEH). If a payload wishes to use VEH it must perform the fix ups itself.

6. (U//FOUO) Uninstallation

(U//FOUO) This specification explicitly does not define a mechanism for the payload to communicate to the loader that it should be removed. This is because persistence techniques vary so widely that a single standard could not reasonably accommodate all of the possible cases. The only requirement that this specification applies is that loaders and payloads must provide some mechanism for a user to stop or de-persist a given payload.

(U//FOUO) Appendix A: Version History

(U//FOUO) Version 2:

- Renamed to Persisted DLL Specification for clarity

- Explicitly permitted loaders to skip zeroing unloaded payloads

- Removed argument passing support since it has not been necessary

- Clarification on release of file handles

- Clarification that payloads may not be simple files on disk

(U//FOUO) Version 1: Initial publication