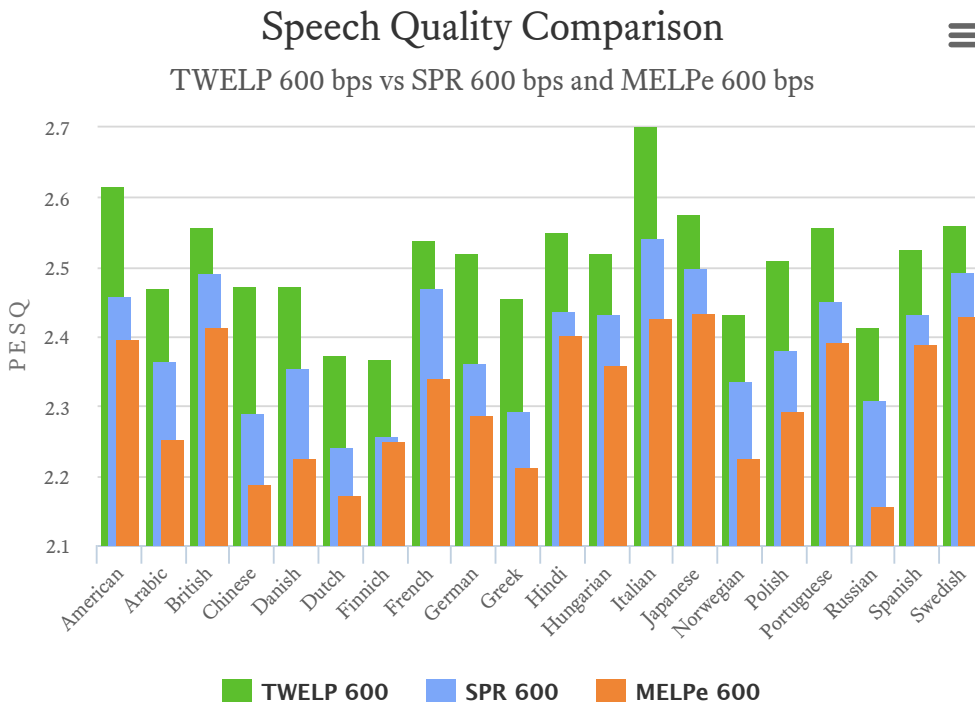


# MELPe 600 bps Vocoder

STANAG 4591 standard 600 bps vocoder.

**MELPe Technology Features.** The MELPe 600 bps Vocoder is based on well-known mixed MBE + LPC technology, where excitation function of the LPC-filter is a frequency-depending mixture of the pitch harmonics with noise, formed like in MBE vocoders.

**Speech Quality.** Here is a comparison with more modern SPR 600 bps and TWELP 600 bps vocoders in noiseless channel. MELPe 600 bps vocoder, SPR 600 bps vocoder and TWELP 600 bps vocoder were tested, using ITU-T P.50 speech base for 20 different languages. ITU-T P.862 utility was used for estimation of the speech quality in PESQ terms:



A diagram demonstrates superiority of the SPR 600 bps over MELPe 600 bps in speech quality in clear channel. TWELP 600 bps vocoder provides the best speech quality, but consumes much more (~3 times more) computing resources and memory in comparison with SPR 600 bps vocoder. Exact numbers of the speech quality are presented in the table below.

Language	TWELP 600	SPR 600	MELPe 600
American	2.617	2.460	2.397
Arabic	2.470	2.366	2.254
British	2.559	2.491	2.414

Chinese	2.471	2.289	2.189
Danish	2.471	2.354	2.227
Dutch	2.374	2.241	2.173
Finnich	2.367	2.257	2.249
French	2.539	2.470	2.34
German	2.521	2.362	2.287
Greek	2.457	2.294	2.212
Hindi	2.549	2.437	2.403
Hungarian	2.520	2.431	2.359
Italian	2.705	2.543	2.428
Japanese	2.576	2.499	2.436
Norwegian	2.433	2.335	2.225
Polish	2.511	2.382	2.294
Portuguese	2.558	2.451	2.393
Russian	2.414	2.310	2.156
Spanish	2.525	2.431	2.389
Swedish	2.562	2.495	2.43
<b>Average</b>	<b>2.50995</b>	<b>2.3949</b>	<b>2.31275</b>

**Superiority of the SPR 600 bps and TWELP 600 bps vocoders over MELPe 600 bps vocoder is on average 0.082 and 0.1144 PESQ appropriately**

**Speech Samples (WAV-files).** A few independent experts listened MELPe 600 bps vocoder in comparison with SPR 600 bps vocoder and TWELP 600 bps vocoder, using method of preferences. Majority of experts preferred SPR to MELPe and TWELP to SPR, having noted much better intellegibility of speech in SPR in comparison with MELPe and much more natural human-sounding of voice in the TWELP vocoder.

