Camera to NVR Ratio for Recording

General Information

An important part in any system design is specifying the correct number of NVRs to support the required number of cameras. Optimizing the use of a system's NVRs will not only save money but will also ensure proper operation of the system and protect the recorded data.

Factors in NVR calculations

When calculating the number of cameras that can be recorded by a single NVR, a few factors must be considered:

1. **Video resolution** – the higher the recorded resolution, the lower the total number of cameras the NVR can support. This factor has become increasingly relevant as megapixel cameras have become commonplace.
2. **Frame rate** – the higher the recorded fps is, the lower the total number of cameras the NVR will support.
3. **Target hard drive** – An NVR writing to a RAID unit (internal or external) will support more cameras than one writing to a direct internal drive.
4. **Video compression** – Cameras that offer MJEPG based compression require much higher bandwidth than those that use MPEG or H.264 based compression and, as a result, put more demand on the NVR.
5. **Scene activity** – Scene-by-scene, the amount of motion the camera is recording, will impact the overall bandwidth and frame sizes, and will influence the NVR's recording

Combined, these factors create an ever-changing stream of data from a system's many cameras into the NVR and from it to the hard drives. In addition, the NVR and drives are also required to quickly read the data back, sending it to anyone requesting video playback. As a result a safety margin must be built into the NVRs maximum capabilities, allowing for higher than anticipated demands and ensuring reliable, continuous operation under a wide range of sometimes unpredictable circumstances.

NVR Hardware Requirements

ViconNet software has been designed to make extremely efficient use of the NVR's resources. As result, the hardware requirements for the NVRs running ViconNet are very low compared to NVRs running other

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industry-standard VMS software. This translates to a cost savings for Vicon customers, both in the purchase of initial NVRs as well as when additional units may be required as part of a system expansion.

 While customers may consider purchasing NVR hardware that exceeds the performance requirements of ViconNet specifications, it might not be a valuable investment. The average cost savings for each additional camera that might be added to a more powerful NVR (fairly low addition) would most likely exceed the additional cost of purchasing this NVR.

Design Assumptions:

- The camera counts are for an NVR dedicated to recording!
  The NVR is not configured as the system Nucleus and is not running any local video display.
- The scene activity used for these estimates is a typical mall or hotel lobby type activity (~50% motion)
- The compression method these estimates are based on is MPEG-4 / H.264, if JPEG is used, the numbers will be up to 25% lower than the ones currently listed
- When connected to an external RAID (typically via iSCSI SAN), the maximum number of NVRs or DVRs sharing a single RAID is 4
- The numbers listed for RAID drives cover both internal RAID (such as Shadow NVR) and external ones such as DAS or SAN
- The maximum number of cameras allowed on a single NVR is 120 regardless of their resolution and FPS. This is a design limit meant to protect from overloading the NVR.

If your system is significantly different in its characteristics than the assumptions above, please be sure to make adjustment to you calculations.
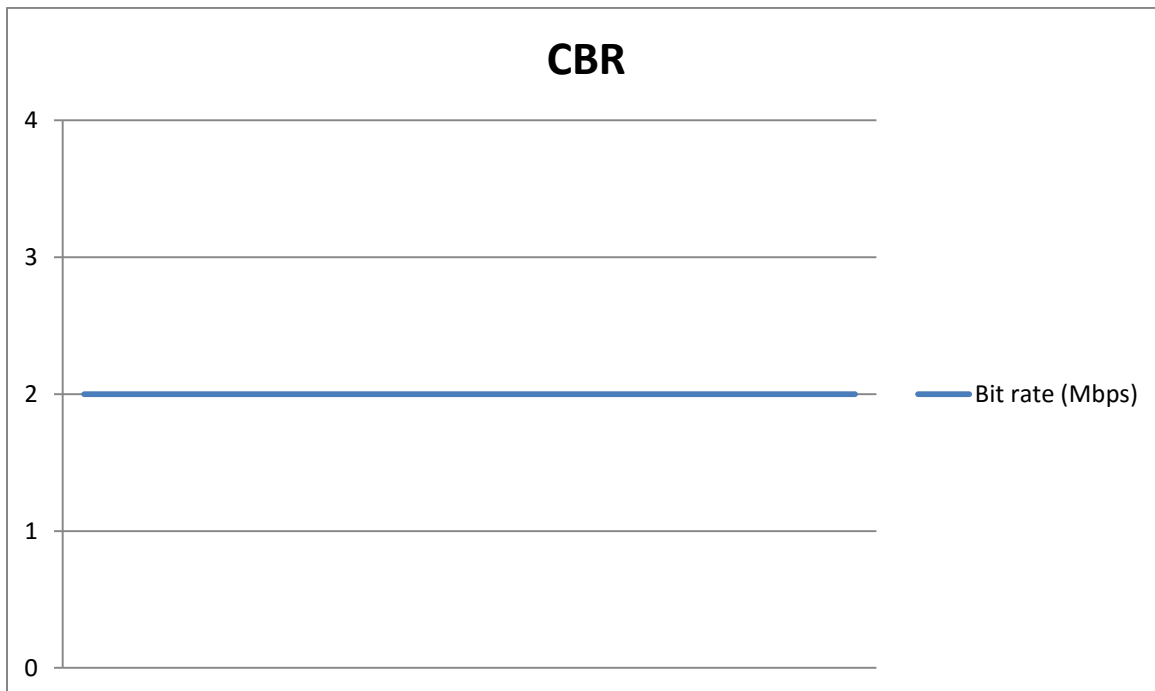
Constant Bit Rate vs. Variable Bit Rate:

