

APC (Asynchronous Procedure Call) in Windows

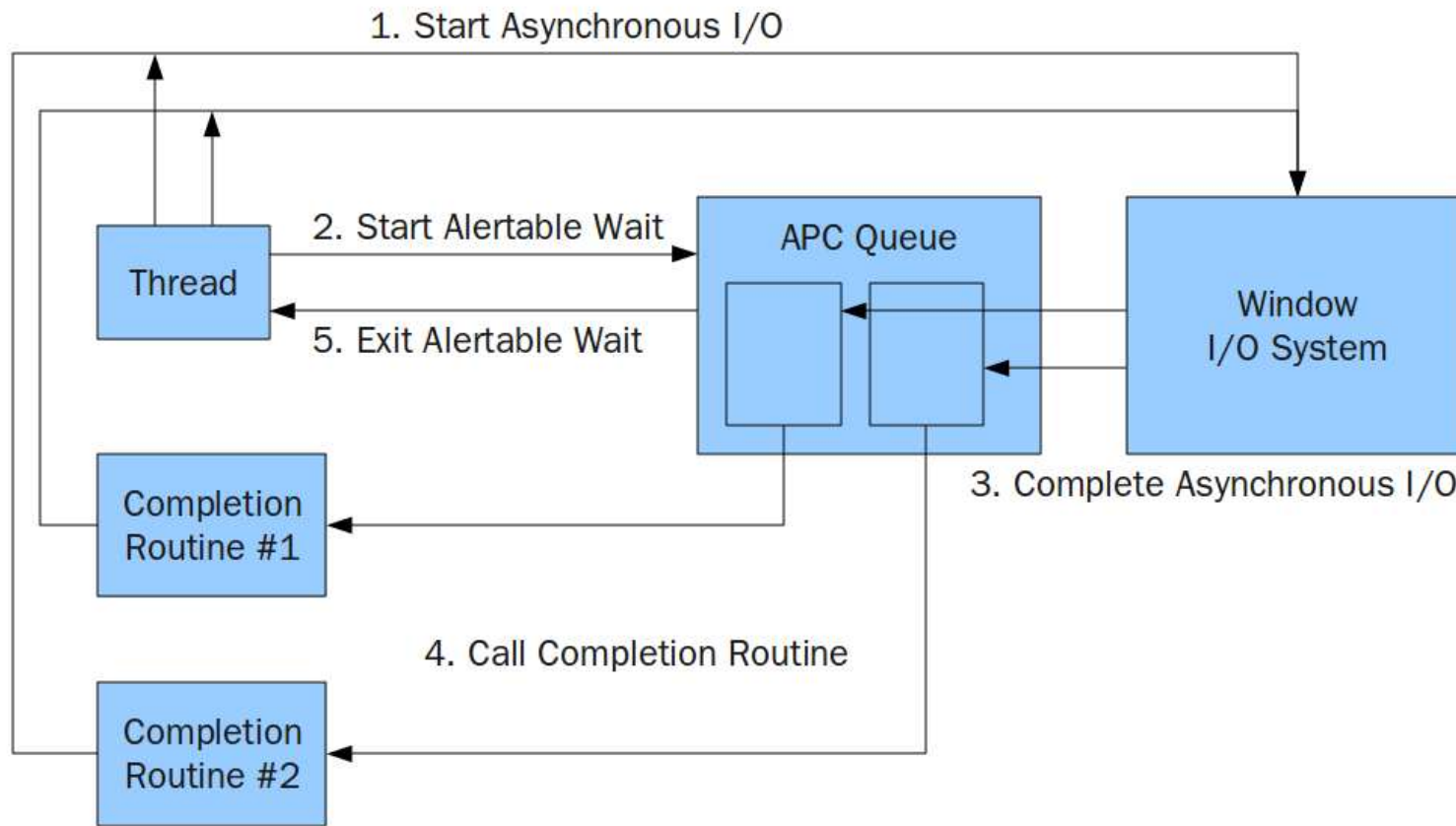
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Agenda

- APC and SPC
- Functional signature of APC
- QueueUserAPC()
- Alertable state
- SleepEx() (and WaitFor...Ex())

Completion Port Based Overlapped Model





APC and SPC

- **Asynchronous Procedure Call (APC)**
 - Like Trigger in database, the OS waits for a certain event (usually I/O event) to occur, and then call a related procedure.
 - That kind of procedure is called “completion routine”.
- **Synchronous Procedure Call (SPC)**
 - Usual functions we use.



Functional signature of APC

- APC functions are called by OS when a certain event occurs.
- So the functions are in a specific form, so that the OS can easily call them.

```
VOID CALLBACK APCProc(ULONG_PTR  
dwParam);
```

QueueUserAPC()

- A user can append their APC procedure to OS's APC Queue.

```
DWORD QueueUserAPC(  
    PAPCFUNC pfnAPC,  
    HANDLE hThread,  
    ULONG_PTR dwData  
);
```

- PAPCFUNC pfnAPC – function pointer of APC procedure
- HANDLE hThread – thread that invoke APC procedure
- ULONG_PTR dwData – parameters of APC procedure

Alertable state

- A thread can be in wait, ready, and running state.
 - Usually, the OS can change the thread's state.
 - The user cannot change the thread's state.
 - Ex) A thread wait for a certain event. When the event occurs, the OS will change the state to ready. And when CPU quantum is given to the thread, the thread will be in running state.
- One more possible state is alertable state.
 - The only state that a user can set with `SleepEx()` and `WaitFor...Ex()`.

SleepEx() (and WaitFor...Ex())

- A user can set the thread's state to alertable by the following functions
 - SleepEx()
 - WaitForSingleObjectEx()
 - WaitForMultipleObjectsEx()
 - MsgWaitForMultipleObjectsEx()
 - WSAWaitForMultipleEvents()
 - SingleObjectAndWait()

```
DWORD SleepEx(  
    DWORD dwMilliseconds,  
    BOOL bAlertable  
);
```