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Filename:

 sosisampleclock.h

Group Name:

 Sample Clock Interface

Group Overview:

A "Sample Clock" provides a mechanism for synchronizing two streams of multimedia.

Each stream is characterized by a frequency and divisor to get the result in samples per millisecond. For instance a 44100Hz audio stream has a frequency of 44100Hz and a divisor of 1000 ($44100 / 1000 = 4.41$ samples per millisecond). A 25 frame-per-second video stream has a frequency of 25/1000 frames per millisecond.

A sample clock contains the frequency and divisor for the stream, plus an instantaneous position mark, consisting of a wall-clock time (in milliseconds) and a sample position (in samples).

Given this set of values we can project back to get the time at which sample 0 would have been played - the "epoch" for this stream.

By comparing two epochs, we can determine the time shift required to bring them into synchronization.

The epoch for a given stream may drift with time for several reasons; audio hardware playout rates do not always exactly match the system clock; in some cases the drift varies depending on the level of interrupt activity on the system. If a stream is paused due to system contention or user intervention the epoch will change.

Typically one clock is identified as the master clock, and all other clocks attempt to match the master. For instance

when playing audio and video, the audio clock is typically the master clock (because audio playout rate is usually regulated by an external DSP clock, and users are more perceptive to changes in audio delivery rate).

Periodically the playout position for the audio stream is copied into the master sample clock. The video stream then uses the difference between it's own sample clock and the audio-derived master clock to determine the frame delivery time for each frame.

Overflow errors must be considered when dealing with samples. A 32-bit millisecond counter will wrap after 2^{32} milliseconds which is approximately 50 days. A 32-bit sample counter at 44100Hz will wrap around in $2^{32}/44100$ seconds which is approximately 27 hours. If any addition or multiplication is performed on sample values, overflow errors may occur much earlier.

Owner:

Guy Carpenter (guyc) 21-Aug-2001

```
-----*/
/* cvsid: $Id: sosisampleclock.h,v 1.5 2001/09/13 20:50:24 guyc
Exp $ */

#ifndef _SOSISAMPLECLOCK_H_
#define _SOSISAMPLECLOCK_H_

#include <sosstrings.h>

/*++
Macro Description:
    Defines the global identifier for the SampleClock interface.
--*/

#define SOS_ISAMPLECLOCK_ID "sampleclock"

typedef struct _SOS_ISAMPLECLOCK SOS_ISAMPLECLOCK;

/*++
Prototype Name:
```

SOS_ISAMPLECLOCK_FREQUENCYSET

Prototype Description:

Set the sample frequency of the sample clock. The frequency is expressed as a ratio of two 32-bit unsigned integers.

Parameters:

SOS_ISAMPLECLOCK * Interface - [in]
 Interface to object.

SOS_UINT32 Frequency - [in]
 Frequency numerator.

SOS_UINT32 Divisor - [in]
 Frequency divisor. May NOT be zero.

Return Value:

SOS_STATUS -
 SOS_Success for successful completion.

 SOS_ErrorParameter if interface is invalid or the divisor is zero.

```
--*/  
typedef  
SOS_STATUS  
(*SOS_ISAMPLECLOCK_FREQUENCYSET) (  
    SOS_ISAMPLECLOCK *            Interface,  
    SOS_UINT32                    Frequency,  
    SOS_UINT32                    Divisor  
);
```

```
/*++
```

Prototype Name:

SOS_ISAMPLECLOCK_FREQUENCYGET

Prototype Description:

Returns the current frequency ratio. If no call has been made to FrequencySet for this object, the values will be zero.

Note that the sampleclock implementation may return different values for Frequency and Divisor than those originally set - the ratio should remain the same.

Parameters:

```

SOS_ISAMPLECLOCK *          Interface - [in]
    Interface to object to be queried.

SOS_UINT32 *                Frequency - [out]
    If not null, current frequency numerator will be
    stored at Frequency.

SOS_UINT32 *                Divisor   - [out]
    If not null, current frequency divisor will be
    stored at Divisor.

```

Return Value:

```

SOS_STATUS -
    SOS_Success for successful completion.

    SOS_ErrorParameter if the interface is invalid.

```

```

--*/
typedef
SOS_STATUS
(*SOS_ISAMPLECLOCK_FREQUENCYGET) (
    SOS_ISAMPLECLOCK *          Interface,
    SOS_UINT32 *                Frequency,
    SOS_UINT32 *                Divisor
);

```

/*++
Prototype Name:

```

    SOS_ISAMPLECLOCK_UPDATE

```

Prototype Description:

Updates the sample position for this clock. The stream position is expressed in the units defined by the call to FrequencySet - typically samples for audio, or frames for video.

Parameters:

```

SOS_ISAMPLECLOCK *          Interface - [in]
    Interface to object being updated.

SOS_CLOCK_TICK              Time      - [in]
    Clock time at which this sample was/will be delivered.

SOS_UINT32                  Sample   - [in]
    Stream position.

```

Return Value:

```

SOS_STATUS -
    SOS_Success for successful completion.

    SOS_ErrorParameter if interfaces is not valid.

--*/
typedef
SOS_STATUS
(*SOS_ISAMPLECLOCK_UPDATE) (
    SOS_ISAMPLECLOCK *      Interface,
    SOS_CLOCK_TICK          Time,
    SOS_UINT32              Sample
);

/*++
Prototype Name:

    SOS_ISAMPLECLOCK_EPOCHGET

Prototype Description:

    Gets the nominal epoch (or stream-start time) for this
    clock. The epoch is the time at which frame zero would
    have been delivered, computed from the last update
    time and frequency settings. This value does not reflect
    the time frame/sample 0 was actually delivered, but rather
    the projected time based on the current frame position.

Parameters:

    SOS_ISAMPLECLOCK *      Interface - [in]
        Interface to clock object.

    SOS_CLOCK_TICK *       Epoch - [out]
        Location to store the computed epoch.

Return Value:

    SOS_STATUS -
        SOS_Success for successful completion.

        SOS_ErrorParameter if the interface is invalid,
        or if Epoch is NULL, or if the frequency has not
        been set.

--*/
typedef
SOS_STATUS
(*SOS_ISAMPLECLOCK_EPOCHGET) (
    SOS_ISAMPLECLOCK *      Interface,
    SOS_CLOCK_TICK *       Epoch

```

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