Appendix Data-driven Mutation Testing:

GomSpace
LibParam Fault Model

Target function

The probes will be inserted in the function *gs_rparam_process_packet*, which is contained in the file *libparam/src/csp_service_handler.c*
This function take care of encapsulating the libParam data and provide it to libCSP.
It is mainly composed of a switch statement that handles the different kinds of action requested within each packet and the different kinds of payload that go along with them.

Target data structure:

In the following, we describe in tabular form the data structure that will be the target of the data-mutation probes.

gs_rparam_query_t

Member	**Type**
Action	uint8_t
Table_id	uint8_t
Length	uint16_t
Checksum	uint16_t
Seq	uint16_t
Total	uint16_t
Payload	gs_rparam_query_payload_t (union)

The possible *Action* values are shown in the following table.

Action	**ID**	**Description**
RPARAM_GET	0x00	Get one or more parameters.
RPARAM_REPLY	0x55	Reply to a request.
RPARAM_SET	0xFF	Set one or more parameters.
RPARAM_TABLE	0x44	Download table specification.
RPARAM_COPY	0x77	Copy memory slot to memory slot.
RPARAM_LOAD	0x88	Load from file (slot) to memory (slot).
RPARAM_LOAD_FROM_STORE	0x89	Load from file (slot) to memory (slot).
RPARAM_SAVE	0x99	Save from memory (slot) to file (slot).
RPARAM_SAVE_TO_STORE	0x9a	Save from memory (slot) to file (slot).

gs_rparam_query_payload_t

The payload is structured as a union to be able to contain different kinds of data, depending on the value of *Action.*

Member	Type
Addr	uint16_t
Packed	uint8_t
Copy	struct
	uint8_t from
	uint8_t to

gs_rparam_query_payload_store_t

This data structure is used for the *RPARAM_LOAD_FROM_STORE* and *RPARAM_SAVE_TO_STORE* in place of the previously described *gs_rparam_query_payload_t*.

Member	Type
table	Vector of 26 char elements
store	Vector of 26 char elements
slot	Vector of 26 char elements

General Fault Model

The first probe will be inserted before the switch statement, so the payload will not be considered but we will be able to target the Table ID field, which is only called upon in initial checks.

Member	Type	Fault Classes
Action	uint8_t	IV(value=0x55) IV(value=0xFF) IV(value=0x44) IV(value=0x77) IV(value=0x88) IV(value=0x89) IV(value=0x99) IV(value=0x9a) IV(value=0x00)
Table_id	uint8_t	VAT(Threshold=20, Delta=1) SS(Delta=1), SS(Delta=-1), HV(Value=10)
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(Threshold=180, Delta=1)

Checksum	uint16_t	None
Seq	uint16_t	SS(Delta=1) SS(Delta=-1)
Total	uint16_t	SS(Delta=1) SS(Delta=-1)
Payload	gs_rparam_query_payload_t (union)	

Action Specific Fault Models

Then, a different mutation probe, with a corresponding fault model, will be inserted for every case of the switch statement, allowing us to target the different kinds of payload with specific operators.

RPARAM_GET Request Fault Model

gs_rparam_query_t

Member	**Type**	**Fault Classes**
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180 D=1)
Checksum	uint16_t	None
Seq	uint16_t	
Total	uint16_t	
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	**Type**	**Fault Classes**
Addr	uint16_t	SS(Delta=1), SS(Delta=-1),

RPARAM_REPLY Fault Model

gs_rparam_query_t

Member	**Type**	**Fault Classes**
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180 D=1)
Checksum	uint16_t	None
Seq	uint16_t	SS(Delta=1) SS(Delta=-1)
Total	uint16_t	SS(Delta=1) SS(Delta=-1)
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Packed	Uint8_t	(BF(min=0, max=7, state=-1, value =1))

RPARAM_SET Request Fault Model

rparam_query_t

Member	Type	Fault Classes
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180 D=1)
Checksum	uint16_t	None
Seq	uint16_t	SS(Delta=1) SS(Delta=-1) HV(V=1)
Total	uint16_t	SS(Delta=1) SS(Delta=-1)
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Packed	uint8_t	BF(min=0, max=7, state=-1, value =1)

RPARAM_SAVE Fault Model

rparam_query_t

Member	Type	Fault Classes
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180, D=1)
Checksum	uint16_t	None
Seq	uint16_t	
Total	uint16_t	
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Copy	struct	

	uint8_t from	SS(Delta=-1), SS(Delta=+1)
	uint8_t to	SS(Delta=-1), SS(Delta=+1)

RPARAM_LOAD Fault Model

rparam_query_t

Member	Type	Fault Classes
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180, D=1)
Checksum	uint16_t	None
Seq	uint16_t	SS(Delta=1) SS(Delta=-1)
Total	uint16_t	SS(Delta=1) SS(Delta=-1)
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Copy	struct	
	uint8_t from	SS(Delta=-1), SS(Delta=+1)
	uint8_t to	SS(Delta=-1), SS(Delta=+1)

Type equation here.

RPARAM_COPY Fault Model

rparam_query_t

Member	Type	Fault Classes
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180, D=1)
Checksum	uint16_t	None
Seq	uint16_t	SS(Delta=1) SS(Delta=-1)
Total	uint16_t	
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Copy	struct	

	uint8_t from	SS(Delta=-1), SS(Delta=+1)
	uint8_t to	SS(Delta=-1), SS(Delta=+1)

RPARAM_REPLY Request Fault Model

rparam_query_t

Member	Type	Fault Classes
Action	uint8_t	
Table_id	uint8_t	
Length	uint16_t	SS(Delta=1), SS(Delta=-1), IV(V=0), VAT(T= 180 D=1)
Checksum	uint16_t	
Seq	uint16_t	SS(Delta=1) SS(Delta=-1) HV(V=1)
Total	uint16_t	SS(Delta=1) SS(Delta=-1)
Payload	gs_rparam_query_payload_t (union)	

gs_rparam_query_payload_t

Member	Type	Fault Classes
Packed	uint8_t	BF(min=0, max=7, state=-1, value =1)