

# Tips on improving network performance, applicable to Windows 10.

## About:

Poor network performance could cause jittered motion or could lead to halt (stop) while performing the realtime motion function, the following instructions give tips for improving the communication performance to achieve good performance of the realtime motion functionality of the toolbox.

## License:

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## Recommendations for reducing TCP/IP latency: (in progress, more tips will be added)

### Hardware based solutions for reducing the latency:

#### Network architecture:

Try to reduce the traffic between the robot and the PC, it is better to limit the network to only two devices the controlling computer and the robot, use good computer with good Ethernet card and good cables.

#### Keep only one network active

Keep only the network between the robot and the PC connected. Turn off and disconnect all other Ethernet or Wifi connections.

### Software based solutions for reducing the latency, **very important**:

#### Reducing the latency in the communication, 1<sup>st</sup> tip:

Disabling the **nagling** algorithm. On a windows machine open the **cmd** console, then follow the steps:

- Type **regedit** then hit enter.
- Navigate to the path, **HKEY\_LOCAL\_MACHINES\SYSTEM\CurrentControlSet\services\Tcpip\Parameters\interfaces**
- Check the folders underneath the previous path, choose the folder that has the key **IPAddress** compatible with the IP address of your adapter that is connected to the KUKA controller, see Figure 1.

- In the keys dialog-box, right click with your mouse, then choose **New** then click on **DWORD (32 bit) value**.
- Name the new **DWORD (32 bit) value** by **TcpAckFrequency**.
- Change its value to **Hexadecimal**, then enter **1** in the adjacent textbox.
- Create a new **DWORD (32 bit) value**. Name it **TCPNoDelay**, and change its value to **Hexadecimal**, then enter **1** in the adjacent textbox.
- Create a new **DWORD (32 bit) value**. Name it **TcpDelAckTicks**, and change its value to **Hexadecimal**, then enter **0** in the adjacent textbox.

