Loudspeaker system Design Arguments

Introduction

During the long, long time I designed loudspeaker systems, I saw other designers making a lot of wrong decisions or at least taking impractical choices. To avoid reinventing the wheel again, I will present some arguments for you.
It is impractical for DIY-ers to plan home brew loudspeaker drivers in your system. Depending on your experience some modifications could be instituted. The drivers used should be available and affordable. A marvelous sounding speaker system will not be imperatively expensive.

Consideration 1
Listening to ESLs (Electro Static Loudspeakers) and small 5" speakers in small radios, human voices attract attention. They sound smooth and very intelligible and if in a two-speaker stereo system the phantom image is well discernable. This is also valid for music instruments as a violin or a trumpet. It turns out that a cross over should not be chosen within the frequency range of, say, 400 Hz up to 8 kHz, so a midrange speaker of up to 2 ÷ 3 kHz combined with a tweeter from 2 ÷ 3 kHz to 20 kHz is undesirable even if they have been built coaxial. The radiation diagram and/or the spot of the sources are different which makes the sound not genuine.

Consideration 2
The size of the systems should be restricted to, say, 30 x 35 x 120 cm. Often boxes which could be overlooked, sitting in the comfortable chair, seem to sound more spatial than taller boxes. This is a psychological effect, so restrict the height of the system if possible.

Consideration 3
The lowest reproduced frequency must not necessarily be 20 Hz. In case windows and furniture will rattle whereas the sound will hardly be swayed if the lower limit is fixed to 40 or even 50 Hz. Moreover the swing of the woofer-cone will be the half which will produce less distortion. With two 8'' woofers per channel a sound pressure of 100 dB_{SPL} could be reached.
40 Hz with an 8" speaker in a small box of about 15 litre dictates special solutions as bass reflex, Ridtahler or MFB (Motional Feed Back).

Consideration 4
The highest reproduced frequency not necessarily must be 20 kHz at -3 dB. A rather smooth response between 200 Hz and 10 kHz is much more important.

Consequences

At least for the mid range a wide band speaker should be used. Perhaps a speaker from roughly 500 Hz to 20 kHz could be a good choice but for a reasonable radiation pattern of a piston loudspeaker it should be small (< 3'') not able to handle much power. In case such speakers should be put in an array which is not simple. See: 'High End Cardioid Loudspeaker Array' and 'High End Circular Cardioid Loudspeaker Array' on this site.
A good solution is a Bending Wave Radiator like the BMR (Bending Mode Radiator) from the last decade. See: 'The BMR: Balanced Mode Radiator' on this site. They operate as a point source from 250 Hz to 20 kHz and are able to handle 20 watt. See: '2 BMRs in een Baffle' (in Dutch) which offers a very nice solution!

For the low frequencies are at least three solutions: a bass reflex box, a Ripole from Ridtahler or MFB (Motional FeedBack). A closed box becomes too large if some power is wanted.
Bass reflex produces no good-sounding bass for a high end application. A Ripole has a small bandwidth (up to 150 Hz) so that the mid range/wide band speaker should have a low resonance frequency to match with it. Moreover it has a low efficiency (70 dB@1m,1w).
MFB stays over indeed. It can be obtained from second hand MFB-boxes from Philips as the RH 544.

Conclusion

For a high end not too expensive loudspeaker system one is dependent on BMRs in combination with MFB.