User Manual

for the

Gigabit Ethernet Adapter

VxWorks Software Driver

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<th>C²I² Systems Document No.</th>
<th>CCII/GE/6-MAN/002</th>
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<td>2009-08-20</td>
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<td>Added command line parameter descriptions.</td>
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<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Program Interface</td>
</tr>
<tr>
<td>BIT</td>
<td>Built-In Test</td>
</tr>
<tr>
<td>bit/s</td>
<td>bits per second</td>
</tr>
<tr>
<td>BSP</td>
<td>Board Support Package</td>
</tr>
<tr>
<td>CCPMC</td>
<td>Conduction-Cooled Peripheral Component Interconnect Mezzanine Card</td>
</tr>
<tr>
<td>CD</td>
<td>Carrier Detect</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic Redundancy Check</td>
</tr>
<tr>
<td>EEPROM</td>
<td>Electrically Erasable and Programmable Read Only Memory</td>
</tr>
<tr>
<td>FIFO</td>
<td>First In First Out</td>
</tr>
<tr>
<td>GE</td>
<td>Gigabit Ethernet</td>
</tr>
<tr>
<td>I/O</td>
<td>Input / Output</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>MHz</td>
<td>MegaHertz</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PCI</td>
<td>Peripheral Component Interconnect</td>
</tr>
<tr>
<td>PMC</td>
<td>Peripheral Component Interconnect Mezzanine Card</td>
</tr>
<tr>
<td>POST</td>
<td>Power-On Self Test</td>
</tr>
<tr>
<td>RAM</td>
<td>Random Access Memory</td>
</tr>
<tr>
<td>SBC</td>
<td>Single Board Computer</td>
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</table>
1. **Scope**

1.1 **Identification**

This document is the user manual for the Gigabit Ethernet VxWorks Software Driver.

1.2 **System Overview**

The Gigabit Ethernet Adapter attach computers to 10 Mbit/s, 100 Mbit/s and 1 Gbit/s Ethernet networks using Copper or Fibre cabling.

The GE Adapter is currently available in Air-Cooled PMC, Conduction-Cooled PMC (CCPMC) and PCI-104 formfactors.

Applicable Part Numbers are:

**PMC**
- CCII/GNET/PMC/2P/RJ/FP/COM UTP Commercial Grade Adapter
- CCII/GNET/PMC/2P/RJ/FP/IND UTP Industrial Grade Adapter
- CCII/GNET/PMC/2P/SX/FP/COM Multimode Fibre Commercial Grade Adapter
- CCII/GNET/PMC/2P/SX/FP/IND Multimode Fibre Industrial Grade Adapter
- CCII/GNET/PMC/2P/LX/FP/COM Singlemode Fibre Commercial Grade Adapter
- CCII/GNET/PMC/2P/LX/FP/IND Singlemode Fibre Industrial Grade Adapter

**CCPMC**
- CCII/GNET/PMC/2P/BP/CC UTP Backplane I/O, Conduction-Cooled Adapter

**PCI-104**
- CCII/GNET/PC104/2P/RJ/COM UTP Commercial Grade Adapter
- CCII/GNET/PC104/2P/RJ/IND UTP Industrial Grade Adapter
- CCII/GNET/PC104/2P/SX/COM Multimode Fibre Commercial Grade Adapter
- CCII/GNET/PC104/2P/SX/IND Multimode Fibre Industrial Grade Adapter
- CCII/GNET/PC104/2P/LX/COM Singlemode Fibre Commercial Grade Adapter
- CCII/GNET/PC104/2P/LX/IND Singlemode Fibre Industrial Grade Adapter

The software driver binaries are provided with explicit installation instructions.