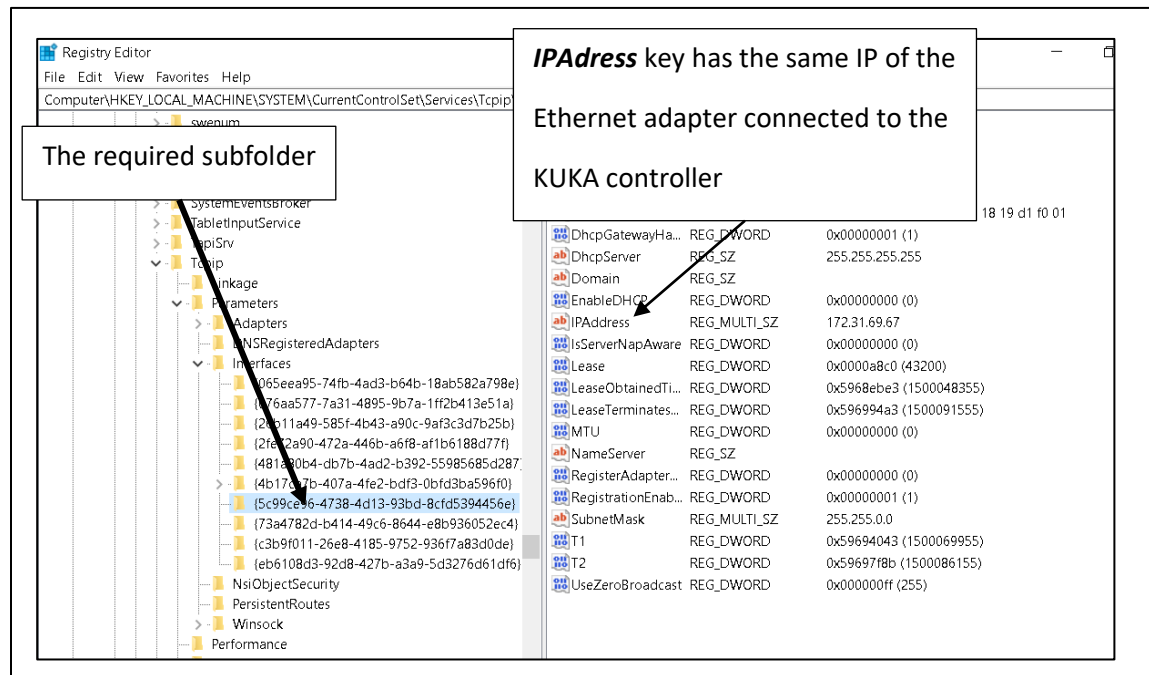


Figure 1 Optimize network performance of Windows 10

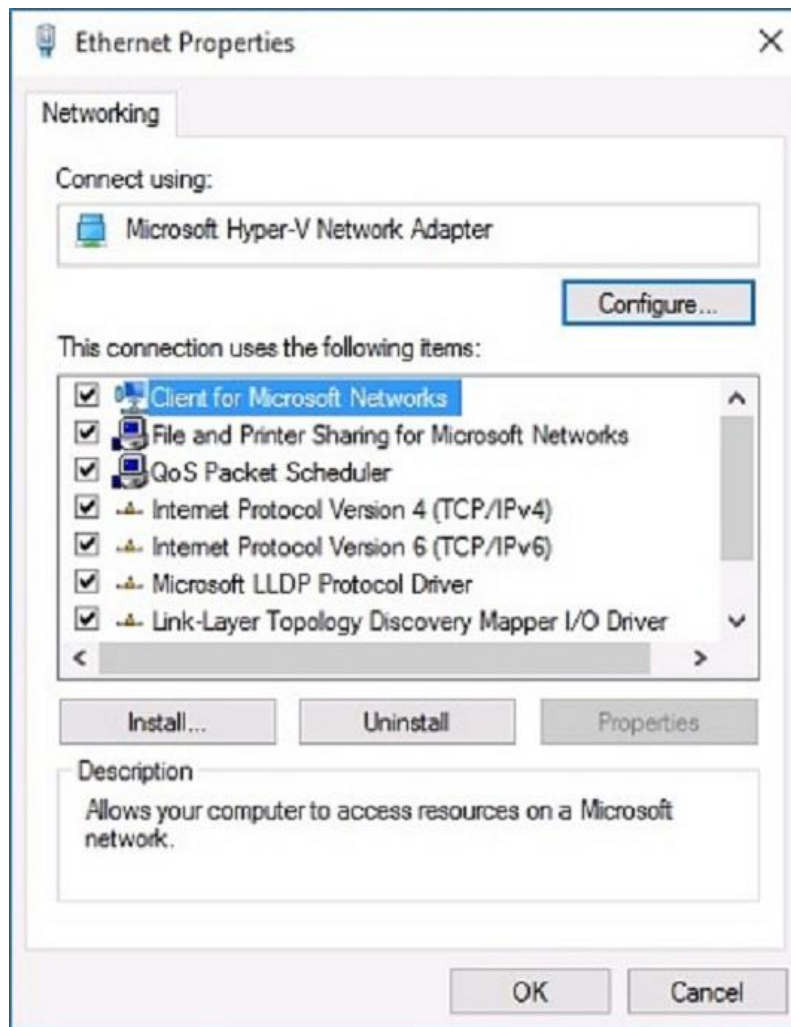
Reducing the latency in the communication, 2<sup>st</sup> tip:

Turn off throttling. For windows machine (Win10), open the **cmd** console, then follow the steps:

- Type **regedit** then hit enter.
- Navigate to the path, **HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Multimedia\SystemProfile**
- If the value **NetworkThrottlingIndex** does not exist. Create it as **DWORD (32 bit) value**.
- Change its value to **ffffff**, or eight **fs**.

Changing Adaptor Settings-very important:

To reduce TCPIP latency, you must change the ethernet adaptor settings, so first go to **Ethernet Settings**, shown in the following figure. Under the dialog box: **This connection uses the following items**, uncheck all the listed items except for **Internet Protocol Version 4 (TCP/IPv4)** which should be kept checked.



Afterwards, click on the button **configure**, then go to **Power Management**, then uncheck the **Allow the computer to turn off this device to save power**.