The typical IP cameras (and encoders) today offer a selection between using VBR and CBR as the method to control the stream of data from the camera. The advantage in using **CBR** is the known bandwidth at all-time which allows a simple calculation of the storage and takes away the dependency on the motion but might lower the picture quality at times when the motion is very high. On the other hand **VBR** which allows the bandwidth to adjust according to motion does not sacrifice quality but will require more storage at times when the motion is very high.
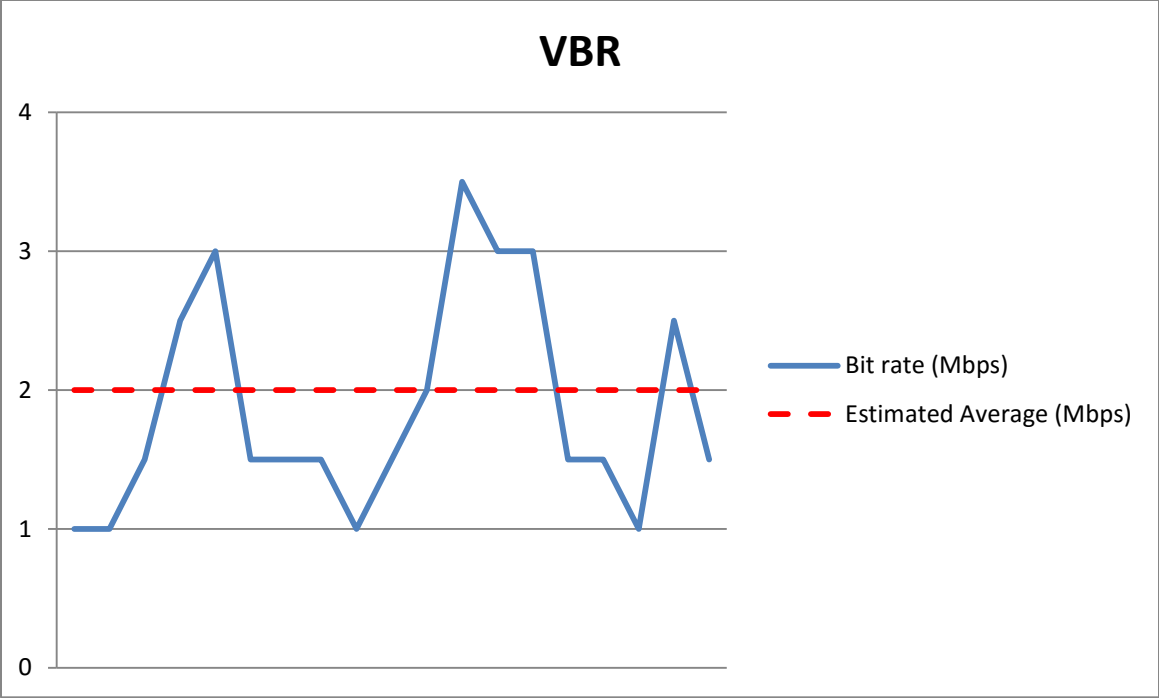
This table shows typically recommended bandwidth settings for **CBR** at different resolutions and fps:

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Resolution	5 FPS	10 FPS	15 FPS	30 FPS
CIF – (320x240)	128	256	384	750
4CIF/D1 (640x40 / 720x480)	384	500	750	1500
800 x 600	750	1250	1750	3000
1280 x 720	1000	1500	2000	3500
1280 x 1024	1000	1500	2000	3500
1920 x 1080	1250	1500	2500	4000
1600 x 1200	1250	1600	2500	4000
2048 x 1536	1500	1750	2750	4500
2288 x 1712	1750	2000	3000	5000
2600 x 1950	2000	2250	3500	6000
3820 x 2160	2500	2750	4500	8000
4000 x 3000	2750	3250	6000	12000

CBR and VBR graphs:

These graphs demonstrate the typical behavior of bandwidth when using CBR vs. VBR where CBR is a known constant bandwidth while VBR changes with motion but creates a certain average that can be estimated for storage purposes.