1.3 **Document Overview**

This document gives an overview of the Gigabit Ethernet VxWorks Software Driver installation procedure and its Application Program Interface (API).
2. Applicable and Reference Documents

2.1 Applicable Documents

2.1.1 CCII/GE/6-MAN/001, Hardware Reference Manual for the Gigabit Ethernet Adapter.

2.2 Reference Documents

None.
3. **Software Driver Distribution**

The software driver distribution consists of (at least) the following files:

- `ccGeEnd<arch><.vxworks_version>.a` Host-architecture specific, driver object file:
  - `cc` - CCII Systems (Pty) Ltd
  - `GeEnd` - Enhanced Network Device (END)
  - `<arch>` - Host for which the binary is built:
    - X86
    - 18x (Dy4 181/182/183)
    - Mv5100 (Motorola MVME-5100)
  - `<vxworks_version>` - VxWorks version:
    - .62 (VxWorks 6.2)
    - `blank` (VxWorks 5.5.1)
  
  e.g. "ccGeEnd18x.62.a" for Gigabit Ethernet VxWorks Software Driver built for a DY4 SVME/DMV 181 PowerPC host for VxWorks 6.2.

- `Readme.txt` General information and installation notes.

- `Release.txt` Release notes and revision history:
  
  Please check this file for information on the latest updates.

- `sysCcGeEnd.c` PCI initialisation for X86 BSPs. See Annexure A.
4. **Installation Procedure**

This paragraph describes the installation procedure for the Gigabit Ethernet VxWorks Software Driver. (The examples given are for a DY4 SVME/DMV181 PowerPC host).

4.1 **Large UDP Packet Support**

In order to transmit large UDP packets (typically larger than 1 992 bytes), the VxWorks "Network Stack Memory Pool Configuration" has to be changed to add larger data clusters. The procedure for doing this differs between VxWorks 5.5 and VxWorks 6.x.

4.1.1 **Procedure for VxWorks 5.5 (if building target images using Tornado)**

This configuration change cannot be performed from the Tornado Project GUI itself. The file {tornado}/target/config/comps/src/net/usrNetLib.c needs to be changed as shown in Annexure B. The example in Annexure B adds 10 clusters each of 4 096, 8 192, 16 384, 32 768 and 65 536 bytes to the Network Stack Memory Pool. This translates to an additional 1,21 MB of system memory being allocated to the Network Stack Memory Pool. Depending on the availability of free memory resources, the number of clusters added can be adjusted. A new VxWorks target image has to be built for these changes to take effect.

4.1.2 **Procedure for VxWorks 5.5 (if building target images using the command line)**

If you are using the command line to build your VxWorks target images, the relevant file to edit will be {tornado}/target/src/config/usrNetwork.c (not usrNetLib.c). The basic procedure and changes though are roughly the same as those indicated in Annexure B. A new VxWorks target image has to be built for these changes to take effect.

4.1.3 **Procedure for VxWorks 6.x (if building target images using the Workbench IDE)**

The Network Stack Memory Configuration can be reconfigured in the Workbench IDE for your VxWorks 6.x target images. Under the Project Navigator tab, double click on Kernel Configuration for the current VxWorks image project. In the Component configuration window, expand and select the "Network Components > Network Core Components > Network Stack Memory Pool Configuration" branch and change the relevant Property Values to include additional (larger than 2 048 bytes) clusters. A new VxWorks target image has to be built for these changes to take effect.

4.2 **To Build the Gigabit Ethernet VxWorks Software Driver into the VxWorks Kernel**

Assume the BSP directory is given as : BSP_DIR = /tornado/target/config/dy4181.

- Copy ccGeEnd18x.a to your $(BSP_DIR)/lib directory as ccGeEnd.a.
- In the Builds section of the Project Workspace, change the Kernel properties to include the ccGeEnd.a library file in the Macros LIBs option.
- Rebuild all VxWorks images.

4.3 **To Load the Software Driver Separately**

Note : This step is not required if the software driver was built into the BSP.

If the software driver is not built into the BSP, a user can load it separately :

- Copy ccGeEnd18x.a to your present working director as ccGeEnd.a.
- From the VxWorks shell, type :
  - `ld < ccGeEnd.a`
5. Using the Gigabit Ethernet Software Driver

5.1 DualNet and RLMT Modes

The two ports of the GE Adapter may be used either to provide two independent communication channels (DualNet mode) or as a single dual redundant channel (RLMT mode).

In DualNet mode, each channel is assigned its own IP address.

In RLMT mode, the secondary port becomes a “hot standby” in the event of failure of the primary port. Only one IP address is assigned as the hardware will determine over which physical channel the data is routed.