You can play and listen short samples of the source speech as well as the speech processed by these vocoders for any of 20 languages, using links in the table below.

Also, you can download full set of the P.50 samples as zip-files for all languages simultaneously, using the links in the "Downloads" para in a bottom of the page.

Language	Source speech	MELPe 600 bps	SPR 600 bps	TWELP 600 bps
American	▶	▶	▶	▶
Arabic	▶	▶	▶	▶
British	▶	▶	▶	▶
Chinese	▶	▶	▶	▶
Danish	▶	▶	▶	▶
Dutch	▶	▶	▶	▶
Finnich	▶	▶	▶	▶
French	▶	▶	▶	▶
German	▶	▶	▶	▶
Greek	▶	▶	▶	▶

Hindi	▶	▶	▶	▶
Hungarian	▶	▶	▶	▶
Italian	▶	▶	▶	▶
Japanese	▶	▶	▶	▶
Norwegian	▶	▶	▶	▶
Polish	▶	▶	▶	▶
Portuguese	▶	▶	▶	▶
Russian	▶	▶	▶	▶
Spanish	▶	▶	▶	▶
Swedish	▶	▶	▶	▶

**Superiority In Quality Of The Non-speech Signals.** In contrast to other LBR vocoders (MELPe, AMBE+2, etc.), TWELP vocoders provide high quality of non-speech signals, including police, ambulance, fire sirens, etc. This feature in conjunction with high quality natural human-sounding of voice makes TWELP vocoders well suitable for replacement of analog radio by digital radio and also for other applications where high quality transmitting of non-speech signals is relevant along with high quality transmitting of speech signals.

Source type	Source signal	MELPe 600 bps	SPR 600 bps	TWELP 600 bps
Siren only	▶	▶	▶	▶
With voice	▶	▶	▶	▶

**High Robustness To Acoustic Noise.** In contrast to other LBR vocoders, TWELP vocoders are well robust to acoustic noise thanks to robust reliable method of pitch estimation and other features of TWELP technology.

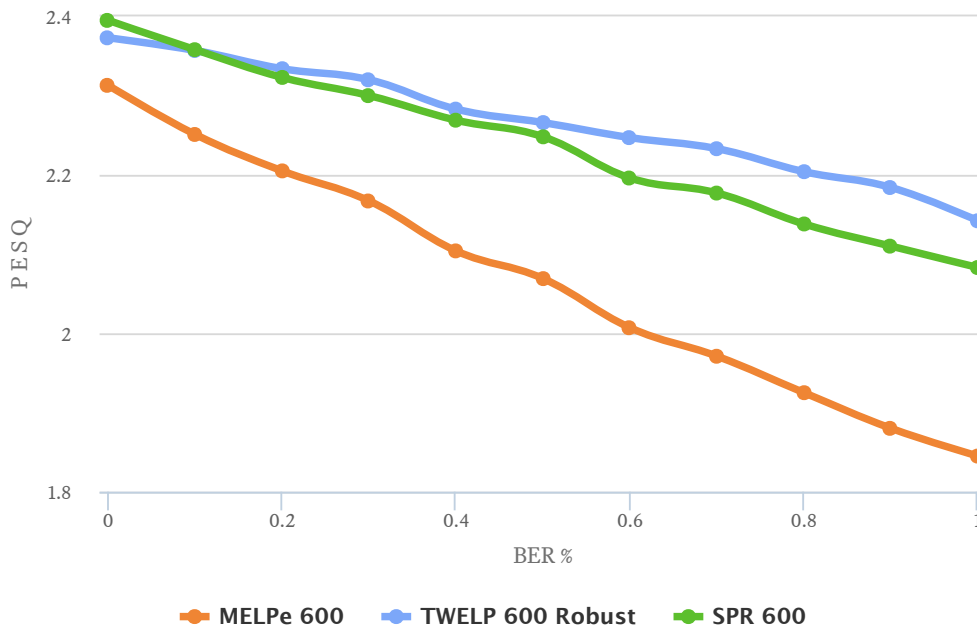
Moreover, vocoder includes in-built Noise Cancellation—Speech Enhancement (NCSE) functionality that improves speech quality in noisy acoustic environment.