In the same window, go to **Advanced**, and disable everything with **Checksums, Green, Energy Saving**. Change **WOL & Shutdown Link Speed** to **not speed down**. Put performance to maximum.

Impressive results were achieved during tests conducted using an Ethernet USB adaptor, **TP-LINK 100MBPS**. Where the following values were assigned to the properties in the **Advanced** tab.

Variable	Value
ARP offload	Disable
Flow Control	Disable
IPV4 check sum Offload	Disable
Large Send Offload v2 (IPV4)	Disable
Large Send Offload v2 (IPV6)	Disable
NS Offload	Disable

Variable	Value
Priority & VLAN	Disable
Speed and Duplex	100 Mbps Full Duplex
TCP Checksum Offload (IPv4)	Disable
TCP Checksum Offload (IPv6)	Disable
UDP Checksum Offload (IPv4)	Disable
UDP Checksum Offload (IPv6)	Disable
Wake on link change	Disable
Wake on Magic Packet	Disable
Wake on pattern match	Disable
WOL & Shutdown Link Speed	Not Speed Down

#### Other software related tips:

Fire walls:

Disable all fire walls.

Turn off Cortana:

1- Got to **run**

2- Type, **regedit** then hit enter

3- Go to the key HKEY\_LOCAL\_MACHINE\SOFTWARE\Policies\Microsoft\Windows\Windows Search

4- Create a new DWORD, name it **AllowCortana**, give it a value of zero.

VMware:

When you install Workstation, two virtual **network adapters**, **VMware Network Adapter VMnet1** and **VMware Network Adapter VMnet8**, are added to the configuration of the host operating system. You might want to disable both of these virtual **network adapters** to improve performance on the host system.

Set Matlab's priority to real-time (Thanks to Nathan Geyer):

From **task manager**, go to **Details**, locate **MATLAB.exe**, right click then **Set priority**→**Realtime**. During a test the update rate achieved using MATLAB2018b is 270 when the priority is set to **Realtime**, as opposed to 180 when the priority is set to **Normal**.

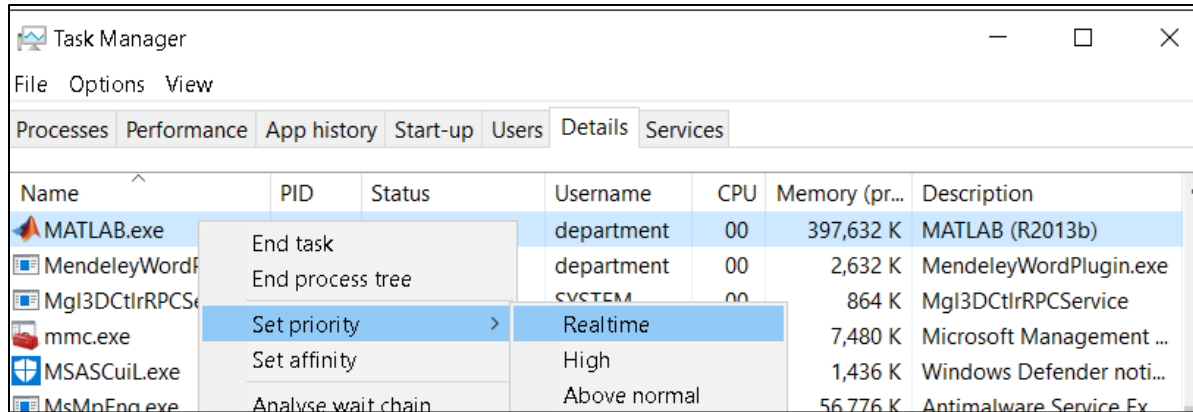


Figure 2 Set MATLAB priority to Realtime

## Recommendations for enhancing the performance of the operating system (windows 10) for use with the KST:

Tips and tricks on how to enhance the performance of windows 10 and configure the PC for realtime control.

### Privacy settings

Go to **settings** → **Privacy**, there you find several entries: **messaging**, **radios**, **feedback** and others. For a computer used for control, you shall disable everything.

### Remove the Apps:

Windows 10 is delivered with lots of Apps by default, those apps have services that run in the background, several of those services utilize the network, to achieve a jitter free motion from the robot it is required to remove those apps, you shall remove those apps from **Add or remove programs**.