5.2 Loading and Starting the Driver in DualNet Mode

To start the driver in DualNet mode:

```
muxDevStart(muxDevLoad(0, geLoad, "", 0, 0))
muxDevStart(muxDevLoad(1, geLoad, "", 0, 0))
```

This will create two devices, “ccge0” and “ccge1”.

5.3 Loading and Starting the Driver in RLMT Mode

To start the driver in RLMT mode:

```
muxDevStart(muxDevLoad(0, geLoad, "RlmtMode=CheckLinkState", 0, 0))
```

5.4 Command Line Parameters

The general form of the Gigabit Ethernet Software Driver loads command is as follows:

```
muxDevLoad(device, geLoad, "parameter-1:parameter-2:parameter-3...", 0, 0)
```

where `device` is a unique instance number starting from 0, and `parameter-n` is as described in the following table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Permitted Values</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed_A</td>
<td>This parameter is used to set the speed capabilities. It is only valid for copper adapters. Usually, the speed is negotiated between the two channels during link establishment. If this fails, a channel can be forced to a specific setting with this parameter.</td>
<td>10, 100, 1000</td>
<td>Auto</td>
</tr>
<tr>
<td>Speed_B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AutoNeg_A</td>
<td>The &quot;Sense&quot;-mode automatically detects whether the link partner supports auto-negotiation or not.</td>
<td>On, Off, Sense</td>
<td>On</td>
</tr>
<tr>
<td>AutoNeg_B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DupCap_A</td>
<td>This parameter is only relevant if auto-negotiation for this channel is not set to &quot;Sense&quot;. If auto-negotiation is set to &quot;On&quot;, all three values are possible. If it is set to &quot;Off&quot;, only &quot;Full&quot; and &quot;Half&quot; are allowed. This parameter is useful if your link partner does not support all possible combinations.</td>
<td>Half, Full, Both</td>
<td>Both</td>
</tr>
<tr>
<td>DupCap_B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FlowCtrl_A
FlowCtrl_B
This parameter can be used to set the flow control capabilities the channel reports during auto-negotiation. It can be set for each channel individually.

- Sym = Symmetric: both link partners are allowed to send PAUSE frames.
- SymOrRem = SymmetricOrRemote: both or only remote partner are allowed to send PAUSE frames.
- LocSend = LocalSend: only local link partner is allowed to send PAUSE frames.
- None = No link partner is allowed to send PAUSE frames.

Role_A
Role_B
This parameter is only valid for the copper adapters. For two 1 000 Base-T adapters to communicate, one must take the role of the master (providing timing information), while the other must be the slave. Usually, this is negotiated between the two adapters during link establishment. If this fails, an adapter can be forced to a specific setting with this parameter.

ConType
The parameter 'ConType' is a combination of all five per-channel parameters within one single parameter. This simplifies the configuration of both channels of an adapter. The different values of this variable reflect the most meaningful combinations of channel parameters.

The following table shows the values of 'ConType' and the corresponding combinations of the per-channel parameters:

<table>
<thead>
<tr>
<th>ConType</th>
<th>DupCap</th>
<th>AutoNeg</th>
<th>FlowCtrl</th>
<th>Role</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>Both</td>
<td>Off</td>
<td>SymOrRem</td>
<td>Auto</td>
<td>Auto</td>
</tr>
<tr>
<td>1000FD</td>
<td>Full</td>
<td>Off</td>
<td>None</td>
<td>Auto (ignored)</td>
<td>1000</td>
</tr>
<tr>
<td>100FD</td>
<td>Full</td>
<td>Off</td>
<td>None</td>
<td>Auto (ignored)</td>
<td>100</td>
</tr>
<tr>
<td>100HD</td>
<td>Half</td>
<td>Off</td>
<td>None</td>
<td>Auto (ignored)</td>
<td>100</td>
</tr>
<tr>
<td>10FD</td>
<td>Full</td>
<td>Off</td>
<td>None</td>
<td>Auto (ignored)</td>
<td>10</td>
</tr>
<tr>
<td>10HD</td>
<td>Half</td>
<td>Off</td>
<td>None</td>
<td>Auto (ignored)</td>
<td>10</td>
</tr>
</tbody>
</table>

Stating any other channel parameter together with this 'ConType' variable will result in a merged configuration of those settings. This due to the fact, that the per-channel parameters (e.g. Speed_?) have a higher priority than the combined variable 'ConType'.