NCSE Mode	Source signal	MELPe 600 bps	SPR 600 bps	TWELP 600 bps
Disabled	▶	▶	▶	▶
Enabled	▶	▶	▶	▶

**High Robustness To The Channel Errors.** The diagram and table below show a dependence of the averaged speech quality for AWGN-noisy channel for different BER in comparison with other vocoders.

SPR vocoder is more robust to the channel errors in comparison with MELPe and TWELP vocoders. Also, special "robust" versions of the SPR and TWELP vocoders include FEC that are integrated with vocoder on base of "joint source-channel coding" approach that provides high speech quality simultaneously in noisy channel as well as in noiseless channel. FEC can operate with "soft decisions" as well as with "hard decisions" from a modem. "Soft decisions" mode provides much better robustness in comparison with the "hard decisions" mode.

## Averaged Speech Quality in AWGN channel



<b>BER %</b>	<b>MELPe 600</b>	<b>TWELP 600 Robust</b>	<b>SPR 600</b>
<b>0.00</b>	2.313	2.373	2.395
<b>0.10</b>	2.251	2.357	2.358
<b>0.20</b>	2.205	2.334	2.323
<b>0.30</b>	2.167	2.32	2.300
<b>0.40</b>	2.104	2.283	2.269
<b>0.50</b>	2.069	2.266	2.248
<b>0.60</b>	2.007	2.247	2.196
<b>0.70</b>	1.971	2.233	2.177
<b>0.80</b>	1.925	2.204	2.138
<b>0.90</b>	1.880	2.184	2.110
<b>1.00</b>	1.845	2.142	2.083

**Additional functionality.** MELPe vocoder software includes NPP (Noise Pre-Processor) module.

### Technical Characteristics And Resource Requirements:

## Technical characteristics

<b>Bit Rate</b> (bps)	<b>Algorithm</b>	<b>Frame size</b> (ms)	<b>Algorithmic delay</b> (including frame size) (ms)	<b>Sampling rate</b> (kHz)	<b>Signal format</b>	<b>Bit stream format</b>
600	MELPe	90	110	8	Linear 16-bit PCM	54

## Resources for ARM Cortex-M4 platform (preliminary)

<b>Module</b>	<b>MIPS*</b> <b>peak</b>	<b>Memory (KBytes)</b>				
		<b>Program</b>	<b>Data</b>			
			<b>Constants</b>	<b>Channel</b>	<b>Heap</b>	<b>Stack</b>
NPP	19.1	76	84.3	16.7	5.9	0.5
Voice Encoder	52.4					
Voice Decoder	20.2					
<b>Total</b>	<b>91.7</b>					

## Resources for TI's C64 DSP platform

Module	MIPS* peak	Memory (KBytes)				
		Program	Data			
			Constants	Channel	Heap	Stack
NPP	7.6	126	84.8	16.7	5.9	0.5
Voice Encoder	17.7					
Voice Decoder	4.7					
Total	30.0					

## Resources for TI's C55 DSP platform

Module	MIPS* peak	Memory (KBytes)				
		Program	Data			
			Constants	Channel	Heap	Stack
NPP	18.8	50.0	83.9	19.1	5.9	0.5
Voice Encoder	27.9					
Voice Decoder	11.8					
Total	58.5					

\* DSPINI continues optimization of the MELPe code in order to minimize computational complexity of the vocoder.

**Guarantee And Support.** DSPINI guarantees a quality and accordance of all technical characteristics of the product to requirement of current specifications. Testing and other method of quality control are used for guarantee support.

**Any Platforms.** DSPINI can port this vocoder software into any other DSP, RISC or general- purposes platform inshort time: 1-2 months.

**Licensing Terms.** Our license covers a right to use our optimized code, but doesn't cover IP-holders rights on the MELPe technology (TI, Microsoft, Thales, etc.).

**Customization.** The vocoder can be customized under any specific requirements- other bit rate, frame size, any other robustness to channel errors, etc. Please contact with us for details.

**Related Software.** This vocoder may be effectively used in a bundle with other DSPINI's products:

- Linear and acoustic echo cancellers,
- Multichannel noise cancellers (including two-microphone adaptive array),
- Wired or radiomodems for any types of channels and bitrates,
- Other products.

#### **Downloads:**

- [Datasheet \(pdf\)](#)
- [ITU-T P.50 source speech samples \(zip\)](#)
- [MELPe 600 bps speech samples \(zip\)](#)
- [SPR 600 bps speech samples \(zip\)](#)
- [TWELP 600 bps speech samples \(zip\)](#)
- PC-evaluation package (zip) — on request
- User's Guide document (pdf) — on request

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