### Disable C-States (not tested yet)

Disable C-States from the Bios.

### Power settings-Important:

Go to Control **Panel\Hardware and Sound\Power Options**, then choose **High performance**. By default, the CPU and peripherals performance are adjusted automatically by the system to save power, at times some of the CPU cores are disabled or clock speed is reduced to mitigate power consumption, this could cause sporadic latency, for optimum performance, change the power plan to **High performance**.

### Background apps

Turn off the **Background apps**, as the following: go to **settings** → **Privacy** → **Background apps**, then turn the knob off as shown in Figure 3.

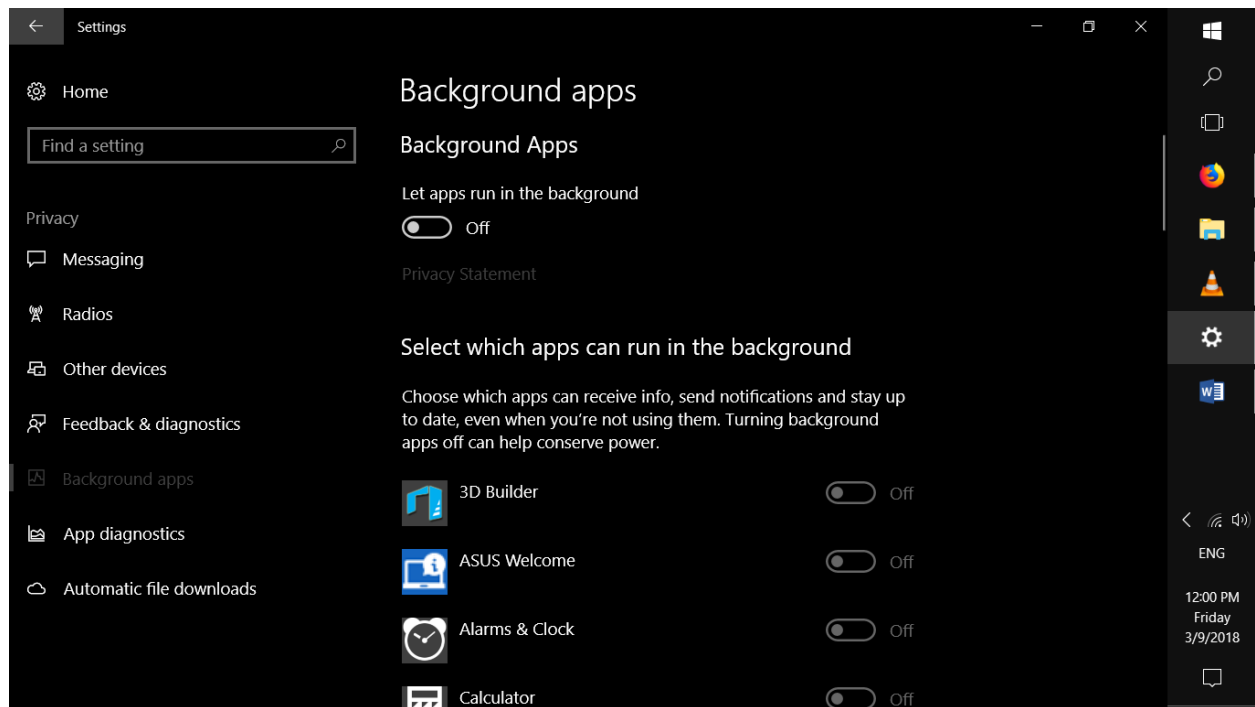


Figure 3 Switch off Background Apps

### Adjust the PC for better performance:

First got to **advanced system settings** as shown in Figure 4, click on **advanced** tap then under **performance** click on **settings** button, from the popup window check the **Adjust for best performance**, then click **Ok**.