Note: This parameter is always used on both channels of the adapter.

PrefPort
This is used to force the preferred channel to A or B (on dual-channel network adapters). The preferred channel is the one that is used if both are detected as fully functional.

<table>
<thead>
<tr>
<th>PrefPort</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Permitted Values</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RlmtMode</td>
<td>RLMT monitors the status of the channel. If the link of the active channel fails, RLMT switches immediately to the standby link. The virtual link is maintained as long as at least one “physical” link is up.</td>
<td>CheckLinkState, CheckLocalPort, CheckSeg                                                                惠于</td>
</tr>
<tr>
<td></td>
<td>• <strong>CheckLinkState</strong> - Check link state only: RLMT uses the link state reported by the adapter hardware for each individual channel to determine whether a channel can be used for all network traffic or not.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>CheckLocalPort</strong> - In this mode, RLMT monitors the network path between the two channels of an adapter by regularly exchanging packets between them. This mode requires a network configuration in which the two channels are able to “see” each other (i.e. there must not be any router between the channels).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>CheckSeg</strong> - Check local channel and segmentation: This mode supports the same functions as the CheckLocalPort mode and additionally checks network segmentation between the channels. Therefore, this mode is only to be used if Gigabit Ethernet switches are installed on the network that have been configured to use the Spanning Tree protocol.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>DualNet</strong> - In this mode, channels A and B are used as separate devices. If you have a dual channel adapter, channel A will be configured as eth0 and channel B as eth1. Both channels can be used independently with distinct IP addresses. The preferred channel setting is not used. RLMT is turned off.</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td>RLMT modes CLP and CLPSS are designed to operate in configurations where a network path between the channels on one adapter exists. Moreover, they are not designed to work where adapters are connected back-to-back.</td>
<td></td>
</tr>
<tr>
<td>IntsPerSec</td>
<td>This parameter is only used, if either static or dynamic interrupt moderation is used on a network adapter. Using this parameter if no moderation is applied, will lead to no action performed.</td>
<td>30 ... 40 000 (interrupts per second)</td>
</tr>
<tr>
<td></td>
<td>This parameter determines the length of any interrupt moderation interval. Assuming that static interrupt moderation is to be used, an ‘IntsPerSec’ parameter value of 2 000 will lead to an interrupt moderation interval of 500 microseconds.</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td>The duration of the moderation interval is to be chosen with care. At first glance, selecting a very long duration (e.g. only 100 interrupts per second) seems to be meaningful, but the increase of packet-processing delay is tremendous. On the other hand, selecting a very short moderation time might compensate the use of any moderation being applied.</td>
<td></td>
</tr>
</tbody>
</table>
### Moderation

Interrupt moderation is employed to limit the maximum number of interrupts the driver has to serve. That is, one or more interrupts (which indicate any transmit or receive packet to be processed) are queued until the driver processes them. When queued interrupts are to be served, is determined by the "IntsPerSec" parameter, which is explained later below.

- **None** - No interrupt moderation is applied on the adapter. Therefore, each transmit or receive interrupt is served immediately as soon as it appears on the interrupt line of the adapter.

- **Static** - Interrupt moderation is applied on the adapter. All transmit and receive interrupts are queued until a complete moderation interval ends. If such a moderation interval ends, all queued interrupts are processed in one big bunch without any delay. The term 'static' reflects the fact, that interrupt moderation is always enabled, regardless how much network load is currently passing via a particular interface. In addition, the duration of the moderation interval has a fixed length that never changes while the driver is operational.

- **Dynamic** - Interrupt moderation might be applied on the adapter, depending on the load of the system. If the driver detects that the system load is too high, the driver tries to shield the system against too much network load by enabling interrupt moderation. If - at a later time - the CPU utilisation decreases again (or if the network load is negligible) the interrupt moderation will automatically be disabled.

Interrupt moderation should be used when the driver has to handle one or more interfaces with a high network load, which - as a consequence - leads also to a high CPU utilisation. When moderation is applied in such high network load situations, CPU load might be reduced by 20-30%.

**Note:** The drawback of using interrupt moderation is an increase of the round-trip-time (RTT), due to the queuing and serving of interrupts at dedicated moderation times.

