

# LCS: Lynx Certifiable Stack

Unmatched TCP/IP security and flexibility for safety-critical systems



## Deterministic communications for DO-178B-certifiable systems and FAA-accepted Reusable Software Components

As the first DO-178B-certifiable TCP/IP protocol stack, the Lynx Certifiable Stack (LCS) offers unmatched performance and flexibility to designers of safety-critical systems.

Hardware-independent LCS is certifiable to DO-178B level A/B and employs the open-standards POSIX® API for networking and transport-layer protocol transactions.

For maximum safety, LCS segregates communications between and within LynxOS®-178 RTOS partitions. For example, DO-178B level A transactions can be restricted to one partition of a system

while DO-178B level B transactions are handled independently in another, and while uncertified communications are being controlled elsewhere.

For maximum flexibility, LCS can operate as a standalone dedicated Virtual Machine (VM) fully occupying its own partition, or it can be included as an adjunct to an application running within a LynxOS-178 partition. Multiple instances of the LCS TCP/IP stack can be used deterministically across a partitioned system without affecting each other.

Prior to the advent of LCS to help avionics developers meet DO-178B certification, the use of TCP/IP/UDP networking stacks between hardware platforms was often avoided due to the stacks' complexity and the difficulty in getting them certified.

LCS is certifiable to DO-178B level A. With LCS, applications using TCP/IP now have a low-cost, low-risk path to standards certification. Meeting the strict requirements of standards such as DO-178B—and its European equivalent, ED-12B—can require enormous resources in terms of man-hours and cost.

### ARINC 664-capable

The flexibility of LCS allows avionics applications to support networked systems such as ARINC 664 Aircraft Full-Duplex Exchange (AFDX) that communicate both inside and outside an aircraft's internal systems.

### LCS software architecture

Protocols certifiable in applications up to to DO-178B level A/B are IPv4, TCP/IP, UDP, ICMP, ARP, and IGMP.

Features can be configured on a per-partition basis and used per DO-178B certification level required. Likewise, Ethernet controllers may be shared or private, as desired.

Applications can communicate with other hardware nodes directly using the stack or they can communicate via ARINC 653 ports to a dedicated partition that uses a single instance of the stack to communicate with other processing nodes.

The LCS stack consists of:

- LCS networking daemon
- LCS proxy socket driver
- LCS networking controller drivers

The LCS proxy socket driver transmits socket system calls to the LCS networking daemon and passes the replies from the daemon to the user applications. The core functionality of the TCP/IP stack is implemented in the LCS networking daemon.

### Integrated with LynxOS-178 for ease of use

LCS is fully integrated with our LynxOS-178 RTOS, the only real-time operating system accepted by the FAA for use as a Reusable Software Component (RSC) in DO-178B certification. LCS uses the same open-standards POSIX API as LynxOS-178 for networking and transport-layer protocol transactions.

## Features & Advantages

- The first DO-178B-certifiable standalone TCP/IP stack, now certifiable to DO-178B level A/B
- Full awareness of LynxOS-178 RTOS partitions
- Operates in standalone mode as a dedicated Virtual Machine (VM) or as part of an application within a LynxOS-178 RTOS partition
- Enables use of debugging and profiling tools so developers can test applications in a deployment configuration
- Uses the open-standards POSIX API of LynxOS-178 for networking and transport-layer protocol transactions
- ARINC 653 ports communications to a dedicated LCS partition or configure each partition with its own network stack
- Use in production or development mode

The LCS TCP/IP supports the following POSIX system calls:

- socket()
- bind()
- listen()
- accept()
- connect()
- shutdown()
- send()
- sendto()
- recv()
- recvfrom()
- setsockopt()
- getsockopt()
- getsockname()
- getpeername()
- write()
- read()
- select()
- close()
- fcntl()
- ioctl()

### Socket types

LCS supports the AF\_INET POSIX socket address family. The socket types supported in the context of the family are:

- SOCK\_STREAM for the TCP protocol
- SOCK\_DGRAM for the UDP protocol
- SOCK\_RAW for raw sockets

LCS also supports the SOCK\_RAW socket type of the PF\_ROUTE protocol family with following routing commands:

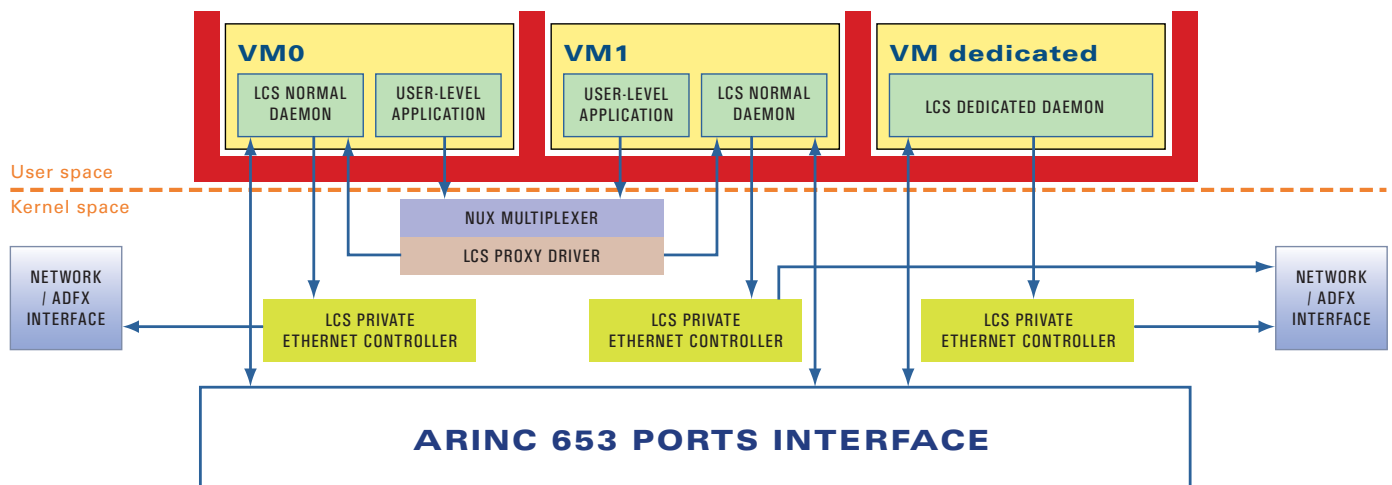
- RTM\_GET - Report metrics and other route information
- RTM\_ADD - Add a route
- RTM\_DELETE - Delete a route

### Socket options

Socket options supported by LCS:

- IP\_TOS
- IP\_MULTICAST\_IF
- IP\_MULTICAST\_TTL
- IP\_MULTICAST\_LOOP
- IP\_ADD\_MEMBERSHIP
- IP\_DROP\_MEMBERSHIP
- SO\_BROADCAST
- SO\_LINGER
- SO\_SNDBUF
- SO\_RCVBUF
- SO\_TYPE
- SO\_ERROR

(The LCS networking daemon also provides the nonblocking socket mode.)



## Lynx Certifiable Stack (LCS) software architecture



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