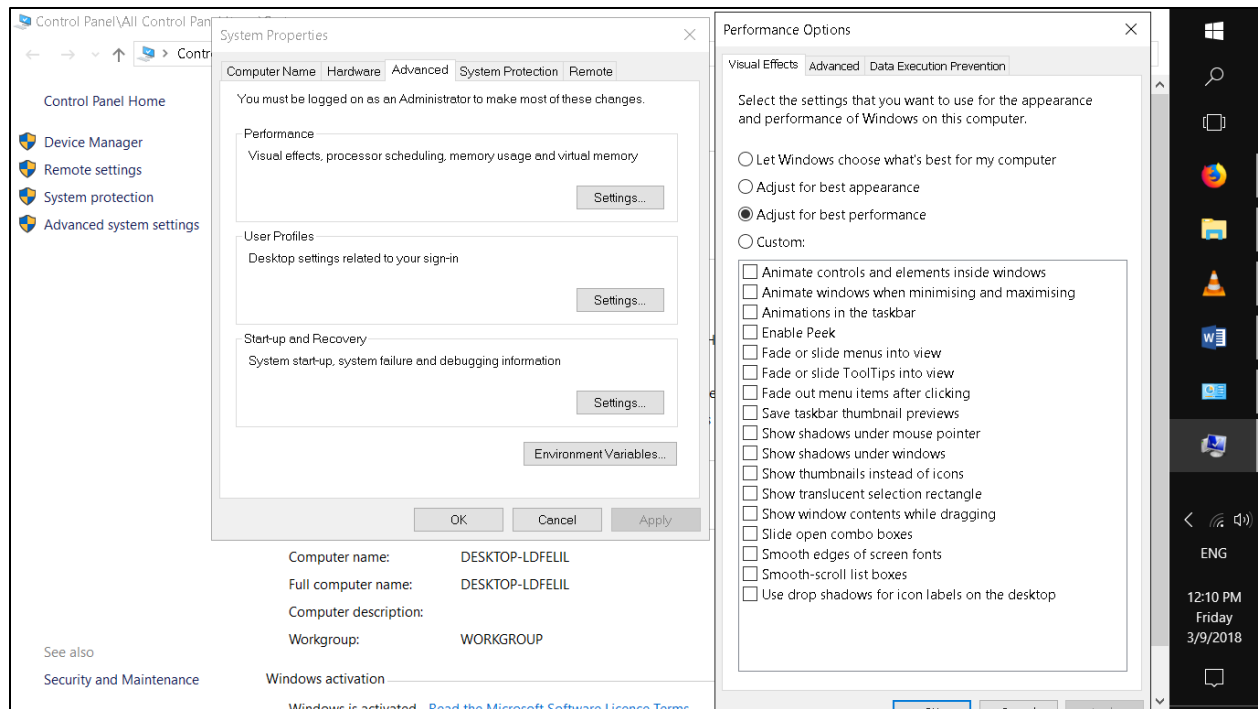


Figure 4 Adjust for best performance

## Disable windows updates.

Disable the automatic updates, do not connect the PC to Internet.

## Turn off services:

Go to search, then type (services)

There you shall **stop**, then **disable** the following services:

- 1- **Print spooler**
- 2- **IP Helper**
- 3- **TCPIP NetBios Helper: Used for file sharing**
- 4- **Diagnostic Policy Service: Used for problem detection**
- 5- **Windows Update: Enables update detection**
- 6- **Adobe acrobat update server**
- 7- **Xbox related services, turned them off all.**
- 8- **Windows search: this service performs indexing of the HDD for fast search of files.**
- 9- **Security Center4Diagnostic Service Host**
- 10- **Windows Time**
- 11- **Credential Manager**
- 12- **Distributed link Tracking Client**
- 13- **Web Account Manager**
- 14- **Themes**
- 15- **Touch Keyboard and Hand writing Panel service**

**16-** Bluetooth Support (if you don't use Bluetooth)

**17-** Remote Registry (it's not usually running by default, but you can disable it for safety)

**18-** Remote Desktop (There are 3 services. If you don't use Remote desktop, disable them)

Others, 2 : Offline Files 3 : Portable Device Enumerator Service 4 : Secondary Logon

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Bold and italic services in the aforementioned list had been tested successfully. Rest had not been tested yet.

You shall also go to ((Narrator)) settings and turn it off.