### LowLatency

This is used to reduce the packet latency time of the adapter. Setting the LowLatency parameter to 'On' forces the adapter to pass any received packet immediately to upper network layers and to send out any transmit packet as fast as possible.

**Note 1:** The system load increases if LowLatency is set to 'On' and a lot of data packets are transmitted and received.

**Note 2:** This parameter is only used on adapters which are based on PCI Express compatible chipsets.

### BroadcastPrio

This parameter specifies whether received broadcast packets have the highest priority for the channel switch decision ("Off") or not ("On").

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Permitted Values</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderation</td>
<td>Interrupt moderation is employed to limit the maximum number of interrupts the driver has to serve. That is, one or more interrupts (which indicate any transmit or receive packet to be processed) are queued until the driver processes them. When queued interrupts are to be served, is determined by the &quot;IntsPerSec&quot; parameter, which is explained later below.</td>
<td>None, Static, Dynamic</td>
<td>Dynamic</td>
</tr>
<tr>
<td>LowLatency</td>
<td>This is used to reduce the packet latency time of the adapter. Setting the LowLatency parameter to 'On' forces the adapter to pass any received packet immediately to upper network layers and to send out any transmit packet as fast as possible.</td>
<td>On, Off</td>
<td>Off</td>
</tr>
<tr>
<td>BroadcastPrio</td>
<td>This parameter specifies whether received broadcast packets have the highest priority for the channel switch decision (&quot;Off&quot;) or not (&quot;On&quot;).</td>
<td>On, Off</td>
<td>Off</td>
</tr>
<tr>
<td>RltmMinToVal</td>
<td>Minimum timeout value for RLMT (in µs)</td>
<td>30 000</td>
<td></td>
</tr>
<tr>
<td>RltmDefToVal</td>
<td>Minimum timeout value for RLMT (in µs)</td>
<td>30 000</td>
<td></td>
</tr>
<tr>
<td>RltmPortdownTimVal</td>
<td>RLMT Port Down Timer (in µs)</td>
<td>90 000</td>
<td></td>
</tr>
<tr>
<td>RltmPortstartTimVal</td>
<td>RLMT Port Start Timer (in µs)</td>
<td>50 000</td>
<td></td>
</tr>
<tr>
<td>RltmPortupTimVal</td>
<td>RLMT Port Up Timer (in µs)</td>
<td>2 500 000</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Permitted Values</td>
<td>Default Value</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------------------------</td>
<td>------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>RlmtSegToVal</td>
<td>RLMT Network Segmentation Reporting Interval (in µs)</td>
<td></td>
<td>900 000 000</td>
</tr>
</tbody>
</table>

Note: If DualNet mode is used, the parameters for both channels must be provided in the first call to muxDevLoad. Parameters provided in the second call will be ignored.
6. **Contact Details**

6.1 **Contact Person**

Direct all correspondence and / or support queries to the Project Manager (Board Level Products) at C²I² Systems.

6.2 **Physical Address**

C²I² Systems  
Unit 3, Rosmead Place, Rosmead Centre  
67 Rosmead Avenue  
Kenilworth  
Cape Town  
7708  
South Africa

6.3 **Postal Address**

C²I² Systems  
P.O. Box 171  
Rondebosch  
7701  
South Africa

6.4 **Voice and Electronic Contacts**

Tel :  (+27) (0)21 683 5490  
Fax :  (+27) (0)21 683 5435  
Email :  info.ccii@ccii.co.za  
Email :  support@ccii.co.za  
URL :  http://www.ccii.co.za/

6.5 **Product Support**

Support on C²I² Systems products is available telephonically between Monday and Friday from 09:00 to 17:00 CAT. Central African Time (CAT = GMT + 2).

Email support is available at support@ccii.co.za
Annexure A

Making Changes to sysNet.c for X86

On X86 platforms, the following amendment must be made to the BSP:

Copy the file sysCcGeEnd.c to your BSP configuration directory (target/config/BSPName).