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VBR

All the numbers in the tables below are based on the assumption **VBR** is used and the scene activity across cameras averages out and does not create an overly loaded scenario – or - that **CBR** is used according to the recommended values shown in the table on page 2.

When recording an unusually active scene such as a casino or moving water, or when using a much higher CBR value than the one recommended, the actual camera counts will be lower due to the additional bandwidth and processing involved.

ViconNet devices including:

Kollector DVRs, SVFT, V910IP, V910PoE, VN-855, VN-856, VN301T, KTX-4

Resolution / ViconNet Quality	Recording at 25 /30 fps		Recording at 12 /15 fps		Recording at 7 fps	
	Max cameras Internal Drive	Max Cameras RAID drive	Max cameras Internal Drive	Max Cameras RAID drive	Max cameras Internal Drive	Max Cameras RAID drive
720x480 / Q1	35	50	40	55	50	70
720x480 / Q2	36	50	41	60	55	75
720x240 / Q3	37	50	42	63	60	80
720x240 / Q4	38	50	43	65	65	85
360x240 / Q5	39	50	44	75	65	90
360x240 / Q6	40	50	45	80	70	95
360x120 / Q7	41	50	46	85	72	95
360x120 / Q8	42	50	48	90	75	95

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Vicon H.264 cameras and encoders including:

IQEye cameras, HD-PTZ, H.264-ecoders, 264, V9xx series cameras, Express devices

3rd party cameras:

See web site for latest list of supported 3rd party cameras and models

Note: the maximum recommended number of cameras (any resolution / FPS) on a single NVR is **120**.

Resolution / Quality	Recording at 25 /30 fps		Recording at 12 /15 fps		Recording at 7 fps	
	Max cameras Internal Drive	**Max Cameras RAID drive**	**Max cameras Internal Drive**	**Max Cameras RAID drive**	**Max cameras Internal Drive**	**Max Cameras RAID drive**
320x240 / CIF	65	120	75	120	85	120
640x480 / 4CIF	65	120	85	120	95	120
702x480 / D1	65	120	85	120	95	120
800x600 / 0.5MP	62	115	75	120	85	120
1280x720 / 1MP	60	110	65	120	75	120
1280x1024 / 1.3MP	55	100	70	120	80	120
1920x1080 / 2MP	35	80	65	120	75	120
1600x1200 / 2MP	35	80	65	120	75	120
2048x1536 / 3MP	30	60	45	90	55	105
2288x1712 / 4MP	27	54	40	81	50	97
2600x1950 / 5MP	22	45	30	67	40	81
3840x2160 / 8MP	20	30	25	45	35	54
4000x3000 / 12MP	N.A.	N.A	8	15	14	18

Note!

When using Vicon's storage calculator, the numbers in the calculation might vary slightly from the numbers in the table.

On Kollector Hybrid DVR the maximum number of IP cameras in addition to the 16 local ones is 8 up to 5MP cameras and 4 for the 8MP and 12MP cameras.

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Calculation tips:

- When using cameras with multiple lenses such as Arecont's panoramic camera, count each view as a camera by itself. For example an Arecont 360 degree camera with 20MP total will be calculated as 4 x 5MP cameras for the NVR design.
- If microphones are being used, consider each microphone as 2 cameras! Audio is a constant stream and is much more sensitive to packet loss than video.
- Using Vicon's storage calculator will not only provide you with a storage estimate, it will also calculate the recommended number of NVRs with – or - without RAID.
- The storage calculator is designed to provide a safe estimate you can submit with your quotes, it is built with extra safety margins. The FPS factor in the calculator is intentionally ignored to ensure in filed changes have some buffer accounted for.
- Sometimes, using CBR will be a better choice, mainly on systems where the normal scene activity is not high and you want to ensure the video stream from the camera is always the same.
- When recording an unusually active scene such as a casino or moving water, or when using a much higher CBR value than the one recommended, the actual camera counts will be lower due to the additional bandwidth and processing involved.
- If there is a doubt regarding the parameters used on a specific design, consult Vicon's sales team to ensure your storage estimates are right.

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