Application Note DK9322-0413-0070
ADS Mailbox

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# ADS Mailbox Optimization from the PLC

**This application example provides basic knowledge about ADS mailbox optimisation. It describes how to optimise the TwinCAT ADS communication when a huge amount of messages has to be handled. Most users will never reach the ADS Mailbox limit (this is a finite number of mailboxes which are available at the ADS message router); this limit can however be reached when many messages are generated at the same time. A second application example DK9322-0513-0071 refers to a TwinCAT sample and explains further details in programming.**

## Purpose

This document is intended as a guideline for how to manage extremely large amounts of ADS messages. The heart of the TwinCAT system is the ADS message router. It is the „local postoffice" which delivers ADS messages to the appropriate ADS mailboxes. There is only a finite number of mailboxes available. Most users will never approach the ADS Mailbox limit; this limit can however be reached when many messages are generated at the same time. There are three tyical scenarios:

1 Relatively few devices (< 50) sending multiple messages to each device.
2 Many devices( > 50) sending individual messages.
3 A combination of 1 and 2: With many devices sending out multiple messages per device, the chances are high that the limit is hit, if the communication is not optimised.

The ADS router is the message handler for the communication between different processes within the TwinCAT Real Time environment and also from the inside to the outside world (e.g. HMI, SCADA). The ADS router is extremely powerful, and with a little bit of management, a mere 20 mailboxes – if used effectively – are able to transmit up to 1,000 messages per second at the default 10 ms PLC cycle time, in other words, to handle a huge traffic volume. Here, the size of an ADS message is generally

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unimportant; it's the number of messages that matters. This document does not cover all cases, for any questions about a specific application, please contact your local Beckhoff Office.

### What kind of messages are ADS messages?

Generally speaking, whenever a function block must communicate with an external service (NC-server, TCP/IP-server, CoE-parameter, SoE-parameter) without using %I and %Q variables, this is done via an ADS Message. All move commands and all parameterisation commands are ADS messages.

### Which resources are available?

For every user, there is only a finite number of mailboxes available. The number varies depending on what other ADS services are installed and running, but generally about 50 mailboxes are available to the user. If a mailbox is not available when an ADS command is issued from the PLC, the block will return ADS Error Code 4 (Insert Mailbox Error). Since there is a finite number of mailboxes, it follows that only a finite number of ADS messages can be issued per PLC cycle.

### How to avoid mailbox overflow

First determine which messages are urgent and important and which messages are configuration type messages. Most users that reach the mailbox limit do so when configuring devices at startup by simply sending all parameters to every device in the same PLC cycle. WARNING: Do not take the lazy approach and simply keep retrying to send a message until a mailbox is free. The ADS router does not prioritise "unimportant" (configuration messages) vs "important" (move/stop) ADS messages. Many users only find out that they have filled up all available mailboxes to overflow when an "important" time-critical message such as „move" (or worse yet „stop") command did not get processed when it should have, because the router was full of "unimportant" (configuration) messages.

### How to optimise

– Plan to not use more than 20 mailboxes per cycle for configuration/initialisation data.
– Issue messages only when necessary (parameterisation data that is loaded once at startup and then after any changes, does not need to be "reloaded" for every PLC cycle).
– Issue messages to devices in a sequential manner.
– Use SumUpRead/SumUpWrite methods to pack many messages into a single request when possible.

A number of 20 mailboxes is actually sufficient, since with a 10 ms PLC cycle time and 20 mailboxes, 1000 messages per second can be issued. (With a 2 ms cycle time, even 5000 messages per second could be issued with 20 mailboxes). If a device must receive several messages, issue the messages such a way that each device utilises only one mailbox at a time. Then, if need be, the devices can be addressed sequentially or in groups or all at once. Some ADS Devices such as the NC process

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support SumUpRead and SumUpWrite commands and in this way, up to 500 ADS Reads and/or Writes can be performed in a single message. The size of the message is generally unimportant, it's the number of messages that is important. This is a very efficient way to reduce the high number of messages required particularly for configuration at startup.

### Timer based transmission, simple now, causing errors later

Using timers to determine when the next ADS messages can be sent often seems to be the simplest way to do things at first, but can be fraught with hard-to-find errors later on. For example, when a message on a test stand requires 5 PLC cycles for transmission using TCP/IP over 100BASE-TX: Setting a 50 ms timer to start the next transmission can cause problems. The first message will take longer as it will have to wait while the TCP/IP socket is opened (up to 10 seconds). Should the PLC cycle time ever be changed, the time set may not be long enough. Perhaps the media is changed from 100BASE-TX to WiFi. The timer setting may not account for that, or may leave a lot of dead time where the messaging takes longer than it should, or else, all the timers line up and fire at the same time. Moreover, the times are usually hardcoded requiring the programmer to re-code to solve a problem that should never have happened in the first place. Since ADS is a confirmed service, it is known exactly when a function is completed successfully or failed (with an error code). And thus, knowing the time when the previous messages are completed, the next messages can be sent. This methodology will result in the best possible efficiency by using the fewest number of mailboxes and keeping them fully utilised. Using timers to determine when something is completed is a poor programming practice and should never be used unless there is absolutely no other choice and no way to know at what time something will be completed.

### Why can't I know how many mailboxes are available?

First off, to ask the router how many mailboxes are full requires a mailbox. Secondly, this data would only tell you how many mailboxes were full during the last cycle and not how many will be emptied out by the user's PLC program at the start of this cycle. In most cases a mailbox is full for a single PLC cycle only, thus, while theoretically possible to provide this data, by the time the PLC receives the data, the data is invalid.

### ADS Router vs. I/O server

The ADS router handles the messages for the communication between different processes within the TwinCAT Real Time environment and to the outside world (User mode). The ADS message router is intended for infrequent (read as: not cyclic) data transfer between processes and to the outside world (HMI/Scada). For frequent (read as: cyclic) data transfer TwinCAT also contains an I/O server: It is inteded for cyclic data transfer as this server and the data communication is completely separate from the ADS communication. For example, if data has to be read or written every 100 ms or faster, the I/O server has been created to handle this. It may be true that the ADS server is able to handle a limited amount of cyclic communication, too, but keep in mind that it is not intended to do so and that there are limits for what it is capable of. If cyclic updates are required, an alternative communication method to ADS utilising the I/O server should be found. There are generally two, if not more,

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methods for the communication between any given device and TwinCAT. If there is no other choice but to use the ADS router as an I/O server and to manage the mailbox use, be sure to do so carefully.

– PLC and Motion Control on the PC

**www.beckhoff.com/TwinCAT**

– Download the TwinCAT sample

**http://download.beckhoff.com/download/document/Application_Notes/DK9322-0413-0070_TwinCAT_Sample.zip**

– ADS device documentation

**http://infosys.beckhoff.com/content/1033/tcadsdevicesoverview/html/tcadsdevices_intro.htm**

– ADS function blocks

**http://infosys.beckhoff.com/content/1033/tcplclibsystem/html/tcplclibsys_intro.htm**

– If availvable, find related application example DK9322-0513-0071 at

**www.beckhoff.com/applicationexamples/**