Make the following two amendments to the file sysNet.c in the same directory:

Amendment 1:

```c
#ifdef INCLUDE_END
    #include "sysDec21x40End.c"          /* dec21x40End support routines */
    #include "sysEl3c90xEnd.c"           /* el3c90xEnd support routines */
    #include "sysElt3c509End.c"          /* elt3c509End support routines */
    #include "sysFei82557End.c"          /* fei82557End support routines */
    #include "sysGei82543End.c"          /* gei82543End support routines */
    #include "sysLn97xEnd.c"             /* ln97xEnd support routines */
    #include "sysNe2000End.c"            /* ne2000End support routines */
    #include "sysUltraEnd.c"             /* ultraEnd support routines */
    #include "sysCcGeEnd.c"              /* CCII GE END driver support routines */
#endif /* INCLUDE_END */
```

Amendment 2:

```c
LOCAL VEND_ID_DESC vendorIdEnet [] =
{
    #if defined(INCLUDE_DEC21X40_END)
        {DEC_PCI_VENDOR_ID,      sysDec21x40PciInit},
    #endif /* INCLUDE_DEC21X40_END */

    #if defined(INCLUDE_LN_97X_END)
        {AMD_PCI_VENDOR_ID,      sysLan97xPciInit},
    #endif /* INCLUDE_LN_97X_END */

    #if defined(INCLUDE_EL_3C90X_END)
        {THREECOM_PCI_VENDOR_ID, sysEl3c90xPciInit},
    #endif /* INCLUDE_EL_3C90X_END */

    #if defined(INCLUDE_GEI8254X_END) || defined(INCLUDE_GEI_HEND)
        {INTEL_PCI_VENDOR_ID, sys543PciInit},
    #endif /* INCLUDE_GEI8254X_END */

    #if defined(INCLUDE_FEI_END)
        {INTEL_PCI_VENDOR_ID, sys557PciInit},
    #endif /* INCLUDE_FEI_END */

    {0x1148, sysCcGePciInit},

    {0xffffffff, NULL}        /* last entry */
};
```

Now remake your VxWorks image.
Annexure B

Making Changes to usrNetLib.c for Large UDP Packets

/* OVS: Added these lines to add larger Network Data Pool clusters to the VxWorks image */
/* C²I² Systems: To restore file to original config, simply delete all lines marked "C²I² Systems" */

/* C²I² Systems */  #undef NUM_CL_BLKS
/* C²I² Systems */  #define NUM_CL_BLKS (NUM_64 + NUM_128 + NUM_256 + NUM_512 + NUM_1024 + NUM_2048 + NUM_4096 + NUM_8192 + NUM_16384 + NUM_32768 + NUM_65536)
/* C²I² Systems */  #undef  NUM_64
/* C²I² Systems */  #define NUM_64 100
/* C²I² Systems */  #undef  NUM_128
/* C²I² Systems */  #define NUM_128 100
/* C²I² Systems */  #undef  NUM_256
/* C²I² Systems */  #define NUM_256 40
/* C²I² Systems */  #undef  NUM_512
/* C²I² Systems */  #define NUM_512 40
/* C²I² Systems */  #undef  NUM_1024
/* C²I² Systems */  #define NUM_1024 25
/* C²I² Systems */  #undef  NUM_2048
/* C²I² Systems */  #define NUM_2048 25
/* C²I² Systems */  #define NUM_4096 10
/* C²I² Systems */  #define NUM_8192 10
/* C²I² Systems */  #define NUM_16384 10
/* C²I² Systems */  #define NUM_32768 10
/* C²I² Systems */  #define NUM_65536 10
/* C²I² Systems */  #undef  NUM_NET_MBLKS
/* C²I² Systems */  #define NUM_NET_MBLKS (2* NUM_CL_BLKS)

CL_DESC clDescTbl[] = {
    /*
       clusterSize         num             memArea         memSize
       -----------         ----            -------         -------
    */
    {64,          NUM_64,         NULL,           0},
    {128,         NUM_128,        NULL,           0},
    {256,         NUM_256,        NULL,           0},
    {512,         NUM_512,        NULL,           0},
    {1024,        NUM_1024,       NULL,           0},
    {2048,        NUM_2048,       NULL,           0},
    {4096,        NUM_4096,       NULL,           0},
    {8192,        NUM_8192,       NULL,           0},
    {16384,       NUM_16384,      NULL,           0},
    {32768,       NUM_32768,      NULL,           0},
    {65536,       NUM_65536,      NULL,           0},
};